193065843.5 74736674131 11706568169 679306392 40503169934 25590990.897436 44110630.25 68008126405 2545114.2394366 22434613.384615 88224041.666667 41563982.527778 8312028823 91245282883 13778624.849315 75877377219 13120708.305556 4144571.40625 1715201.7083333

College algebra julie miller 2nd edition pdf printable pages 2019

Monthly Budget

EXPENSES	January	February	March	April	May	June	July	August	September	October	November	December
HOUSING												
INCOME												
RENT / BOARD												
RATES												
FEES												
ELECTRICITY												
GAS												
TELEPHONE												
INTERNET												
MAINTENANCE												
OTHER												
PERSONAL												
FOOD/ GROCERIES												
CLOTHING/SHOES												
MOBILE PHONE												
PUBLIC TRANSPORT												
MEMBERSHIP (GYM)												
ENTERTAINMENT												
OTHER												
MOTOR VEHICLE												
FUEL												
INSURANCE												
REGISTRATION												
LICENCE												
CAR PARKING												
SERVICE												
OTHER												
TOTALS												

(t 1 u) 61. The resulting equation is not equivalent to the original equation. The common difference is d 5 20.8 in. The number of such six-number combinations is 22,957,480 (see Example 8). Assuming that the items all match together well, how many different outfits does Debbie have if she selects one item from each category? x2 5 230.4y for 21.2 # x # 1.2 b. 2x 2 3 5 x 2 1 b. 179 Reference SECTION 2.3 Functions and Relations A set of ordered pairs (x, y) is called a relation in x and y. on [21, 0] b. Find the difference quotient . The format to enter the function is as follows. y 5 0 x 2 2 0 93. Suppose that 1 two hikers are located at 25 24 23 22 21 21 points A and B. equivalently as a11, a11 A 1r B, a11 A 1r B 2, a11 A 1r B 3, p . The origin is identified as (0, 0). If x is the cost of the meal, then the total bill C(x) with an 18% gratuity and a 6% sales tax is given by: C(x) 5 x 1 0.06x 1 0.18x. {7}; The value 22 does not check. Furthermore, each time at bat is independent of the time before. 2019 35. 49 5 a1 1 14d Multiply by 21 249 5 85 5 a1 1 26d 285 5 236 5 203 5 2a1 2 14d 2a1 1 26d 2a1 1 12d d 49 5 a1 1 14d 49 5 a1 1 14(3) 07 5 a1 With d 5 3 and a1 5 7, we have an nth term of an 5 7 1 (n 2 1)3. x-intercepts: (8, 0), (28, 0); y-intercept: (0, 28) 79. 5 4 3 2 TIP T IP Avoiding Mistakes 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 Answers Note that the function cannot have a closed dot at both (21, 1) and (21, 2) because it would not pass the vertical line test. ln(x 1 h) 2 ln x 1 1 x1h 101. k(x) 5 x3 2 2 18. e ln , ln 4 f ; x < 20.6931, x < 1.3863 2 113. Parent function: f (x) 5 x2. 3 27 x4 1 x3 1 x2 1 54x 1 81 16 2 2 1024c10 2 1280c8t4 1 640c6t8 2 160c4t12 1 20c2t16 2 t20 2960t3 v14 29. S(x) 5 0.11x 1 500, for x $ 0 b. n(d) 5 c. 0 x 2 1.7 0 1 4.95 5 11.15 b. The associative property of addition indicates that the manner in which quantities are grouped under addition does not affect the sum. 2 1 i51 5 25 125 1 1 1 p 2 8 32 In Example 9, we use the formula for the sum of an infinite geometric series to write a repeating decimal as a fraction. Evaluate s10 and interpret its meaning in the context of this problem. f has at least one zero on the interval [a, b]. m 5 2 4 5 4 4 3 3 e. The kth term of (a 1 b)n is a ban2(k21)bk21 k21 Reference SECTION 8.6 Principles of Counting Fundamental principle of counting: If one event can occur in m different ways and a second event can occur in n different ways, then the number of ways that the two events can occur in sequence is m ? A car accelerates from 0 to 60 mph (88 ft/sec) in 8.8 sec. This is a finite geometric series with a1 5 P and common ratio of (1 1 r). EXAMPLE 2 Using Mathematical Induction Use mathematical induction to prove that 1 1 1 n 1 1 1 1p1 5 . 228 109. 3; 4 23. (Using techniques from calculus, we can show that this sum converges to π.) 8. A solution to an equation in the variables x and y is an ordered pair (x, y) that when substituted into the equation makes the equation a true statement. We have shown that P4 is true, and that if Pk is true, then Pk11 is true. Then substitute arbitrary values of x into the equation and solve for the corresponding values of y. y2 5 x y 5 6 1x Solve the equation for y. y 5 34.9e c. A function that is symmetric with respect to the origin is called an odd function. (0, 75); The base cost to rent the car is $75. Objective 4: Investigate Increasing, Decreasing, and Constant Behavior of a Function For Exercises 89–96, use interval notation to write the intervals over which f is (a) increasing, (b) decreasing, and (c) constant. {41} 31. Maximum value: 37,800 50 Section 6.1 Practice Exercises, pp. In such a case, a z-axis is taken perpendicular to both the x- and y-axes. (h + f)(22) 55. 36 1 30 1 25 1 28. [0, 1] b. [0, `) b. R; (2`, `); 27. y 1 2 3 4 5 x 25 24 23 22 21 21 22 3 4 5 1 2 3 4 5 x 5 4 3 2 1 1 1 25 24 23 22 21 21 22 2 y 42. x 5 22 61. She recorded Dodger's weight during the first two months. This is a point slightly to the left of the relative maximum. 22x 2 28 17. f (g(8)) 48. The number of permutations of n elements taken r at a time is denoted by nPr and is computed by u or nPr 5 n(n 2 1)(n 2 2) p (n 2 r 1 1). Not a real number 1 1 c. The first equation represents an ellipse centered at the origin, whereas the second equation represents a line with slope 249 and y-intercept (0, 4). Write a linear revenue function for selling x cups of lemonade. V 5 lwh 5 (30 2 2x)(24 2 2x)(x) 5 4x3 2 108x2 1 720x The domain is restricted to 0 , x , 12 because the width of the rectangular sheet is 24 in. O1 b. 5 4 3 2 8 7 6 5 4 3 2 22 1 2 3 4 5 x 1 2 3 4 5 23 b. y 6 5 4 y , 2x2 1 b. (2`, 232] 113. y 5 0 y 35. (y 2 4) (x 2 3) 1 51 4 9 62. 2k and show that (k 1 1)! . xk21 for x . 2 23 20 18 8 7 107. It is defined by y 7. For example: y y5f 1 2 6 5 x (24, 22) becomes a 4 3 2 (22, 4) becomes a 1 28 27 26 25 24 23 22 21 21 22 1 2 3 4 x 24 1 2 22 1 2 , 22b 5 (28, 22). In Examples 6 and 7, we graph piecewise-defined functions. Since h(2x) ? f (x) 5 Œx 1 3œ 82. Transformation Effect on the Graph of f Changes to Points on f Vertical translation (shift) y 5 f (x) 1 k y 5 f (x) 2 k Shift upward k units Shift downward k units Replace (x, y) by (x, y 1 k). With each bounce, the ball rebounds to 50% of its original height. 8! 5 840 2! ? The initial swing (one way) of a pendulum makes an arc of 4 ft. Section 8.6 EXAMPLE 1 739 Principles of Counting Counting the Outcomes of a Sequence of Events Suppose that a frozen custard shop offers 4 flavors of custard, 2 types of syrup, and 2 toppings. a400 5 2399 Now add to get 2 S5. P(all boys) 5 P(boy on 1st) ? 5, 10, 20, 40, ... 26. f (x) 5 x 1 3 3 3 3 a. n Pr 5 u 8. Shift the graph to the right 2 units. Section 3.1 EXAMPLE 1 287 Quadratic Functions and Applications Analyzing and Graphing a Quadratic Function Given f (x) 5 22(x 2 1)2 1 8, a. 4x2 1 4y2 2 20y 1 25 5 0 52. f (x) 5 12x 1 3 72. gA212 B d. 10 5 6,760,000 b. One solution 5. Therefore, count the number of combinations rather than permutations. x3 1 4x2 2 5x 2 2 1 2 3x3 2 6x2 1 2x 2 4 x 15 5x 2 2 3x2 1 1 1 2 19. R.2. x 5 Section 6.3 Practice Exercises, pp. c 2c3 3 4 65. Passes through a2 , b and is perpendicular to the 9 3 x-axis. In this case, define {an} with domain n $ 0 to allow for the possibility of 0 units sold. For Exercises 35–56, evaluate the function for the given value of x. a b 0 4 b. 2.5 3 1013 red blood cells In the expression 6x0, the exponent 0 applies to x only. 42. If event. 37,200,000 mi Ellipse; B 69. 6 5 4 3 2 f(x) 5 |x| 1 25 24 23 22 21 21 22 23 24 1 2 3 4 5 g(x) 5 |x| 2 3 x The graph of g (shown in blue) is the graph of f shifted downward 3 units. This is between approximately 7.7 ft and 8.9 ft. Sn 5 5. 1f + g21x2 5 3 1 4; x21 Domain: (2`, 1 ) ´ ( 1, `) b. For now, we present the point-plotting method to graph the solution set of an equation. To find a50, substitute 50 for n. The dancer will save money on the 17th dance during a 3-month 55 period. x-intercept: (4, 0); y-intercept: (0, 22) 85. How many 4-letter palindromes are possible from a 26-letter alphabet? 12C5 5 792 63. The graph of all solutions to an equation is called the graph of the equation. To Elka Block, Jennifer Blue, and the team at DiacriTech, many thanks for doing multiple levels of accuracy checking. x 5 24 g. y 5 2x2 2 4x 1 6 53. (f + g)(5) 109. This provides us with a tool for visually examining two different models at the same time. 0 103. 2 129 in. Foci: A6 12, 21B, A26 12, 21B y e. 2 m5 111. ceil(4) 114. EXAMPLE 3 Applying the Fundamental Principle of Counting A quiz has five true/false questions and five multiple-choice questions. m (x) 5 47. y 5 22x 2 1 2 2 1 4 y5 x1 9. n/a, $12,214.03 29 47. (Note that the reflections in steps 2 and 3 can be applied in either order.) v(x) 5 212x 1 2 reflect across x-axis y 5 4 3 (21, 1) 2 1 (22, 0) y 5 4 y 5 Îx 1 2 3 2 y 5 Îx 1 2 y 5 Îx 25 24 23 22 21 21 22 1 2 3 4 5 Reflect over the y-axis: Replace x by 2x. Informally, a function is increasing on an interval in its domain if its graph rises from left to right. {a 0 a # 8.5}; (2`, 8.5]; 15. If we place the y-axis along this line, a point (x, y) on one side has a mirror image at (2x, y). Skill Practice 1 Determine whether the sequence is arithmetic. We first need to show that the statement is true for n 5 1. Neither 45. f (x) 5 20.6x2 1 2x 1 3 133. Write A as a function of d. transverse y 5 ba x; y 5 2ba x 29. Therefore, 4! . For Exercises 123–126, determine whether the curve is (a) concave up or concave down and (b) increasing or decreasing. Solution: TIP We denote the distance between points P and Q as d(P, Q) or PQ. EXAMPLE 9 Writing a Repeating Decimal as a Fraction a. 2x2 2 2xh 2 h2 2 5x 2 5h 1 2 22x 2 h 2 5 48 b. Therefore, given y 5 f (x), the x-coordinate of the vertex is 4 because 4 is midway between 2 and 6. That is, m(a) 5 m(b) 5 23, but a fi b. x15 6. 2 A 73, 53 B F 29. 10x 1 22 53. y 5 1x 1 4 b. 212 3 3 89. one 31. Use the model in part (b) to predict the height of the volcano in the year 2030 assuming that the linear trend continues. 3 loga 33. 0.048 51. Examples Standard form Center Radius (x 2 4)2 1 (y 1 3)2 5 25 (x 2 4)2 1 [y 2 (23)]2 5 (5)2 (4, 23) x2 1 Ay 2 12 B 2 5 12 (x 2 0)2 1 Ay 2 12 B 2 5 A 112B 2 2 (x 2 0) 1 (y 2 0) 5 A 17B 2 2 x 1y 57 2 2 5 A0, 12 B 2 13 (0, 0) 17 In Example 1, we write an equation of a circle in standard form. (2`, 25) ´ (25, 3) ´ (3, `) 107. If the slope of a line is 58 , how much horizontal change will be present for a vertical change of 216 m? If he anticipates working for the company for 12 yr, find the total amount he would earn from each job. Prove a Statement Using In this section, we present a technique of mathematical proof that enables us to prove the validity of a statement that is true over the set of positive integers. R(x) 5 C(x) (the company breaks even) b. 163–164 2y(y 2 3x) 24 2 x c. If bn 5 2180, what is n? 0.8 74. 5k11 2 3 5 5 ? Then estimate the location of the earthquake. g(x) 5 2 x 2 3 4 5 b. How many 4-digit numbers can a player choose? Center: (2, 3); Radius: 2 13 b. The customer paid by credit card or by cash. xm12 x12mn 121. and a d. The second rule f (x) 5 x2 is one of the basic functions learned in Section 2.6. It is a parabola with vertex at the origin. Thus, the 500th term is given by a500 5 7 1 (500 2 1)3 5 1504. m 5 23 26 23 33. w2y3 5 37. f (2) 5 5 because the function contains the point (2, 5). 2113 5 7 1 (n 2 1)(24) 2113 5 7 2 4n 1 4 2113 5 11 2 4n 4n 5 124 n 5 31 To find the number of terms n, substitute a1 5 7, d 5 24, and an 5 2113 into the formula for the nth term. s 5 216t2 1 16t b. 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 x 10 Section 2.3 y 91. e 0, , 26 f 2 1 4 9. Taken together, the closed dot “plugs” the hole in the graph. Notice that each term after the first is 2 times the preceding term. (0, 0), (0, 90), (80, 90), y (120, 60), (120, 0) 120 e. 2 c. In how many ways can a judge award blue, red, and yellow ribbons to 3 films at a film festival if there are 10 films entered? AB 5 c d 20 44 22 37 51 23. 20,000 # x # 20,000 . 0.6718 b. Interpret the meaning of the y-intercept in the context of this problem. b1 5 23; bn 5 3bn21 1 4 26. (g + f)(5) h(x) 5 1 x11 g 107. Examples: π and 12 Section R.1 Point of Interest Computers have approximated π to over 1 trillion digits, but for most applications, the approximation 3.14159 is sufficient. The length of a latus rectum is 2y 5 a 2 2 y x 83. y 5 2.75x 1 29.5 b. Then identify the center and radius. {0} b. Linear; {216} d. As a result, P(A ´ B) can be . 1 (k 1 1) (k 1 2) (k 1 1)(k 1 2) 5 k2 1 2k 1 1 (k 1 1)(k 1 2) Add the fractions. Pn represents the statements, P1, P2, P3, and so on. { } 13. In how many ways can the books be arranged on the book shelf? (Highlighted in green tint.) f(x) 5 4 3 2 y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 f(x) 5 4 3 2 y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 Skill Practice 10 Use interval notation to write the interval(s) over which f is a. (See Example 9) 70. Economists call this the multiplier effect. 1 144b8 2u12 33. Passes through (25, 1) and m 5 0. a1 5 5, r 5 2 14. The function is one-to-one. f 21(x) 5 (x 2 1)3 1 4 Section 5.1 Practice Exercises, pp. Ascending order: Descending order: S5 5 1 1 4 1 7 1 10 1 13 S5 5 13 1 10 1 7 1 4 1 1 2S5 5 14 1 14 1 14 1 14 1 14 2S5 5 5(14) 2S5 5(14) 5 2 2 S5 5 35 ✓ Answer 6. Yes; d 5 211 11. Each true/false question has two possible choices (true or false). Ar b 12P 57. [35, 38]; If the refrigerator is set to 36.58F, the actual temperature would be between 358F and 388F, inclusive. y 5 2.99x 1 1 c. P1 is true because 2 is a factor of 51 1 1 5 6. For Exercises R.2–R.4, graph the set and express the set in interval notation. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 y 95. If the x term is linear, then the parabola opens horizontally. ac 5 b 10,000 log5 125 5 3 19. 21 1 4 1 9 1 ... 1 49 62. g(0) 5 2(0) 1 1 51 Substitute 0 for x. x-intercept: None; y-intercept: (0, 2) y 28 27 26 25 24 23 22 21 21 22 3 4 23 5 4 3 2 23 x 5 26 2 59. Chapter 3 Review Exercises, pp. Determine the area in the second quadrant enclosed by the equation y 5 2x 1 4 and the x- and y-axes. 15, π6 f. x b. 5 h 24xh 2 2h2 1 4h Combine like terms. (n + r)(x) 74. (g + f)(24) 100. 22 Section 3.5 Practice Exercises, pp. All three digits in the code must be the same. (n 2 r)! (n 2 r)! ? x 5 4 23. 83.5 ft c. f (x) 5 20.32x2 1 4.2x 1 8.2 b. y2(y 1 1) 5x 1 21 1 49. x 5 18; 28 39. {14} b. f (x) 5 x 3(x 2 4)2 46. 5 x 117. This is because the calculator has a rectangular screen. Solving the equation f (x) 5 0 to find the x-intercepts results in imaginary solutions: 0 5 2x2 1 4x 2 5 x5 Therefore, there are no x-intercepts. 3 110 7. Therefore, the product 2.00x gives the amount of revenue for x cups of lemonade sold. Round to the nearest $100. x-intercept: (2, 0); y-intercept: (0, 24) 77. Each dimension was decreased by 1 in. To our brand manager, Caroline Celano, as the pilot on this long journey you set the standard for leadership. Write the solution sets to the inequalities in interval notation. A detailed summary is located at www.mhhe.com/millercollegealgebra. k(x) 50 40 30 20 k(x) 0 30 20 10 24 23 22 21 210 220 10 25 24 23 22 21 210 220 67. a , b 2 4 41. Vertices: (6, 3), (6,23) c. Write About It 123. Evaluate Finite Geometric Series 3. 5 < 0.00022 C 52,451,256 34 9 c. No; The elements on the main diagonal are not 1 with zeros above and below. {13} b. See also Systems of linear equations; Systems of linear equations in three variables; Systems of linear equations in two variables in applications, 84–85, 213–216, 276 graphs of, 197–202 method to solve, 83–84 as rational equations, 86–88 Linear equations in one variable in applications, 84–85 explanation of, 82, 113, 158 method to solve, 83–84 Linear equations in three variables, 506, 577. 1 2 3 x 14 12 10 8 6 4 2 22121821521229 26 23 22 3 6 9 x 24 26 2 45. EXAMPLE 4 Graphing an Equation by Plotting Points Graph the equation by plotting points. 3 6 9 12 , , , , p 5 25 125 625 For Exercises 3–5, 6. Quadratic; {0, 22} 75. f (20.5) 75. Analyzing Graphs of Functions and Piecewise-Defined Functions OBJECTIVES 1. n(a) 5 0.0011a2 2 0.027a 1 2.46 b. (0, 25) 31. 755 The probability of A or B: Given events A and B in a same sample space, P(A or B) is given by P(A ´ B) 5 P(A) 1 P(B) 2 P(A > B). paper) — ISBN 978–1–259–57046–9 (alk. Constant 2 1 2 1 x1 b. 3y 5 5 33. Graph H 14. If one card is selected from a standard deck of cards, what is the probability that the card selected is a diamond or an ace? Write the nth term of a sequence defining the number of minutes that Sandy spends on the treadmill per day for her nth week at the gym. t 5 or n ln A1 1 nr B n ln 1l 2 nr 2 a. 24. 69. an 5 3000n 1 57,000 b. Find an equation of the line tangent to y 5 x3 1 1 at the point (22, 27). Undefined n n n SA-1 SA-2 Student Answer Appendix 29. Consider a horse race with 8 horses. A second job offers $54,000 the first year with a raise of $2000 each year thereafter. 11,000 b. (4, 25) b. (3, 0) and (5, 0) d. Find the 78th term of an arithmetic sequence with a1 5 64 and d 5 211. {(24, 1)} 43. a a b n51 3 69. 167 7. a b 5 TECHNOLOGY CONNECTIONS Evaluating Binomial Coefficients To evaluate binomial coefficients on a graphing utility, use the nCr function found menu under PRB. 1.2 3 1014 39. Pair up two equations in the system and eliminate a variable. D 5 10(M28.8)y5.1 A ln a b P ln A 2 ln P or 13. Then Pn is true for all positive integers n if p. 165: © Image Source/Getty RF; p. Solution: Let Pn be the statement: n! . Write a set of ordered pairs (x, y) that defines the relation. 82. k(x) 5 2 c. Write a rule for a linear function y 5 f (x), given that f (0) 5 4 and f (3) 5 11. If 0 r 0 $ 1, then the sum (does/does not) exist. Assume that 34 1 163 1 p 1 4k 5 1 2 A 14 B k (Inductive hypothesis). m(x) 5 !2x 1 5 25 24 23 22 21 21 22 81. 9c2d 12d 2 3 4 5 x 07 2 x 0 10 d 3 20. Section 8.7 763 Introduction to Probability Mixed Exercises The blood type of an individual is classified according to the presence of certain antigens, substances that cause the immune system to produce antibodies. 13. False; log(10 ? What is the probability that an individual from the population can donate blood to a person with AB1 blood? Center: (2, 23); Radius: 5 67. 28 5 22(x 2 1)2 2 4 5 (x 2 1) 6 14 5 x 2 1 1 6 25x x 5 3 or x 5 21 The x-intercepts are (3, 0) and (21, 0). The reason is that for each combination of 3 items, such as A, B, and C, there are 3! 5 6 permutations: ABC, ACB, BAC, BCA, CAB, CBA. f (2) x 281 Review Exercises 0 x 0 for x # 2 2 for x . g(x) 5 0 x 0 3 c. y 5 1 b. (f 1 g)(1) 5 f (1) 1 g(1) 5 4 1 (23) 51 c. The domain of (f + g)(x) is the set of real numbers x in the domain of g such that g(x) is in the domain of f. an even number? 3 ? In how many different ways can the survey be filled in? 5 4 3 71. 5 4 222 219 1 x 3 2 1 24. 1 1 1 b. Since the vertex of the parabola is below the x-axis and the parabola opens downward, the parabola cannot cross or touch the x-axis. The sum of the numbers on the dice is less than 4. a 13 b 3 12. P(E) 5 1 13. Prove that a (ai 1 bi) 5 a ai 1 a bi. Performing these two transformations in the reverse order, would not result in the function we want. 12 ft a. 630–631 5 1 4 23 1 4 † 22 § 2 6 3 3. 1.2% f. 72 mCi b. x 1 2y 2 z 5 25 y 1 3z 5 13 x 1 2z 5 5 49. Choose the row or column with the greatest number of zero elements. 26115.5 264 63. 5 52 13 52 13 52 13 52 4 14 98 49 168 21 112 5 61. The equation x2 1 y2 5 z2 has infinitely many positive integer solutions for a, b, and c. 0.08c b 2 0.06c2b2 1 0.01cb3 1 11 21. Ellipse; 16 9 (y 2 2)2 x2 1 51 11. • Applications and real-world data have been updated, where appropriate, to ensure that content remains relevant and current. y 5 2f (x) 54. i51 n n n 3. 15, 19, 23, 27, ... 11. f (x) 5 1 x and g(x) 5 x 2 7 28. (See Examples 3–4) 15. R(x) 5 2.00x The price per cup of lemonade is $2.00. 1 39. This is generalized as the fundamental principle of counting. 46 # x1 # 96 vehicles per hour; 67 # x2 # 117 vehicles per hour 23. In the Minnesota Lotto game “Gopher 5” a player wins the grand prize by choosing the same group of 5 numbers from 1 through 47 as is chosen by the computer. (0, `) 7. To visualize the infinite series, suppose that we add 12 of a pie plus 14 of a pie plus 18 of a pie and so on. In how many ways can the word HIPPOPOTAMUS be misspelled? {(3, 1), (2, 5), (24, 2), (21, 0), (3, 24)} b. g(2) 5 2(2) 1 1 55 Substitute 2 for x. 2πr(r 1 h) 4 π(R 2 r)(R2 1 Rr 1 r2) 95. 2 2 45. (2`, 4) ´ (4, `) g. A point P is assigned an ordered triple P(x, y, z) relative to a fixed origin where the three axes meet. Assume that 3 1 7 1 p 1 (4k 2 1) 5 k(2k 1 1) (Inductive hypothesis). • Over 600 algorithmic homework exercises were added to Connect Math Hosted by ALEKS to ensure 90% textbook coverage. Use the formula for the nth term of a geometric sequence. s s r d Linear Equations in Two Variables and Linear Functions OBJECTIVES 1. P1 is true because 2 5 2(1)2. For Exercises 3–4, write the first five terms of the sequence. Hyperbola b. Begin with the formula for the nth term of a geometric sequence. x 5 3 27. Determine the solution set for the equation (x 1 1)2 1 (y 2 5)2 5 0. For Exercises 23–25, use mathematical induction to prove the given statement for all positive integers n. Center: (25, 22); Radius: 121 23. Write the nth term vn of the sequence representing the velocity in the downward direction after n seconds. Objective 1: Apply the Point-Slope Formula For Exercises 5–20, use the point-slope formula to write an equation of the line having the given conditions. The horizontal distance between the points is @ 4 2 5 3. (4, 26) and (21, 2) (x1, y1) and (x2, y2) m5 Label the points. (T + C)(x) 5 1.5794x 2 1.06 (T + C)(10) 5 1.5794(10) 2 1.06 5 14.734 The total cost for a first-time visitor to buy 10 songs is $14.73. How much profit will the vendor make if 50 cups of lemonade are produced and sold? Down to the left, up to the right; As x S 2`, f (x) S 2`, and as x S `, f (x) S `. x-axis 11. Hyperbola; 2 51 144 25 y F SA-43 SA-44 Student Answer Appendix 25. 148 Given a right triangle with a leg of length 7 km and hypotenuse of length 25 km, find the length of the unknown leg. Solution: Each of the 10 marbles in the box is equally likely to be selected. a t b1x2 31. Determine the slope of a line perpendicular to the given line, if possible. y 5 x2 EXAMPLE 2 b. 218 1 (223) 1 (228) 1 ... 1 (2183) Objective 3: Apply Arithmetic Sequences and Series 65. P(50) 5 1.50(50) 2 120 5 245 Substitute 50 for x. f (2) 36. Q(t) 5 300e20.0063t b. For example, consider the salary plan for a job that pays $75,000 the first year with a $4000 raise each year thereafter. (0, 258); The average consumer spending on television services for the year 2004 was $258. 4x 2 2 5 23x 1 5 b. c 8 212 4 26 213 2 216 d 1 20 230 c. Find (g ? m)(x) 5 5x 1 1 c. Compare the graphs of the sequence defined by an 5 8A 12 B n (see Figure 8-1) versus the function defined by f (x) 5 8A 12 B x (see Figure 8-2). b 5 15 Vertices: A2 13, 0B, A22 13, 0B Endpoints of minor axis: A0, 15 B, A0, 215 B f. pq 1 p 15. Time h 80 Height (ft) 4 Depth (ft) 1 24 25 y 3 2 60 40 20 1 0 1 x 23 100. Let Pn be the statement a1 2 b a1 2 b p a1 2 b5 . 772–774 1. Use the graphs of f and g to find the function values for the given values of x. 128. 6 5 6 5 4 3 2 4 3 2 1 27 26 25 24 23 22 21 21 22 1 1 2 3 x 21 21 22 23 1 2 3 4 5 6 7 8 9 x 23 24 24 2 2 15. 16, 3π 2 f. c(x) 5 22ax 1 b 1 b. (y 1 2)2 (x 2 2)2 2 51 10. y 2 y1 5 m(x 2 x1) y 2 (23) 5 22(x 2 2) y 1 3 5 22x 1 4 The slope of a line perpendicular to the given line is 22. 8, 14, 20, 26, ... , 320 36. (4x 2 1)4 21. 2 13 5. Write the set of ordered pairs that defines the relation. For Exercises 59–66, use the data in the table categorizing cholesterol levels by the ages of the individuals in a study. 160–162 7 40 1 3. , 2 , ,2 , p 5 25 125 625 Solution: a. 104 5 10,000 61. f (24) 5 (24)2 1 2(24) 5 8 Evaluate f (5) first. How much will the sales person earn in a year for selling 42 new units? 61, 62, 64, 68, 6 , 6 , 6 , 6 , 6 , 6 , 6 2 3 3 3 3 4 6 12 1 1 5 15. f (x) 5 e 24x 2 3 for x , 0 x2 for x $ 0 d. We use the same process to write a quadratic function f(x) 5 ax2 1 bx 1 c (a fi 0) in vertex form f (x) 5 a(x 2 h)2 1 k. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 y 93. 131. Domain: (2`, `); 3 2 13 1 Range: c 2 , `b x 28 27 26 25 24 23 22 21 1 2 4 21 22 23 24 25 25. Find a b(x) and write the domain of in interval notation. f (x) f (21) 1 5 5 5 5 5 2x 2 1 2(23) 2 1 2 23 23 c. 5 4 3 2 y 112. R(x) 5 60x c. b 9. We can plot several strategic points as an outline for the new curve. Recognize Basic Functions 2. a 5 22m2 1 c2 2 b2 Compound inequality b. This indicates a horizontal shrink. f(x) 6 5 4 3 2 y 5 f(x) 1 26 25 24 23 22 21 21 22 23 24 25 26 1 2 3 4 5 6 x Section 2.3 191 Functions and Relations Solution: a. 3 4 SECTION 2.7 86. 4! 5 4 ? The solution set is {(h, k)}. Yes; The center of Hawthorne is 15 km from the earthquake. A0, 22 2B e. 28.7128; 428.7128 < 5.68 3 1026 1 1 89. To Nora Devlin, thank you for managing the solutions manual projects, lecture notes, and Internet Activities. Find the sum of the integers from 220 to 256. x-intercept: None; y-intercept: (0, 2) y-intercept: (0, 2) y 5 4 3 2 1 22x 1 4y 5 8 1 25 24 23 22 21 21 22 41. Neither b. Does the function have a relative minimum or maximum at a? y When the light turns green, the car under54 y 5 45 45 goes a constant acceleration for 20 sec until 36 it reaches a speed of 45 mph. y 5 4 3 2 24 25 24 25 27. m 5 26 28. x y 69. The two equations form a system of linear equations in two variables. 5k 1 1 5 5(2a 2 1) 1 1 5 10a – 4 5 2(5a 2 2). h 34. (x 1 3)(x 2 1)(x 1 2i)(x 2 2i) 109. ln 1x 1 3 25. 2.) In interval notation the solution set is (2, `). 1 1 2 1 3 1 p 1 98 1 99 1 100 sum 101 sum 101 In Example 8, we evaluate an arithmetic series written in summation notation. At x 5 22, the function has a relative maximum of 4. ¢t 13 2 13 3 2 51. Explain how to find the x- and y-intercepts from an equation in the variables x and y. y 5 x 2 1 31. Same equation: Test for symmetry with respect to the x-axis. 3.4454 14. P(x) . 691 A recursive formula defines the nth term of a sequence as a function of one or more terms preceding it. 2 13 b. [1, 5) h (5, `) 20. The number of white marbles is 0. 500,500 The three arithmetic means between 4 and 28 are 10, 16, and 22. 3 Focus: (0, 21); Focal diameter: 4 2 1 b. 52 terms Section 8.2 EXAMPLE 6 Arithmetic Sequences and Series 705 Finding a Specific Term of an Arithmetic Sequence For an arithmetic sequence, a15 5 49 and a27 5 85. Write r as a function of d. What does ¢d ¢t represent? 0 0 0.4 0 1 1 Greatest integer less than or equal to 0 is 0. [Hint: Write the expression as (1 1 0.01)4.] 47. a 2 db 2 3 x 28. • Alternatively, the least-squares regression line is a model that utilizes all observed data points. 8 2 4(1 2 x) 2 7 2 2x , 0 c. n The expression a b r will also be used in Section 8.6 when we study counting n principles. a d(2c 2 d) 37. $8000 b. ln 3 f ; x < 0.5600 3 ln 4 2 2 ln 3 ln1 2.989 ln 400 2 ln 2.989 400 2 e f or e f ; t < 2.4483 22 2 5ln 86; x < 2.0794 71. Choose x $ 21 so that the radicand is nonnegative. 2 22. (m 1 n)(x) 5 2 0 x 0 1 4 Figure 2-38 6 x (f 1 g)(4) 5 f(4) 1 g(4) 5315 58 Section 2.8 Algebra of Functions and Function Composition 263 In Example 2, we evaluate the difference, product, and quotient of functions for given values of x. If an individual is randomly selected from the population, find the probability that the individual will have the Rh factor. 5e3 2 26; x < 18.0855 {4}; The value 23 does not check. No 35. The range of a one-to-one function is the same as the domain of its inverse. The slope-intercept form of a line is particularly useful because we can identify the slope and y-intercept by inspection. Given g1x2 5 1x 2 5, the domain is restricted so that x $ __________. y 5 f (x) 34. The slope-intercept form of a line can be used as a tool to define a linear function given a point on the line and the slope. 0 y 0 5 x 1 1 Testing for Symmetry Determine whether the graph is symmetric with respect to the y-axis, x-axis, or origin. 2 ai 5 i51 n(n 1 1)(2n 1 1) 6 ai5 i51 n 4. successinmath.com xiii Our Commitment to Market Development and Accuracy Acknowledgments: Paramount to the development of College Algebra was the invaluable feedback provided by the instructors from around the country who reviewed the manuscript or attended a market development event over the course of the several years the text was in development. 1 y1 1 y 14. The standard form of an equation of a circle with center (h, k) and radius r is given by 2 2 4. The dashed horizontal and vertical line segments form a right triangle with hypotenuse d. f (1) d. log4 7 1 log4 y 1 log4 z 27. The distance d(t) (in ft) that the car travels t seconds after motion begins is given by d(t) 5 5t2, where 0 # t # 8.8. d(t 1 h) 2 d(t) . $103,974 $42,560 73. EXAMPLE 8 Using Transformations to Graph a Function Use transformations to graph the function defined by v(x) 5 212x 1 2. 22 23 24 25 22 23 8 10 5 25 24 23 22 21 21 1 4 6 24 x 21 2 x 1 1 26 n(x) 5 x 28 210 109.94 1 20x C(x) 5 109.94 1 20x b. (21, 22) c. 0 mg/L 97. In Example 3, we write an expression for the nth term of a geometric sequence given the first four terms. Assume that h 5 6 in. 239 a. Avoiding Mistakes A statement of the form “if p, then q” is called a conditional statement. {21} 11. y 5 x 1 9 b. Median Yearly Income by Level of Education 80,000 Median Income ($) 2. 8 e. 244 Chapter 2 Functions and Relations EXAMPLE 1 Testing for Symmetry Determine whether the graph is symmetric with respect to the y-axis, x-axis, or origin. (Hint: This means that the first digit cannot be zero.) 76. 19 105. The digits in the password may be selected from 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Then 5k 1 1 5 2a for some positive integer a. Skill Practice 2 Evaluate. If she anticipates working for the company for 5 yr, find the total amount she would earn from each job. f (x) 5 2x3 1 4 50. A number greater than or equal to 1 is rolled. 200 0 80 80 c. log2 (x 1 y) 1 log2 z 13. a , 0b 79. Apply Vertical and Horizontal Shrinking and Stretching Horizontal and vertical translations of functions are called rigid transformations because the shape of the graph is not affected. 12 1 6 1 0 1 1 (26n 1 18) 5 23n(n 2 5) 1 10. 25 1 5 4 24 25 210 3 4 x y 23 22 21 21 22 5 4 3 2 5 5 5 4 3 2 1 10 3 4 1 25 24 23 22 21 21 22 210 2 24 25 1 25 k(x) 5 x3 2 2 1 23 24 25 10 y 5 4 3 2 1 x x 1 2 3 4 7. 2 i 85. 1660 at (4, 9) 21. P 5 $100, n 5 24, r 5 5.5%, t 5 28 yr Section 8.3 87. Assume that a1 2 b a1 2 b p a1 2 b5 2 3 k11 k11 (Inductive hypothesis). No e. f (2x) is in the form f (ax) with a 5 2 . ln 2x 1 3 57. absolute; {k, 2k} 7. In Example 4, we start by selecting several values of x and using the equation to calculate the corresponding values of y. Graph Equations Using a 1. (22, 1] 55. 22x 1 4y 5 8 38. f(a) 5 3a2 1 2a b. z 5 0.62x 1 0.50y 9. Find the 46th term of an arithmetic sequence with a1 5 210 and a60 5 2262. There is no maximum value because the y values of the function become arbitrarily large for large values of 0 x 0. 315 a. The point (2, 1) is the highest point in a small interval surrounding x 5 2. This book is printed on acid-free paper. Y1 5 2x 2 3 1 2 3 4 5 6 x 206 Chapter 2 Functions and Relations TECHNOLOGY CONNECTIONS Verifying Solutions to an Equation We can verify the solutions to the equations and inequalities from Example 8 on a graphing calculator. (y 2 2)2 (x 1 1)2 1 51 4 9 38. 12 8. Therefore, log a1, log a2, log a3, ... 5 log a1, log a1r, log a1r 2, ... , log a1r n21, log a1rn, ... Apply Arithmetic Sequences and Series (Exercise 66) n53 k53 118. (21, 2) 1 2 3 4 5 6 7 8 1 28 27 26 25 24 23 22 21 21 22 1 22 23 5 4 3 2 (27, 5) (7, 6) 3 2 22 21 21 y 74. Evaluate a Difference Quotient In Section 2.4, we learned that if f is defined on an interval [x1, x2], then the average rate of change of f between (x1, f (x1)) and (x2, f (x2)) is given by m5 f(x) f (x2) 2 f (x1) . 0 (multiplicity 3), 2 (multiplicity 2), 21 (multiplicity 4) 4. f 21(x) 5 x3 + 7 8. 21, 4, 29, 16, ... 54. Notice that the calculator expects the equation represented with the y variable isolated. Chapter 5 Test, pp. Find the sum of the first 100 positive odd integers. The elements above the leading 1 in the third column are not all zero. (2`, 3] 2 3 4 x 5 24 25 y 7 6 Y2 5 2x 2 2 Y1 5 x 1 1 5 4 3 2 (3, 4) 1 22 23 b. y y (x 2 4)2 1 (y 2 4)2 5 4 y 5 x2 1 1 x x No x-intercept No x- or y-intercept 5. Replace x by 2x and y by 2y. Place the tacks at A 111, 0B and A2111, 0B. a (ai 6 bi) 5 a ai 6 a bi i51 i51 i51 765 Key Concepts Reference SECTION 8.2 Arithmetic Sequences and Series An arithmetic sequence is a sequence in which each term after the first differs from its predecessor by a common difference d. The 5-yr survival rate for stage I breast cancer is 88%. For A and C of opposite signs and k fi 0, the denominators and A C have opposite signs, indicating that the terms on the left side of the equation have opposite signs. In Figure 2-2, six points have been graphed. For example, given the event E 5 {2, 4, 6}, n(E) 5 3. p(x) 4 5 x 212 220 225 216 220 230 235 240 224 228 232 73. e 2 , 2 f 2 4 2 2 {0, 4} 17. m 5 27. Output g(x) Input g(x) Apply function f to g(x). Assume that Pk is true; that is, assume that F1 1 F2 1 ... To graph the circle, first locate the center and draw a small open dot. 0, B ? For Exercises 65–66, use the Using techniques from calculus, we can show that (1 1 x)n 5 1 1 nx 1 first four terms of this infinite series to approximate the given expression. 39,902 b. The distribution of blood types for people living in the United States is given in the table. a cai 5 c a ai i51 A constant factor can be factored out of a summation. We have Y1 5 2x 2 1 and Y2 5 x 1 5. In Example 7, notice that there are 3! 5 6 times as many permutations as combinations. Let Pn be the statement (xy)n 5 xnyn. Center: (4, 1); Radius: 4 6 5 21 21 22 23 24 SA-51 2 9 1 3 219 x 42. Let M 5 logb x and N 5 logb y, which implies that bM 5 x and bN 5 y. Given f (x) 5 2 4x2 1 1, define functions m, n, h, and k such that f (x) 5 (m + n + h + k)(x). Directrix: x 5 14 ; Axis of symmetry: y 5 0 c. Find the number of terms of the arithmetic sequence. a 11 b 5 9 14. Center: (0, 21) 31. a 6a b 3 8 49. Replace (x, y) by (2x, y). m is undefined For Exercises 29–36, determine if the lines defined by the given equations are parallel, perpendicular, or neither. R b. 1 2 1 24 25 12. r(x) 5 31. One solution Infinitely many solutions a. (23, 21] ´ [2, `) 69. e 1 6 157 f 4 4. Assume that 6 1 10 1 p 1 (4k 1 2) 5 k(2k 1 4) (Inductive hypothesis). Transformations give us tools to graph families of functions that are built from basic “parent” functions. Answer Number of ways to select Number of ways to select Total number ° 3 women from 8 women ¢ ° 2 men from 7 men ¢ a of committees b 5 ? a 4 j51 66. The maximum height is the value of h(t) at the vertex. (3m 1 21n 1 7)2 (3c 2 8)(2c 1 2) or 2(3c 2 8)(c 2 2) (p 2 4)(p2 1 4p 1 16)(p4 1 1)(p2 1 1)(p 1 1)(p 2 1) (m 1 3)(m2 2 3m 1 9)(m 2 1)(m2 1 m 1 1) 2z(2x 1 3)(4x2 2 6x 1 9)(x 2 1)(x2 1 x 1 1) (x 2 y)(x 1 y 2 1) 75. Domain: (0, `); Range: (2`, `) 2 y 5 f(x) 1 f. { } 4. i51 i51 n 19. The rate of increase, $12.99 per additional family member, is the slope. R.3. a2`, R.2. (2`, `) f 21(x) 5 x13 2 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x f(x) 5 2x 2 3 23 Section 4.2 Practice Exercises, pp. We will quickly enhance this method with other techniques that are less cumbersome and use more analysis and strategy. Minimum: 28 h. 1.763 3 1012 7 2 7 7 2 7 2 41. From the graph of a function, how can you determine if the function is even or odd? Write the first five terms of the sequence defined by an 5 2n 1 3. a , 0b 4 c. During a time of drought, the water level decreases at a rate of 3 in./day. g(35) 5 35 2 4 5 31 Skill Practice 6 Refer to functions f and g given in Example 6. To show that a statement is not true, all we need is one case in which the statement is false. 15 y 5 2x2 1 12 Answer 220 173 20 y 5 |x| 2 15 7. Concept Connections 1. List all the combinations of three elements from the set. log 8 1 log c 1 log d 11. x-intercept: (22, 0); y-intercept: None 2 3 4 5 x 24 25 23 y 5 |x 1 1| 1 23 22 5 4 3 2 1 1 1 2 ; ax 1 b 49 7 5 4 3 2 6 5 4 3 2 x y R.2. n 5 R.3. 5 12 R.4. x2 2 4x 1 4 1. A ball is dropped from a height of 12 ft. A21 5 c 2 5 2151 1 5 2 d 15 21. is not 5. 6! 6 ? (22) 5 20(22) 5 240 a5 5 a4 ? See also specific functions absolute value, 229 algebra of, 262–265, 277 average rate of change of, 203–204 composition of, 266–270, 277 constant, 202, 301 continuous, 249 cub, 229 cube root, 229 decomposition of, 269 determining intercepts of, 188 domain of, 188–190, 263–264, 267–268, 275 evaluation of, 187, 263 even, 245–246 explanation of, 184, 186 exponential, 414–422, 483 floor, 249–250 graphs of, 190–191, 202–204, 229–230, 276–277 greatest integer, 249–250, 277 with horizontal stretch/shrink, 233–234, 236 identity, 229 increasing, decreasing, and constant behavior of, 251–252 inverse, 402–409, 482 linear, 202, 216–218, 229, 301 logarithmic, 427–437, 483 objective, 547–548 odd, 245–246 one-to-one, 403–405, 482 performing operations on, 262–264 piecewise-defined, 247–251, 276–277 polynomial, 300–310, 391–392 power, 301–302 quadratic, 229, 286–294, 301, 391 range of, 188–190 rational, 345–361, 393 reciprocal, 229 relations vs., 184–186 relative minima and maxima of, 253–255, 277 square root, 229 step, 249–250 transformations of, 230–238 with vertical stretch/shrink, 232–233, 236 Fundamental principle of counting, 739–740, 743, 766. Suppose that two fair dice are rolled. Square matrix 17. Find (m ? Let Pn be the statement 3 1 7 1 p 1 (4n 2 1) 5 n(2n 1 1). 5 mph 200 y 5 21.22x 1 1273 10 0 850 210 10 210 73. Linear Cost, Revenue, and Profit Functions A linear cost function models the cost C(x) to produce x items. m 5 b. Otherwise the sketch will be inaccurate. Find the number of terms in the arithmetic sequence. The given statement log5 (25) 1 log5 (225) is not defined because the arguments to the logarithmic expressions are not positive real numbers. 8 1 4 1 0 1 1 (24n 1 12) 5 22n(n 2 5) 9. Fixed cost: $5625 Variable cost per item: $0.40 Price at which the item is sold: $1.30 224 Chapter 2 Functions and Relations 57. 125 2 4x 95. to keep the amount of aluminum to at most 90 in.2. 3 25 24 23 22 21 23 26 2. Determine the pitch of the roof from point A to point C. (24, 21) h. 1 59. Write the equation using function notation where y 5 f(x). That is, a logistic growth model has an upper bound restricting the amount of growth. Show that P1 is true. b 45. c 1.1 79 c. x 1 3x h 1 3xh 1 h 1 2x 1 2h 2 5 63. (21, `) c. y 5 x 1 3 32. {1} 61. (2`,22) ´ (22, 2) ´ (2, `) c. In the case where c . Find all values of y such that the distance between (4, y) and (22, 6) is 10 units. ea2 , 2 , bf 77. No solution Infinitely many solutions 11. In how many ways can 7 different books be arranged on a bookshelf? {32} 53. f(5) 45. 350 300 250 200 150 100 50 0 R(x) 5 2.00x (80, 160) C(x) 5 0.50x 1 120 Revenue 5 Cost for x 5 80 0 40 80 120 160 Number of Lemonades Produced and Sold Figure 2-22 Profit , 0 for 0 # x , 80 Profit . Graph f 77. SA-8 Student Answer Appendix Chapter 1 Cumulative Review Exercises, p. 3 665 17. Each week thereafter, she increases the time on the treadmill by 5 min. This represents the amount of time (in yr) required to completely pay off a loan of A dollars at interest rate r, by paying P dollars per month. 770 Chapter 8 Sequences, Series, Induction, and Probability 89. Compute the sum of all integers between 40 and 100 that are exactly divisible by 3. x 5 2y or x 5 2y 123. Technology Connections For Exercises 71–74, use a graphing calculator to graph the circles on an appropriate square viewing window. The population in a certain town has been decreasing at a rate of 2% per year. Find 1A + A2 1x2 and interpret the result. {(5, 21), (8, 27)} 79. Find the locations and values of the relative maxima and relative minima of the function on the standard viewing window. 120 40 120 Chapter 8 Cumulative Review Exercises, pp. 5 5 5 25 25 5 25 5 5 25 25 25 25 5 5 Section 2.6 Practice Exercises, pp. Graph g 73. Blood Alcohol Concentration vs. 0 is true for all values of x excluding 3. Smartbook® is the first and only adaptive reading experience available for the higher education market. If a customer can select 1 item from each group for a sundae, how many different sundaes can be made? José must choose between two job offers. C(x) (the company makes a profit) P(x) y 5 P(x) x 730 59. {(0, 5)} 27. f (x) 5 0 x 0 12. a b 1 3 c. A 5 or a heart. x approaches 5 from the left 5. Rational equation 9 6 241 v 2 7. Center: a2 , 0b; Radius: 111 3 b. 0 2 1/2 11 2 x 2 2cd 5 x2y6 5 1 99. 4 3 2 1 1. Multiply row 1 by 3 and replace the original row 1 with the result. (0, 50) 45 50 40 (20, 40) 35 40 15. The complement of E, denoted by E (or sometimes by ,E or E9) is the set of outcomes in the sample space but not in event E. Therefore, p(x) ? 4 [A 2. Shift 3.7 units to the right. (2.7, `) 40. 5k 2 14 5 14(5 ? (See Example 8) 81. Approximately 109 cups Section 2.5 EXAMPLE 7 Applications of Linear Equations and Modeling 219 Writing a Linear Model to Relate Two Variables Pressure (mmHg) The data shown in the graph represent the age and systolic blood pressure for a sample of 12 randomly selected healthy adults. 0.9981 age 40 in the United States, 8038 die before the age of 41 and 4,216,062 survive. Given a function defined by y 5 f(x), explain how to determine the x- and y-intercepts. The midpoint of a line segment is the point equidistant (the same distance) from the endpoints (Figure 2-5). 12`, 22 ´ 12, `2 b. 264 Chapter 2 Functions and Relations b. (n 1 1)! 3! 4! 2! 1 1 1p1 7 14 21 7n 1 8 27 64 b. 0.00625 m or 6.25 mm 1681 m < 0.28 m 73. 4! 2 n 5 6 and r 5 2. 32 yr 89. 759–764 R.1. R.2. 1. 4 h. 6 2 y or 6A 2 yB 4 1y2 3y1y3 43. Passes through (7, 26) and is parallel to the line defined by 2x 5 5y 2 4. A quiz consists of 6 true/false questions and 4 multiplechoice questions. Write a function that represents the distance traveled d(r) (in ft) for r revolutions of the wheel. EXAMPLE 9 Solving Equations and Inequalities Graphically a. [$1820]; The value $1820 represents the total revenue from the sale of these four items. R 2. y 5 2 2 3 x 91. No asymptotes f. EXAMPLE 3 Identifying Even and Odd Functions By inspection determine if the function is even, odd, or neither. f (x 1 h) Solution: a. EXAMPLE 7 Finding an nth Partial Sum of an Arithmetic Sequence Find the sum of the first 50 terms of the sequence. x 1 5 The solution set is the set of x values for which Y1 . Evaluate f for several values of x. R(x) 5 1.50x c. There are no real numbers x and y that would make the sum of two squares equal to 21. If two nonvertical lines are perpendicular, then the slope of one line is the opposite of the reciprocal of the slope of the other line (Figure 2-21). 237 e. 199 p. The proofs of these formulas are addressed in Exercises 17–20. What is the probability that all three will be defective? EXAMPLE 6 Computing the Probability of A or B Suppose that one card is selected at random from a standard deck of cards. (f + g)(9) d. 2x(2x 2 5y)2 85. Yes 41. x 19. 236 12. Use the regression line to predict the longevity for an animal with an 80-day gestation period. Therefore, n(E1) 5 18 and n(E1) 18 9 5 5 < 0.4737. f (x) 5 2x 2 4 77. x 5 1 g. 16 2y7 x32 49. (2x 2 7)3y2 5 b. 120. ix Efficient. 3n for n $ 7. y 5 4 3 2 y 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 67. In a carnival game, players win a prize if they can toss a ring around the neck of a bowling pin. x Figure 2-5 Midpoint Formula The midpoint of the line segment with endpoints (x1, y1) and (x2, y2) is M5a x1 1 x2 y1 1 y2 , b 2 2 average of x-coordinates EXAMPLE 3 Avoiding Mistakes average of y-coordinates The midpoint of a line segment is an ordered pair (with two coordinates), not a single number. 6x 1 3h 2 4 b. Applying the Pythagorean theorem produces d2 5 0x2 2 x1 0 2 1 0y2 2 y1 0 2, or equivalently d 5 2(x2 2 x1)2 1 (y2 2 y1)2 for d $ 0. A face card (jack, queen, or king). 693 By definition, 0! 5 1. 1 1 51. In the event that the linear trend continues, use the model from part (a) to predict the number of attendees in week 24. Graph Equations by Plotting Points 4. an 5 (21) 4. By the inductive hypothesis, [8 1 4 1 p 1 (24k 1 12)] 1 [24(k 1 1) 1 12] 5 22k(k 2 5) 1 (24k 1 8) 5 22k2 1 6k 1 8 as desired. {9} {22} ´ [0, 3] ´ [5, `) 17. 8 16. See also Applications Index absolute value inequalities in, 151–152 compound interest in, 418–420 ellipse in, 642–644 exponential equations in, 460–461 exponential functions in, 421 hyperbolas in, 660–661 linear equations in, 84–85, 213–216, 276 linear functions in, 216–219 linear inequalities in, 151 linear programming in, 549–552 logarithmic equations in, 461 logarithmic functions in, 436–437 matrices in, 594–595 mixture, 96 parabolas in, 674–675 piecewise-defined functions in, 250–251 polynomial inequalities in, 376–377 proportion, 99 Pythagorean theorem in, 127 quadratic equations in, 126–129, 159 quadratic functions in, 286, 291–294 quadratic models in, 127–129 rational functions in, 360–361 sequences in, 702–703, 718–720 series in, 707–708, 718 simple interest, 94–95 systems of inequalities in, 543 systems of linear equations, 498–500, 512, 580–581 systems of nonlinear equations in, 531–532 uniform motion, 97, 134–135 variation in, 385–387 work, 98 Approximation of common and natural logarithms, 431 of rational and irrational numbers, 3 Area, of rectangle, 42 Argument, of logarithmic expressions, 428 Arithmetic sequences in applications, 702–703 common difference of, 701, 702 explanation of, 701, 765 finite, 705 nth partial sum of, 705–706 nth term of, 702–705 Arithmetic series, 707–708, 765 Associative property of addition, 10 of matrix addition, 588 of multiplication, 10 Asymptotes explanation of, 230 horizontal, 349–352, 393 slant, 352–353 vertical, 346–348, 393 Augmented matrix elementary row operations and, 565–566 explanation of, 564 in row-echelon or reduced-echelon form, 566–569 writing and interpreting, 564 Average rate of change, 203–204, 276 Axis of symmetry explanation of, 286 of parabola, 667, 671 B Base explanation of, 8 of exponential functions, 415, 418 of logarithmic expressions, 428 Base e, 418, 470–471, 696 Binomial coefficients, 732–734, 766 Binomial expansion explanation of, 732–733 finding specific term in, 735–736 Binomials. 2 (n 2 r)! 3 15. Linear c. Based on the sample of data, the estimated systolic blood pressure for a 55-year-old is 132 mmHg. Skill Practice 7 Suppose that y represents the average consumer spending on television services per year (in dollars), and that x represents the number of years since 2004. 25a4b 1 70a2b2 1ab 1 49ab4 89. a g b(8) h 16. x1 y2 52 To find the x- and y-intercepts from an equation in x and y, follow these steps. • 6 C 25 6 153 ¶ 2 kF a P1V1T2 4π2L 2 2 113. 22016c8d25 69. Domain: (2`, 21) ´ (21, `); Range: (3, `) 103. False 89. Solution: By definition a geometric sequence follows the pattern a1, a1r, a1r2, a1r3, ... x 1 3 for x , 21 x2 for 21 # x , 2 Solution: The first rule f (x) 5 x 1 3 defines a line with slope 1 and y-intercept (0, 3). x2 1 y2 1 22x 2 4 5 0 47. Now find the sum of the first 50 terms. f (x) 5 e 2.5x 1 2 for x # 1 x2 2 x 2 1 for x . (23, 22) and (2, 5) (x1, y1) and (x2, y2) m5 y m5 6 Label the points. (22) 5 210(22) 5 20 a4 5 a3 ? {5}; The value –2 does not check. y 5 2.3(1.12) 43. • The sequence can be defined recursively as a1, an 5 an21r for n $ 2. x2 1 y 2 3 5 4 a. Find the indicated function and write the domain in interval notation. That is, 2A 5 [2aij]. 44–47 1. 3x2 10. h(x) 5 2x3 45. Write the first five terms of an arithmetic sequence with the given first term and common difference. 5 300,000,000 75 75 75 15 16 4 4 13 1 d. 1.975 5 1.9757575 p 19 75 75 5 1 c 1 1 p d 10 1000 100,000 Infinite geometric series 75 1 and r 5 100 with a1 5 1000 1.975 5 75 S5 75 a1 1000 1000 75 5 99 5 990 5 665 5 1 12r 1 2 100 100 19 5 326 1 5 10 66 165 Skill Practice 9 a. The speed of the car s(t) (in mph) at a time t (in sec) after the car begins motion can be modeled by: 5 2 t for 0 # t # 12 12 for 12 , t # 72 60 s(t) 5 3 (92 2 t)2 for 72 , t # 92 20 1.5t for 0 # t # 20 30 for 20 , t # 40 t 2 19 Determine the speed of the sled after 10 sec, 20 sec, 30 sec, and 40 sec. {(5, 22), (25, 2)} 14. E617, 62iF 13. Prove a Statement Using the Extended Principle of Mathematical Induction Mathematical induction can be extended to prove statements that might hold true only for integers greater than or equal to some positive integer j. g(x) 5 2 1x 15. Julie earned a bachelor of science in applied mathematics from Union College in Schenectady, New York, and a master of science in mathematics from the University of Florida. Arithmetic Sequences and Series 1. Yes 49. 489 R.4. R y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 1 2 3 4 5 x 1 x-intercept: (1, 0); slope: m 5 ; y-intercept: (0, 21) 5 y-intercept: (0, 4) system 3. Use the distance formula d 5 2(x2 2 x1)2 1 (y2 2 y1)2 1 (z2 2 z1)2. {25, 24, 23, 22, 21, 1, 3, 5} sample; space 3. (23, 0) f. Number of Oscar Nominations y Actor x Elevation at Airport (ft) y City x 5 Albany 285 12 Denver 5883 Sean Penn 5 Miami 11 Dustin Hoffman 7 San Francisco 11 Tom Hanks Jack Nicholson y 11. Show that n2 2 n 1 1 is odd for all positive integers n. The value 0 B 0 5 2 0 A 0. logb x 2 logb y 1 1 2 2 49. Find a b(x) and state the domain in interval f notation. Determine the vertical velocity 1 sec after release and 5 sec after release. 1 x13 2x 1 5 x12 (x 1 2)2 3 1 8 23 4x 2 2 26. 2 3 m(x) 1 1 x2 23 25 24 23 22 21 21 22 23 24 24 25 28 27 26 25 24 23 22 21 21 22 1 2 x 7 57. y y 5 f(x) 1 1 2 3 4 5 x 6 25 24 23 22 21 21 22 23 23 24 25 24 25 82. 1 2 3 4 5 b. E2: A black sock is selected. A sum of 7 will occur if the dice land on one of the following 6 outcomes. 1 2 3 4 5 x This is a function. 15 11. Answers 4. Which of the viewing windows would show both the x- and y-intercepts of the graph of 780x 2 42y 5 5460? (24, 22); m 5 73. 2 5 1; x $ 0 or x 5 2 1 1 2 2 4 81 B 81 (372) (334) 12 microns 65. Show that (xy)k11 5 xk11yk11. y 8 7 6 8 7 6 5 4 3 2 5 4 3 2 5 4 3 2 1 0 c. None of these 89. 5 2k11 From the string of inequalities we have shown that (k 1 1)! . (4, 0), A 12, 0B, and A212, 0B (4, 0), A 12, 0B, and A212, 0B 14. (f 2 g)(22) 3 SECTION 2.8 e. Suppose that a line passes through the points (4, 26) and (2, 21). Write an Equation of a Circle in Standard Form 1. b 13. 0 (multiplicity 2), 21 (multiplicity 2), and 6i 110 (each multiplicity 1) 81. 14.6 ft 43. a2`, b ´ a , `b 53. {24} 5e2.1 1 86; n < 16.1662 77. Therefore, we are arranging 6 different (distinguishable) items in various orders. 21 45. Therefore, a third-degree polynomial has at most 2 turning points. t(3) 52. y 5 0.511x 1 104 y 5 0.511(55) 1 104 5 132.105 (55, 132) 0 200 y 5 0.511x 1 104 0 0 80 To approximate the systolic blood pressure for a 55-year-old, substitute 55 for x. 7i 12 9. y 5 0x0 1 1 2x 1 1 for x # 1 for x . Find the fifth term. EXAMPLE 4 Determining if an Equation Represents the Graph of a Circle Write the equation in the form (x 2 h)2 1 (y 2 k)2 5 r2, and identify the solution set. e , 2 f 525 6 1296 3 4 3 1 18. x-intercept: (24, 0); y-intercept: (0, 3) 55. 5 22 5 5 x2 2 x1 7 1 2 122 2 2 25 24 23 22 21 21 22 m 5 22 1 2 3 4 5 x 23 24 25 26 A line with a negative slope “falls” downward from left to right. 9, 12, 16, 21, 27, ... 21. i, 21, 2i, 1, i, 21, 2i, 1 111. 6! 1 ? That is, the exponent on b is one less than the term number. Yes; 5 3 5 b. x 2 2 2 1 2 2 27. Mathematically, a probability of 0 means that the event is impossible. g(0) 54. 767–770 1. 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 x y 94. y2 x2 b. {(23, 2), (9, 5), (1, 0), (23, 1)} Section 2.3 y 4 3 2 (3, 1) 1 22 21 21 22 3 4 5 23 24 (3, 24) 25 6 7 8 x Points align vertically 26 Figure 2-14 185 Functions and Relations A relation that is not a function has at least one domain element x paired with more than one range element y. 2x 2 4y 5 8 52. Center: (0, 0) e. {(5, 21)} 3. The angles are 168, 248, and 1408. x 5 24, x 5 0 e. y 5 f(x) 1 2 3 4 5 x 274 Chapter 2 Functions and Relations 111. The vertex is (1, 8). The truck is 6 ft by 6 ft by 8 ft. 3 d. Evaluate C(225) and interpret the meaning in the context of this problem. Write P as a function of s. 3y 5 1.5x 2 5 c. y 5 m(x) 1 25 24 23 22 21 21 22 1 2 3 4 b. in Standard Form 2. Write A as a function of C. {x 0 0 # x , 2} c. P(s) 5 4s b. E64, 617F 3 e , 25 f 21. The bounding line would be 4 drawn as a dashed line. Singular matrix 4 5§ 0 21 11 8 25 d ; This matrix represents the reflection of the 2 triangle across the y-axis. The calculator asks for a right bound. (2`, 2] 77. 2c3y4(c 1 2) x4 y4 2(2x 1 1) 8x 1 5 85. Isolate the absolute value. However, we must also exclude values of x that make the denominator zero. 1, then xn . 2 3 4 5 6 3 4 5 x 23 y 5 4 3 2 x y 23 22 23 0 1 23 2 23 4 25 24 23 22 21 21 22 x 5 23 1 2 x 23 24 25 y can be any real number. 3 Reflect across the x-axis. Write a function that represents the number of revolutions r(t) in t minutes. Graph the function. If the lines in the system are parallel, then the lines do not intersect and the system has no solution. {23} 45. paper) 1. (g + f)(5) Solution: TIP When composing functions, apply the order of operations. 1 x 40. (1.9, 90) 150 4 0 3 0 c. 8 9 10 11 ,2 ,2 ,2 , p 11 22 33 44 50. See the red portion of the graph in Figure 2-34. 422–427 24 25 41. 665 5 8 59. 21028 26 24 22 22 21028 26 24 22 22 2 4 6 8 10 x 2 4 6 8 10 x 24 26 24 28 26 28 210 212 (x 2 8)2 1 (y 1 11)2 5 25 35. g 25. By mathematical induction, we conclude that the statement is true for all positive integers. {x 0 x , 9} d. E A 79 45 , 45 B F 29. Solution: 4 3 2 1 22 21 21 22 23 24 25 26 Writing an Equation of a Circle in Standard Form A sketch of this scenario is given in Figure 2-12. (k 1 1)! 5 (k 1 1) ? The formula Ln 5 a 2 2 the nth Lucas number. y 5 0 x 0 35. (b, c) c. If a couple has 4 children, how many boy/girl sequences are possible for the four births? 5! 5 120 59. (0, 0) f. x 2 1 y . 25 25 24 23 22 21 24 28 215 71. Solve Applications Involving Quadratic Functions Quadratic functions can be used in a variety of applications in which a variable is optimized. The ball does not land on the number 8. 16 113 in. 0 2x 2 5 0 2 3 61. 1 27 , f 27 8 89. 2 y 81. ¢t 48. 10 h. (2`, 25] ´ [22, `) 57. 1) Horizontal stretch (if 0 , a , 1) Replace (x, y) by A ax , yB. We are already familiar with the graph of f (x) 5 x2 (Figure 3-1). In this case, the monthly income is $3000 plus 5% of sales over $20,000. 3 9 27 Because 0 r 0 5 @ 43 @ $ 1, the sum does not exist. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 23 24 25 1 2 y5 3 4 1 2 x2 2 5 x 25 24 23 22 21 21 22 91. 2i 23. {x 0 x , 28 or x $ 21} f. y 5 f(x) For Exercises 89–94, determine if the function is even, odd, or neither. Parent function: y 5 x3 1. The length is 20 in., the width is 8 in., and the 5 height is 4 in. (See Example 4) 32. True 65 a. 5040 35. Y1 5 2x 2 3 5 Y2 5 x 2 1 25 x-coordinate of the point of intersection (2, 1) 5 25 In Example 9 we solve the equation 6x 2 2(x 1 2) 2 5 5 0. Foci: A3 1 151 4 , 2B , A3 2 151 4 , 2B y e. If x is the amount of money initially invested, then A(x) 5 1.045x represents the amount of money in the account 1 yr later. $17 b. 25 24 23 22 21 0 1 2 3 4 x 5 There are no fractions or radicals that would restrict the domain. f(x), where a is a positive real number. 8! 35. The northbound boat travels 8 mph and the 3 southbound boat travels 14 mph. a 12a2 b 3 i51 ` 2 44. 3 1 n 1)(2n 1 1) 5 2n 1 1 . Doctors know that certain restrictions apply when considering the administration of blood to a patient. Even function Odd function Neither even nor odd Odd function Even function Neither even nor odd Skill Practice 4 Determine if the function is even, odd, or neither. C-1 Subject Index A Abel, Niels, 344 Absolute value bars, 7 Absolute value equations explanation of, 135 method to solve, 135–136, 159 Absolute value functions, 229 Absolute value inequalities in applications, 151–152 methods to solve, 148–151, 159 properties involving, 149 Absolute values of real numbers, 7, 73 to represent distance, 8 Addition associative property of, 10 commutative property of, 10 of complex numbers, 107–108 distributive property of multiplication over, 11, 12 identity property of, 10 inverse property of, 11 of matrices, 587–588, 626 of polynomials, 39 of radicals, 33 of rational expressions, 62–63, 74 Addition method to solve systems of linear equations, 494–497 to solve systems of nonlinear equations, 529–530 Additive inverse of matrix, 588 for real numbers, 11 Algebra of functions, 262–265, 277 fundamental theorem of, 332–335 linear, 497 Algebraic expressions explanation of, 10 method to simplify, 10–12 properties of exponents used to simplify, 20–21 Algebraic models, 12–13 Alternating sequences, 691, 764 am/n, 28–29 a1/n, 28–29 Analytic geometry, 178. Reduced row-echelon form is the same format as row-echelon form with the added condition that all elements above the leading 1's must be 0's. Answers 10. x(k11) 5 xk ? Expression; 4x 1 36 (x 2 3)(x 1 7) 3. Skill Practice 3 Write the nth term of the geometric sequence. x2 5 1.8 m 57. How many passwords can be made if there are no restrictions on the letters or digits? 2 11. {(0, 4), (22, 0), (2, 0)} 91. There is no need to test whether f is an odd function because a function cannot be both even and odd unless all points are on the x-axis. 3 5 a. C(x) 5 90 2 x 121. 4! ? • The y-coordinate is the value of the relative maximum or minimum. Domain: (2`, `); Range: (0, `) 1 2 3 4 77. b 5 4 or b 5 24 Section 3.2 Practice Exercises, pp. y 5 2g(x) y y 47. $97,920 $2088 75 a. Find the average rate of change on the interval [1, 3]. {1} 101. 288π in.3 b. The value x 5 0 is already excluded because it is not on the interval [1, `). Use the results from Exercise 107 to determine the slope and y-intercept for the graphs of the lines. A number less than 3 is rolled. x 28. 2 5 32 c. Determine the perimeter and area. f(a) 5 8 2 Za 2 2Z b. 232 Chapter 2 Functions and Relations EXAMPLE 3 Translating a Function Horizontally and Vertically Use translations to graph the function defined by p(x) 5 1x 2 3 2 2. { } 3 97. 25, 21, 3, 7, 11 Because the common difference is 4, each term after the first must be 4 more than its predecessor. 560–561 23 1 6 6 ` d 4 2 11. The value x is equidistant between c and d, 2 so the sequence c, x, d is an arithmetic sequence. 1 25 24 23 22 21 21 22 1 2 3 4 5 g. 1 1 1 1 15. 9 12 5 4 3 2 y5x 1 1 2 3 4 5 x 21 21 22 23 23 24 25 24 25 10 25 5 210 21000 93. y 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 2 3 4 5 R.1. 27 1 24i R.2. a. Sandy has a personal trainer who encourages her to get plenty of cardiovascular exercise. Find the function and write the domain in interval notation. (23, 22) c. If one student is selected at random, find the probability of the following events. In this case, we say that entire sample space, and P(E2) 1 P(E3) 5 19 19 events E2 and E3 are complementary events. log1y5 125 5 23 log 1,000,000,000 5 9 23. 1 1 2 1 22 1 23 1 ... 1 2n21 5 2n 2 1 3 3 3 3 1 n 1 1 1p1 n512a b 4 16 64 4 4 ... 13. 1 2 3 4 5 6 7 8 9 x x 1 y2 5 2 x 4. {6} 28. The card is a 2 or a 10. {(5, 0)} b. (223, 184) c. m 5 y 5 2 x 2 ; f (x) 5 2 x 2 3 3 3 3 7 2 3 a. How many groups of 5 numbers are possible? y y 5 4 3 2 5 4 3 2 1 2 3 4 5 x 28 27 26 25 24 23 22 21 21 22 23 23 24 25 24 25 31. 4 15 1 2 13 103. If so, identify the common difference d. m 5 1 b. (a3 1 4b)6; term containing a9. a (21)j j51 3 n22 15. (0, 4) c. The word MICROSCOPIC has 11 letters. 216 26. y 5 2x 2 6 b. f (x) 5 x2 Function f squares the result. In calculus, we can show that the slope of the line drawn tangent to the curve y 5 1x at the point Ac, 1c B is given by 2c12 . In how many ways can a jury of 6 women and 6 men be selected? Consider a sequence representing the salary for job B for year n. If two nonvertical lines have the same slope but different y-intercepts, then the lines are (parallel/perpendicular). Maximum value: 31 11. 0 2x 2 11 0 1 1 # 12 3 20. {1} 33. E7 6 155F 85. 2i c. Basketball player Lebron James makes approximately 76% of free throws. Objective 3: Create Linear Functions to Model Data 51. A map of a wilderness area is drawn with the origin placed at the parking area. The graph of y 5 f (x) 2 c is the graph of y 5 f (x) shifted (up/down/left/right) c units. y 5 12 f (x 1 2) 2 3 30 526 40 650 50 760 54 813 1 87. x(x 1 1); x2 1 x d. 2 7 x(x 1 h) 67. c 1 5 c 21 c. 24 (odd multiplicity), 1 (odd multiplicity), 3 (odd multiplicity) Student Answer Appendix 49. A21 5 c a 1 d 0 b 5 6 65. n n n n a banb0 1 a ban21b1 1 a ban22b2 1 a ban23b3 0 1 2 3 These values match the exponent on b. 2 k 2. 7 10 21. 10 5 1,757,600 b. Formula for the nth term of an arithmetic sequence an 5 54 1 (n 2 1)(20.8) Substitute 54 for a1 and 20.8 for d. 285: NASA; p. x2 1 6x 2 27 61. 12x 1 6y 5 6 b. f (x) 5 4x3 1 3 46. (n 2 2)! n! 43. Label the shorter sides as a and b. 2` 69. d 5 2[7 2 (25)]2 1 (23 2 1)2 Apply the distance formula. 0.81 78. Examples: 0! 5 1 1! 5 1 2! 5 2 ? a 6(2)i21 52. f 1x2 5 where x fi 25 x14 c. This is the interval where the blue line is above the red line. The midpoint of the line segment with endpoints (x1, y1) and (x2, y2) is given by the formula 5. 2y 5 a 95. Once the plane goes over the vertex of the parabola, flyers free fall inside the plane. 9! 2! ? { } {5}; The value 24 does not check. The interval(s) over which f is increasing. There may be multiple representations. 83. {x 0 3 , x , 11}; (3, 11) ((3 11 97. The two N's can be arranged in 2! different ways. In how many ways can 5 children be arranged in a line for a photograph? The graph of a step function is a series of discontinuous "steps." One important step function is called the greatest integer function or floor function. A6 2 i 13B 2 2 12 A6 2 i 13B 1 39 5 0 ✓ 10 8 6 4 b. Then solve the resulting system of nonlinear equations. 211.2 2 4.6(c 2 3) 1 1.8c , 0.4(c 1 2) 112. Therefore, P1 is true. (x 1 3)2 1 (y 2 1)2 5 11 y b. 22 a. Give an example of two events that are mutually exclusive. from x1 5 0 to x2 5 1. (See Examples 3–4) 41. Explain how the graph of f (x) 5 21x 2 1 1 3 is related to the graph of y 5 1x. Directrix: x 5 7; Axis of symmetry: y 5 21 c. Skill Practice 3 Use translations to graph the function defined by q(x) 5 1x 1 2 2 5. 80x 1 400y 1 480z 5 9280 50x 1 350y 1 400z 5 7800 75x 1 525y 1 600z 5 10,500 b. E21, 13, 213F 2 c. y 1 31. 3.2839; 73.2839 < 596 1n 7 65. (1, 2), (3, 0), and (23, 22) 21. • Then show that the truth of the statement for an integer greater than or equal to j implies the truth of the statement for the integer that follows. c 23. For i 5 121, find the first eight terms of the sequence defined by an 5 in. Yes; r 5 15 2 2 17. Find the frequency for C two octaves above middle C. y y 2 23 22 21 21 22 1 2 3 4 5 6 7 x y 79. Domain: (1, `); Range: (2`, `) c. 1 51 25 25 9 2 2 y (x 2 3) 53. 2 65. 0 x 2 4 0 5 6 or equivalently 0 4 – x 0 5 6 b. Apply the point-slope formula with x1 5 24, y1 5 1, and m 5 214 . SECTION 8.5 58. If we expand the binomials and combine like terms, we can write the equation in general form. 10 L should be drained and replaced by water. Neither even nor odd y f. (See Example 3) r(x) 5 23x p(x) 5 x2 1 3x q(x) 5 11 2 x 19. 100: © BananaStock/Jupiter Images RF; p. e f ; The value does not check. The minor is the determinant of the matrix obtained by deleting the ith row and jth column of the original matrix. Given a 2.5% grade, write this as a slope in fractional form. 2 55. The manufacturer should produce 600 grill A units and 500 grill B units to maximize profit. Domain: (2`, `); Range: (0, `) c. Find the average slope of the hill. Where will it pass through the x-axis? Thank you for making us shine. 10,400 ft 33. Find the probability that a student guesses on each question and gets a perfect score. The table gives a partial list of data from the graph. 4x 1 3 a. Solution: Let x represent the amount in sales. 1 1 1 1 1 1 1 1 p 6 36 216 61. Powered by the intelligent and adaptive LearnSmart engine, SmartBook facilitates the reading process by identifying what content a student knows and doesn't know. 2a2, a5, 2a8, a11, p 51. 23, 323, 4323, p Technology Connections For Exercises 113–114, use a graphing utility to find the first four terms of the sequence. Five questions are true/false and five questions are multiple-choice. zeros 3. an 5 13 n14 2 For Exercises 11–28, evaluate the sum if possible. Given f (x) 5 1 x12 12 , x a. 250 Chapter 2 Functions and Relations EXAMPLE 8 Graphing the Greatest Integer Function Graph the function defined by f (x) 5 Œx œ . x y b. Determine f(21). y 5 1x 7. Review Exercises CHAPTER 8 SECTION 8.1 For Exercises 13–14, write the sum using summation notation. Q e. The dealer spins the wheel in one direction and rolls a small ball in the opposite direction until both come to rest. viii Key Features Supplement Package Supplements for the Instructor Author-Created Digital Media Digital assets were created exclusively by the author team to ensure that the author voice is present and consistent throughout the supplement package. 24428 23. Also, the selected points must fairly represent the shape of the graph. 1 3 x(x 1 4) x(3x 1 y) c. f (x) 5 2 x 2 4x 1 4 x 2 3x 2 10 111. Determine Binomial In Section R.4 we learned how to square a binomial. P(0) 5 2,000,000; P(6) 5 1,000,000; P(12) 5 500,000; P(60) 5 1953 31. c 13. y 5 1 x For Exercises 9–18, graph the functions by plotting points or by using a graphing utility. 0 y 63. h(27) 41. k(x) 5 e 3x for x , 1 23x for x $ 1 65. These ideas are stated formally using mathematical notation. 2x 1 3 1x 2 1 1 2 3 4 24 25 f. None d. 0.72 m c. {(23, 21, 0)} 1 {(0, 2, 24)} 47. Equation 1: e 5 4 , Equation 2: e 5 53 b. The center is (3, 1) and another point on the circle is (6, 5). Write the domain of the relation. x 5 y2 29. an 5 a1 1 (n 2 1)d 49 5 a1 1 (15 2 1)d 49 5 a1 1 14d an 5 a1 1 (n 2 1)d 85 5 a1 1 (27 2 1)d 85 5 a1 1 26d Substitute a15 5 49 and a27 5 85 into the formula for the nth term. A parenthesis is used if an endpoint to an interval is not included in the set. 5 4 3 2 y 5 f(x) f (x) 5 Œx œ where Œx œ is the greatest integer less than or equal to x. (a, f (a)) and (b, f (b)) 51. That is, test whether g(2x) 5 2g(x). F 5 1.06D 5 c d $30,210 $28,514 71. x2 1 y2 5 25 2 3 4 8 2. e , 22 f 11. This gives us y 5 1x 1 2. left 7. Domain: (2`, `); Range: [0, `) 7 6 5 4 13. { } 57. McGraw-Hill sites may contain links to websites owned and operated by third parties. f (x) 5 x2 2 14x 1 113 Direct substitution; 22 85. ISBN 978–0–07–783634–4 (alk. TIP Dividing the x values by 21 is the same as multiplying the x values by 2. {21 1 ln 20} (2`, 24) ´ [3, `) 17. For example: (0, 0, 22), (0, 3, 0), and (6, 0, 0) a. 1 4x8y2 b. g(x) 5 Œx 2 3œ 1 83. 0 y y 67. y¿ 5 2 25y 5 75. h(21) EXAMPLE 6 c. The event that the numbers on the dice do not present a sum of 7 is the complement of event E. {24} 13. 1 Fk 1 Fk11 5 (F1 1 F21 ... 4x2 1 4y2 2 12x 1 9 5 0 53. Given functions f and g, explain how to determine the domain of QgR(x). Explain why many graphing utilities give an error message for the expression 120! . Determine the domain of f. (2`, `) 1 3 a. 2 3 4 x 5 25 21. 21 and 2 6 3i (each multiplicity 1) 85. y 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 23 24 25 24 25 24 25 24 25 40. Minimum: 3 h. Figure 2-19 shows that the graphs Section 2.4 205 Linear Equations in Two Variables and Linear Functions of the two lines intersect at (23, 2). The table of points reveals that for corresponding x values, the values of g(x) are 2 more than the values of f(x). If the scholarships were for equal amounts (say for $500 each), then the order in which the 2 students are selected does not matter. Answer y 5. Write a function that represents the total cost T(a) for a dollars spent in merchandise and shipping. Graph the data in a scatter plot using the number of calories as the independent variable x and the amount of cholesterol as the dependent variable y. y(t) 5 116 2 t b. In this case, x 5 3 is excluded from the domain. 3 a. 5 4 3 2 25 24 23 22 21 21 22 1 1 2 3 4 5 x 28 4 5 6 x Section 2.3 x 24. 24x 2 16 y , 214x 1 114 73. 1, then the graph of y 5 f (ax) is the graph of y 5 f (x) shrunk horizontally by a factor of 1a . The nth term of the sequence from Example 3 can be written in several equivalent algebraic forms. A car starts from rest and accelerates to a speed of 60 mph in 12 sec. Supplements for the Student Student Worksheets including guided lecture notes that step through the key objectives and Problem Recognition Exercise worksheets. 1 2 3 4 5 6 7 8 x (21, 0) and (3, 4) (x1, y1) and (x2, y2) The center is a 21 1 3 0 1 4 , b 5 (1, 2). 207–212 R.1. x-intercept (7, 0); y-intercept (0, 242) 3 4 5 23 24 25 24 25 2 x 25 24 23 22 21 21 22 17. How many outfits can be made from 4 pairs of slacks, 5 shirts, and 3 ties, if one selection from each category is made? 25e2x 27 9. P(A) 5 524 . 18 a. 2k 1 2 for k $ 7. For Exercises 52–53, find the sum. 2 1 11i 55. (See Example 5) 45. See nth term of sequence Geometric sequences explanation of, 712, 765 nth partial sum of, 715 nth term of, 714–715 terms of, 713–714 Geometric series finite, 715–716 infinite, 716–718, 765 Geometry. How many days will it take Johan to read a 920-page book if he reads 20 pages the first day, 25 pages the second day, 30 pages the third day, and so on? † 22 5 211 † 5 0 1 25 13 b. (See Example 3) s1x2 5 x22 x2 2 9 t1x2 5 x23 22x 27. (See Examples 7–9) m(x) 5 2x 1 8 n(x) 5 x 2 5 p(x) 5 x2 2 9x q(x) 5 1 r(x) 5 0 2x 1 3 0 x 2 10 65. No 51. Therefore, we want a factor of –1 raised to an even exponent on odd-numbered terms and an odd exponent for evennumbered terms: (21)n11 Skill Practice 5 Find the nth term an of a sequence whose first four terms are given. The survey consists of 14 questions. Profit: z 5 160x 1 240y b. The x- and y-axes divide the plane into four quadrants. (6 2 2)! 2! ? 4 cups b. f (x) 5 • 892.50 1 0.15(x 2 8925) 4991.25 1 0.25(x 2 36,250) or y 1 1 26 25 24 23 22 21 21 22 2 0x 0 for x , 2 22 for x $ 2 113. g(x) 5 e x 1 2 for x , 21 2x 1 2 for x $ 21 64. 2 y d. 2x3 1 x2 2 2x 2 10 d. At x 5 1, there are two different y values. Table 8-4 Age (yr) Probability of 1-yr Survival 10 0.9999 20 0.9991 30 0.9990 40 0.9981 50 0.9959 60 0.9907 70 0.9791 80 0.9434 90 0.8543 Experiment: Sample Space: Flip a coin {head, tail} Roll a single 6-sided die {1, 2, 3, 4, 5, 6} An event is a subset of the sample space and is often denoted by E or some other capital letter. 5 y 5 (x 2 2)2 4 x 22 3 2 1 23 24 25 25 24 23 22 21 21 22 25 24 23 22 21 21 1 2 3 4 5 y 25 24 23 22 21 21 22 1 2 3 4 5 6 7 8 9 x 26 24 25 27 28 y 5 4 3 2 1 2 3 4 5 x 25 24 23 22 21 21 22 x t(x) 5 22|x| 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 y 83. The zeros are 12 , 3i, and 23i. y 5 f(x) 1 b. Find the average amount earned per year between the 20th year and the 25th year. 58.28 in. 12! 3 ? y 5 4 21. Finally, to the dedicated people in the McGraw-Hill sales force, thank you so much for your continued confidence, encouragement, and support. y 5 53. Student-Friendly Learning Experience ALEKS is designed to meet the needs of today's students. H(t) 5 4.86 1 6.35 ln t b. Graphing calculator examples are placed in self-contained boxes and may be skipped by instructors who choose not to implement the calculator. (22) 5 5(22) 5 210 a3 5 a2 ? f (a 1 4) 52. EXAMPLE 5 Finding Permutations of n Items Taken r at a Time Suppose that 5 students (Alberto, Beth, Carol, Dennis, and Erik) submit applications for scholarships. 61, 63, 67, 621, 6 , 6 , 6 , 6 2 2 2 2 7 c. Every individual has two biological parents, a mother and a father. 2 135 79. a 5 3 Section 1.2 Practice Exercises, pp. f (22) g c. (See Example 9) 97. EXAMPLE 3 Using Mathematical Induction Use mathematical induction to prove that 4 is a factor of 9n 2 1. (0, 9); The pot should be placed 9 in. r(x) 5 x2 2 4x 2 12 b. Determine the exact length and width of the rectangle shown. h(x) 5 11 x23 Mixed Exercises For Exercises 99–102, the graphs of two functions are shown. 4! 2 ? x 5 e. Arithmetic; $1,770,000 b. Assuming that the linear trend continues, use the model from part (a) to predict the number of students enrolled in public colleges for the year 2020. How many terms must be taken so that the nth partial 1 of the actual sum? (See Example 6) 48. 510 ? Substitute n 5 50, a1 5 2, and a50 5 100. (See Example 5) b. e 6 if 87. P < 2π 16 units y2 y2 x2 c2 c2 93. However, French mathematician Pierre de Fermat (1601–1665) posed the statement that the equation x n 1 y n 5 z n has no such solutions for positive integers n . Cost for 0 # x , 80 for x . [23, 21] ´ [1, 3] 5 39. Section 2.8 EXAMPLE 7 Algebra of Functions and Function Composition Composing Functions and Determining Domain Given f (x) 5 2x 2 6 and g(x) 5 the domain in interval notation. Find the sum of the first 1000 positive integers. x 22 23 d. 25 Scenario 2: The salesperson sells over $20,000. 0 x 2 1.7 0 1 4.95 # 11.15 For Exercises 113–114, graph the lines in (a)–(c) on the standard viewing window. a. The lengths of the sides of the lower triangle are 6 ft, 8 ft, and 10 ft. y 5 107 x and y 5 2107 x 105. The cofactor is the product of the minor and the factor (21)i1j. Excluding x 5 4, the domain of hk is [1, 4) ´ (4, `). (x 1 1)2 1 (y 1 5)2 5 25 y x 26. • Consider a set of n elements with r1 duplicates of one kind, r2 duplicates of a second kind, ... , rk duplicates of a kth kind. ceil(5.5) b. 27 (((m + p)(x) 5 m(p(x)) 5 2 27 Skill Practice 8 Given f (x) 5 1x 2 1 and g(x) 5 x 21 3 , find (g + f)(x) and write the domain of g + f in interval notation. A21 5 ≥ 20.12 0.15 b a ad 2 bc a ` 1 a 2ac 0 d 1 ad 2 bc 2ad 2b bc d a ad 2 bc 2b d , provided ad 2 bc fi 0. 1 ab 2b 1 a 4 1y 69. Shift the graph of f to the left 5 units, shrink the graph horizontally by a factor of 12 , stretch the graph vertically by a factor of 2, and reflect the graph across the y-axis. reflected across the Objective 1: Recognize Basic Functions For Exercises 9–14, from memory match the equation with its graph. Passes through (3.4, 2.6) and m 5 1.2. 10. 5 6 y 23 22 21 21 2 15. 5 4 3 2 c. Let Pn be the statement 4n 2 1 is divisible by 3. (g + f)(5) 5 g(f (5)) 5 g(35) 5 31 Evaluate f (23) first. (2`, 4) c. Consider a right circular cone with 3 fixed height h 5 6 in. Evaluate Infinite Geometric Series 4. Compare the results to the result of Exercise 58. (4, 1) 35. 15 8 6 4 12 9 6 2 3 21028 26 24 22 22 24 2 4 6 8 10 x 21521229 26 23 23 26 3 6 9 12 15 x 26 29 212 215 29. 15, 5, 515, 25, ... 3 3 3 16. Extended Principle of Mathematical Induction Let Pn be a statement involving the positive integer n. Solution: a. Determine Domain and Range of a Function Given a relation defining y as a function of x, the domain is the set of x values in the function, and the range is the set of y values in the function. k 5 4.2 7 2 28. Write a linear function that represents the total property tax T(x) for a home with a taxable value of x dollars. {x 0 x , 21 or x $ 0} f. The values 481 and 521 are called constants because their values do not change in the formula. Note that the choice for (x1, y1) and (x2, y2) will not affect the outcome. 10, 13, 16, 19, 22 8. y 17. t30 1 6t25u3 1 15t20u6 1 20t15u9 1 15t10u12 1 6t5u15 1 u18 65. Answer 1. • The Guided Lecture Notes are keyed to the objectives in each section of the text. Find the difference between b88 and b20. Neither 20. The minimum value of f is k. logistic 70 0 0 b. Use a graphing utility to find the least-squares regression line. a1 5 128; r 5 2 49. {3, 23} 1 105. Skill Practice 1 A sock drawer has 6 blue socks, 2 white socks, and 12 black socks. Approximately 45 hr a. Therefore, by the fundamental principle of counting, the number of ways the pair of dice can fall is 6 ? Test for Symmetry 1. 8 6 4 15. x 5 24 e. m 5 < 0.068 75. (x 2 3)2 1 (y 1 1)2 5 16 y b. The slope is 0.4. This means that the average increase in systolic blood pressure for adults is 0.4 mmHg per year of age. ; (4, `) 4 41. (3, 4) d 5 2(x2 2 x1)2 1 (y2 2 y1)2 1 24 23 22 21 21 Circles 1 2 3 4 5 6 r 5 2[1 2 (21)]2 1 (2 2 0)2 5 2(2)2 1 (2)2 5 28 x An equation of the circle is: (x 2 h)2 1 (y 2 k)2 5 r2. x 2 y 3 3 11. 5 4 3 2 22 21 21 22 1 2 3 4 5 6 7 8 x 23 24 24 25 21. Therefore, (y2 2 y1) can be represented by Dy and (x2 2 x1) can be represented by Dx. Slope Formula x2 x1 Change in x The slope of a line passing through the distinct points (x1, y1) and (x2, y2) is change in y (rise) Figure 2-17 m5 ¢y y 2 2 y1 5 provided that x2 2 x1 ? A function f is a linear function if f (x) 5 y-intercept. 4 Using the Zero feature, we have Y1 5 0 for x 5 2.25. 115. 1 2 3 4 5 6 7 8 9 n 5 4 3 2 1 1 21 21 1 2 3 4 5 6 7 8 9 n 21 21 22 23 24 25 1 2 3 4 5 6 7 8 9 n 95. (x 1 3)(x 2 1)(x2 1 4) b. (2`, 0] ´ {3} 13. Explain. in the 2. In how many different ways can a customer fill out the survey? 212 Chapter 2 Functions and Relations Expanding Your Skills 103. a b(23) h d. The steps are the same with the following exception. 230–231 • Vertical translation (shift) y 5 f (x) 1 k Shift upward y 5 f (x) 2 k Shift downward • Horizontal translation (shift) y 5 f (x 2 h) Shift to the right y 5 f (x 1 h) Shift to the left • Vertical stretch/shrink y 5 af (x) Vertical stretch (if a . 1 f + f 21x2 5 ; 12`, 252 ´ 125, 242 ´ 124, 42 ´ 14, 52 ´ 15, ` 2 x22 5 5 ; 12`, 22 ´ a2, b ´ a , `b 22x 1 5 2 2 3 3 83. y 5 0 y 43. No c. (See Examples 7–8) 63. Interpret a Function Graphically In Example 10, we will review the key concepts studied in this section by identifying characteristics of a function based on its graph. 2 1 8 1 14 1 ... 1 (6n 2 4) 5 n(3n 2 1) n 5. linear; Ax 1 B A B A B A B 5. Passes through (0, 5) and m 5 2 . f (x) 5 x 1 3 where x fi 2 c. Find the 23rd term of an arithmetic sequence with a1 5 15 and a57 5 239. 220 # x1 # 270 vehicles per hour; x2 5 150 vehicles per hour 130 # x2 # 180 vehicles per hour a. Use the arithmetic mean for Exercises 103–104. Suppose that a cell tower is located at a point A(4, 6) on a map and its range is 1.5 mi. 4x3 1 1 11. {x 0 x , 211}; (2`, 211); 5. (See Example 11) y y y 98. p)(0) p c. f(x) 5 3(x 2 1)2 2 2 3 6 16 c. Wait Time, x 120 # x , 150 x , 30 90 # x , 120 60 # x , 90 5 2 15 32 21 41. 34 5 5184 56C12 a. a (21)n21(2n) (Exercise 65) n 1 117. f (29) 80. • Julie Miller created video content (lecture videos, exercise videos, graphing calculator videos, and Excel videos) to give students access to classroomlike instruction by the author. f 21(x) 5 log4 x 83. Simplify the complex fraction by multiplying numerator and denominator by the LCD x2 2 1. x 2 24 91. (x 2 1)(x4 1 x3 1 x2 1 x 1 1) n21 b. (p 2 r)(x) 21. (2`, 22) 14. Avoiding Mistakes It is important to use parentheses when substituting (k 1 1) into a statement for n. (25, 0) c. Determine the solution set for the equation (x 2 3)2 1 (y 1 12)2 5 0. {w 0 w # 3}; (2`, 3]; 3 13. e 19 13. The same logic is used when selecting the digits. By the inductive hypothesis, [2 1 4 1 ... 1 2k] 1 2(k 1 1) 5 [k (k 1 1)] 1 2k 1 2 5 k2 1 3k 1 2 5 (k 1 1)(k 1 2) as desired. Avoiding Mistakes Slope-Intercept Form of a Line An equation of a vertical line takes the form x 5 k, where k is a constant. c 1c b. z 5 y2; This is an equation of a parabola in the yz-plane. The main objectives of this college algebra textbook and our digital content are threefold: • To provide students with a clear and logical presentation of fundamental concepts that will prepare them for continued study in mathematics. Write the first four terms of the sequence. {(1, 2, 3, 4)} 59. See Figure 2-13. 4! Skill Practice 5 Determine the number of ways that 2 students from a group of 4 students can be selected to hold the positions of president and vice president of student government. For example, consider the different arrangements of the letters in the word FIVE. Use the points (950, 110) and (1000, 50) to write a linear 100 (1000, 50) model for these data. f (g(24)) b. f (20.09) 77. (4, 27) and (2, 21) 26. For each value of n, we have a corresponding statement Pn involving the value of the partial sum. { } 41 41 45. (0, 0, 0) is the only solution. Chapter 4 Cumulative Review Exercises, p. e f ; x < 0.5269 e ln 19 4 5 1 ln 2 ln 3 f or {5 ln 3}; t < 5.4931 25. Skill Practice 6 A judge at the County Fair must give blue, red, and white ribbons for first-, second-, and third-place entries in a poetry contest. y 5 212x 1 20 2 x18y10 22 1 ln 22 37 Neither 10. (9C3) ? • Sections R.1, R.2, 1.7 & 1.8 have been streamlined to provide greater clarity. 220 sec or approximately 31.4 sec 21. a p b(x) q 24. 6 5 4 3 2 1 1 25 24 23 22 21 21 22 Section 5.5 Practice Exercises, pp. • New "Prerequisite Review" exercises appear in every section. Write the equation in slope-intercept form if possible, and determine the slope and y-intercept. Given a function defined by y 5 f (x), the statement f (2) 5 4 is equivalent to what ordered pair? 30. (q + q)(x) 76. {(2, 2), (0, 22)} 1 2 3 4 5 x 9. f (x) 5 x 2 2 f (4) 5 (4) 2 2 5 2 f (1) 5 (1) 2 2 5 21 EXAMPLE 5 f (4) 5 2 can be interpreted as (4, 2). a2, b and m 5 0 49. Debbie travels several times a year for her job. Add 3 times row 1 to row 2 and replace the original row 2 with the result. positive 149. a2`, b 2 1 1 22. Therefore, the sign of each term is dictated by the denominator. 3 4 5 6 2 2 1 2 1 1 4 9 16 25 Solution: a. y 1 3 7 6 5 4 3 1 1 1 24 25 b. That is, d5 85 2 49 53 27 2 15 Substituting a15 5 49 and a27 5 85 into the formula an 5 a1 1 (n 2 1)d, we can set up a system of linear equations to solve for a1 and d. Parent function: f (x) 5 1x. 1st Generation 2nd Generation 2 parents 4 grandparents 3rd Generation 8 great-grandparents The terms of the sequence 2, 4, 8, 16, ... give the additional number of ancestors for each generation back in time. y 95. 2h(x), the function is not an odd function. bn 5 4n ; find b3 (n 1 1)! 47. 8 6 25. 2058F 2 b. (0, 0) 3 g. That is, (f + g)(x) ? If no such restriction is stated, then by default, the domain is all real numbers that when substituted into the function produce real numbers in the range. Determine the distance remaining after 122 mi. Insert three arithmetic means between 4 and 28. V 5 khr 17. 7 6 117 7 1 117 b. (x2 1 x)2 2 14(x2 1 x) 1 24 5 0 c. x 5 4 j. P1 is true because 1 ? A R.3. y 5 x-intercept: (0, 0); y-intercept (0, 0) x-intercept: (26, 0); y-intercept: (0, 3) x-intercepts: (23, 0), (3, 0); y-intercept: (0, 9) x-intercepts: (3, 0), (7, 0); y-intercept: (0, 3) x-intercept: (21, 0); y-intercepts: (0, 21), (0, 1) x-intercept: (0, 0); y-intercept: (0, 0) x-intercept: None; y-intercept: None d(A, C) 5 2 126 mi and d(B, C) 5 2 117 mi a. 1.84 b. (0, 22) e. Yes, because (f + g)(x) 5 (g + f)(x) 5 x 7. Passes through (6, 2) and (23, 1). {22, 0, 4, 8, 12} d. Determine if the function is linear, constant, or neither. Down to the left and up to the right; As x S 2`, f (x) S 2`, and as x S `, f (x) S `. After having driven x miles, the distance remaining r(x) (in mi) is given by r(x) 5 250 2 x. Graph iii 55. 680 deer d. f (x) 5 0 for x 5 24 and x 5 4. (gf)(5) d. Enter 55 for x and press the ENTER key. If one cookie is selected at random, find the probability of the following events. {21}; The value 4 does not check. a. (21)k(6k) 116. h(22) , , , , x for 0 2x for 1 50. p)(x) 5 (x 1 3) 1x 1 1; Domain: [21, `) p 1x 1 1 c. Suppose that 50 people buy raffle tickets. f(x) 5 5 a. 5 4 3 2 79. provided that fi 0. y 5 2 x 1 3 y5 x2 4 2 2 2S 2 an 3V 2S 2 a or d 5 81. R(x) 5 6x c. Answers y 5 mx 1 b y 5 24x 1 b 23 5 24(2) 1 b 1 4. (See Example 4) 35. 0.64 76. 10, 02 and a , 0b 2 7 49 y e. 6 By the inductive hypothesis, k11 k i51 i51 2 2 2 2 a i 5 a a i b 1 (k 1 1) 5 2k3 1 9k 1 13k 1 6 as desired. y 87. Use mathematical induction to show that 4n , (n 1 2)! for integers n $ 2. Given a square with sides of length s, diagonal of length d, perimeter P, and area A, a. 2x 2 2 x1y b. Directrix: y 5 22; Axis of symmetry: x 5 26 c. With the values of a1 and d known, the nth term is represented by an 5 24 1 (n 2 1)(8). (x 1 1)3 2 (x 2 1)3 f (x 1 h) 2 f (x) h 51. 25 x ? Typeface: 10.5/12 pt. R.2. a. (25p2 1 4)(5p 1 2)(5p 2 2) 2 (y 1 4)(y 2 4y 1 16) 45. Scenario 1: The salesperson sells $20,000 or less. (0, 24) 2 2 1. 4! 6 6! 5 5 5 15 c. f (x) 5 (x 2 5)(x 2 i)(x 1 i) b. To find a5, substitute 5 for n. Infinitely many solutions 65. p 5 5 b. 4! 5 24 4! ? Answers will vary. (See Example 9) 3 4 78. Therefore, the sequence is geometric with common ratio 1r . ` e. The kitchen is 14 ft by 10 ft. 3y 5 24x 1 6 13. What is the probability that a player will win if the numbers do not have to be selected in any particular order? Teach a more informed classroom and provide more personalized guidance. 62 32 6 71. 40 97. Not collinear The points (x1, y1) and (x2, y2) define the endpoints of the hypotenuse d of a right triangle. 625 1. In how many ways can the letters in the word XRAY be arranged? p(x) 5 x16 x2 2 2 1 1x 1 9 99. 24x2 2 8xh 2 4h2 2 5x 2 5h 1 2 59. , 5n The signs are positive for oddnumbered terms. Easily manage your courses and track student progress, all through one simple interface. • All terminating and repeating decimals are rational numbers. a) because b lies to the right of a. x is between 3 and 4. Compute Average Rate of Change The graphs of many functions are not linear. i21 a. 5.3 days 73. Is g(2x) 5 g(x)? Which blood type is most common ? r(x) 5 e x2 2 4 for x # 2 2x 2 4 for x . P(x) 5 0 (the company breaks even) b. 988,000 49. (21, `) i. f (1.7) b. 9k 2 1 9 ? Give the exact distance and an approximation to 2 decimal places. y 5 213x 1 1; m 5 213 ; y-intercept: (0, 1) y b. The center is (22, 24) and the circle is tangent to the x-axis. f (x) 5 e 2x2 1 1 2x 112. 27 26 25 24 23 22 21 21 23 x n(x) 5 x2 2 4x 1 q(x) 5 x25 111. Foci: Q 1149 R, Q2 1149 4 , 0R 4 ,0 e. 2 2 2 a b a b2 2 2 7. 3 25. 23 1. 66 43. e 2 6 f 2 2 2 6 6 a 5 1, b 5 27, c 5 4 53. y y 5 4 3 2 y 5 23f(2x) 1 2 3 4 1 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 1 x y 5 f(2x) 2 2 2 89. Given f (x) 5 80. The range is (2`, 21]. 0.3 15. 1T + C21x2 5 16.88x 1 4.99 represents the total cost to buy x tubes of paint. (24, `) SECTION 2.3 Use the function f pictured to find: f (22). What is the probability that a given offspring will have green peas? f (x) 5 22(x 2 1)2 1 8 0 5 22(x 2 1)2 1 8 To find the x-intercept(s), find all real solutions to the equation f (x) 5 0. The cost to rent the booth is $120. Use the model in part (a) to approximate the time required for Dodger to reach 90% of his full-grown weight of 70 lb. 4 4 4 4 4 (a 1 b)4 5 a ba4 1 a ba3b 1 a ba2b2 1 a bab3 1 a bb4 0 1 2 3 4 4 4 4 4 4 (2x 1 3)4 5 a b(2x)4 1 a b(2x)3(3) 1 a b(2x)2(3)2 1 a b(2x)(3)3 1 a b(3)4 0 1 2 3 4 5 1(16x4) 1 4(8x3)(3) 1 6(4x2)(9) 1 4(2x)(27) 1 1(81) 5 16x4 1 96x3 1 216x2 1 216x 1 81 Skill Practice 3 Expand by using the binomial theorem. Then Pn is true for all positive integers n $ j if 1. Answer 1 24 25 x must be 23. (0, 27) c. Linear b. The graph of the profit function P is consistent with this result. 0 ng/mL 12x 2 x 3t 1 32 13x 1 6 cm 91. f [g(24)] d. 2x4 2 4x3 1 8x2 2 15x 1 25 1 x12 23. 32. a1 5 7, d 5 10 b. Find the total income for an employee who works at the job for 20 yr. 13 11 1 1 27. k(x) 5 2 0x 0 42. inconsistent a. x2 c. Undefined 45. E1: The ball lands on an odd number. See the proof in the online appendix at www.mhhe.com/ millercollegealgebra. E 5 {(1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)}. 21 5. Be sure that the window is set to accommodate x values between 17 and 70, and y values between 110 and 142, inclusive. 3 1 p 1 n(n 1 1) 5 n(n 1 1)(n 1 2) . Determine the location and value of any relative minima. Center: (24, 2) 27. y 5 2.28x 2 4.08 45. Then access the Maximum feature from the CALC menu. 752: © Brand X Pictures RF; p. 1029 W/m2 29 81. 2 ? Y2 for x , 23 Y1 , Y2 for x . 2 Display the graphs of Y1 and Y2 and use the Intersect feature to determine the point of intersection. In Example 1, the graph of function f is a semicircle and the graph of function g is a horizontal line (Figure 2-38). y Determine the distance between each pair of points. n2 5n Terms in the numerator are perfect squares: 12, 22, 32, 42, . Find the probability that a dart thrown at the target will land in the shaded region. P(0) 5 310 means that in the year 2010, the U.S. population was approximately 310 million. No Section R.6 Practice Exercises, pp. A "C." Distribution of Grades Party Distribution F (5) Other 18 A (8) D (10) Independent 56 B (15) Democrat 206 C (21) Republican 220 Objective 3: Find the Probability of the Union of Two Events For Exercises 49–58, consider the sample space for a single card drawn from a standard deck. 236 c. EXAMPLE 8 Evaluating a Finite Arithmetic Series 60 Find the sum. The graph will have a "hole" at x 5 22 rather than a vertical asymptote. How many outcomes are there if a fair coin is flipped 10 times? The rectangle is 10 m by 8 m. x1 1 x3 5 370 x1 1 x2 5 400 e. In how many ways can 3 students from a group of 15 students be selected to serve on a committee? The feasible region for a linear programming application is found by first identifying the constraints on the relevant variables. TIP 2(4) 6 2(4)2 2 4(21)(25) 2(21) x52 6 i For more accuracy in the graph, plot one or two points near the vertex. £ 1 0 214 5 4 1 2 1 25. {(1, 5)} 29. QP 5 c 1 47. 8! 3! ? Substitute a1 5 1 and an 5 n. p(x) 5 5 3 4 d. 4.2 mi 3 x11 3 x11 b 2 1 5 4a b 215 x 1121 5 x B 4 4 4x3 2 1 1 1 4x3 3 3 5 3 52 x 5x B 4 B 4 3 SA-30 Student Answer Appendix 2. a 6a b 3 n21 n51 ` 4 i21 20. E1: A blue sock is selected. 1g + f 21x2 5 1 2x 2 1 2 3 Domain: [1, 10) ´ (10, `) ; The domain is [2, 27) ´ (27, `). (See Examples 4–5) 37. n(x) 5 216 2 (x 2 3)2 38. E22 6 12F 83. An even function is symmetric with respect to the . For example, consider the function h defined by h(x) 5 (x 2 3)2. p p c. {2}; The value 142 does not check. q(x) 5 5x For Exercises 65–74, a. [6, 8] (Hint: t 5 6 and h 5 2) 124. 181–183 R.1. n 5 16; (c 2 4)2 5 4 3 2 25 24 23 22 21 21 22 1 2 3 4 5 x y 2 |x| 5 2 1 23 25 24 23 22 21 21 22 24 25 41. Hit ENTER. {216, 38} 77. 7! 34. Such a relation is called a function. The yearly salary for job A is $60,000 initially with an annual raise of $3000 every year thereafter. CN 5 c d ; This represents the total number of calories burned 8040 by two individuals with different weights after biking 6 hr, running 3 hr, and walking 5 hr. 9, a ? • For the instructor, references to an even-numbered exercise are provided next to each example. Determine the number of ways that 6 people can be arranged in line at a ticket counter. 1 25 24 23 22 21 211 222 1 2 3 4 5 x 23 The range is shown on the y-axis in red tint. Range: {y 0 y . (See Example 3) 33. Let Pn be the statement that n2 2 n is even. 32 87. As the plane climbs toward the top of the parabolic path, occupants experience a force of nearly 2 Gs (twice their body weight). For Exercises 33–36, consider the sample space when two fair dice are rolled. a b 3 4 e. 10) fi (log 10)(log 10) (The left side is 2 and the right side is 1.) 97. Linear; {10} 11. (The wavelength is the distance between two consecutive wave crests.) a. Down left and up right. How many license plates can be made if no digit or letter may be repeated? 2 3 4 1 1. x25 t12 x3 y 42(t 2 1)5 SA-3 x(x2 2 32) 24. a i2 5 a (j 1 1)2 5 a (k 2 1)2 i51 j50 k52 89. The range of an exponential function is the set of positive real numbers; that is, 2x is nonnegative for all values of x in the domain. a 57. 5 4 3 2 1 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 y 108. b; x ? Explain why a person with type O2 blood is called a universal donor. y 5 Ĭâx 210 1 25 24 23 22 21 21 22 35. x 5 2 and x 5 22 11. a1(1 2 rn) Sn 5 Divide by (1 2 r). 46 16x4 y6 57. Solution: In this situation, the order in which the group of 6 numbers is selected does not matter. What is the total distance that the ball will travel in 10 sec? {21.4408, 2.8584} 129. Replace x by 2x. y 5 0 1 23 22 21 21 22 1 2 3 4 5 6 7 x 23 24 25 41. Evaluate the function for the given values of x. Both the numerator and denominator of the rational expression are positive for all real numbers x. y 46. Assume that 1 ? e f ; x < 0.1733 e 2 ln 3 2 ln 2 4 {0} 32. Section 2.1 EXAMPLE 6 The Rectangular Coordinate System and Graphing Utilities 171 Finding x- and y-Intercepts Given the equation y 5 0 x 0 2 1, a. There are 13 spades in the deck out of 52 cards. If the two players move directly toward each other at the same speed, where will they meet? p in interval notation. (2`, `) 37. Given a line defined by y 5 22, what is the slope of the line? Is this function even, odd, or neither? Minimum: 219 p(x) 5 3x 2 12x 2 7 16 h. 5. Yes 31. (T + C)(x) 5 23.267x 1 10.99 d. 2, 3, , , ... 2 4 Solution: a2 3 5 a1 2 n21 an 5 a1r 3 n21 an 5 2a b 2 r5 Dividing any term by its predecessor, we have a common ratio of 32 . 5 101. If one student is selected at random from the group, find the probability that a. Therefore, the intersection of their domains is [1, `). 0 13. The sum of the first 50 positive even integers is 2550. principle; counting; m ? 2(x 1 c)2 1 y2 5 2a 2 2(x 2 c)2 1 y2 (x 1 c)2 1 y2 5 4a2 2 4a 2(x 2 c)2 1 y2 1 (x 2 c)2 1 y2 4a 2(x 2 c) 1 y 5 4a 1 (x 2 c) 2 (x 1 c) 2 2 2 2 2 2 4 6 8 10 21028 26 24 22 2 22 24 F 26 28 210 4 6 8 10 y 10 8 6 F 4 2 y 12 F 9 6 3 21521229 26 23 3 26 29 212 F 215 x y 3 2 1 F 25 24 23 22 21 21 1 2 3 4 1 2 3 4 x 5 22 23 24 a 2(x 2 c)2 1 y2 5 a2 2 xc 25 d. This is the break-even point. Your talents are absolutely amazing. < 0.3916 2(3n 1 1)(3n) 13C4 4 16 5 60. x2 1 y2 1 2x 1 5 5 0 TECHNOLOGY CONNECTIONS Setting a Square Viewing Window and Graphing a Circle A graphing calculator expects an equation with the y variable isolated. A chess tournament has 16 players. Y1 5 2.38(1.5)x b. TestGen is a computerized test bank utilizing algorithmbased testing software to create customized exams quickly. C 5 159n 1 0.11(159n) or C 5 176.49n b. 2 in. The numbers in the sequence defined by a1 5 1, a2 5 3, and an 5 an21 1 an22 for n $ 3 are referred to as Lucas numbers in honor of French mathematician Edouard Lucas (1842–1891). Round to 4 decimal places. (2`, 23) ´ A 12, 5B 8. Put another way, this means that approximately 99.91% of 20-yr-olds will live to age 21 (see Example 5). A proper rational expression is a rational expression in which the degree of the numerator is less than the degree of the denominator. 1 2 3 4 5 The function is not symmetric with respect to either the y-axis or the origin. Parent 2 4 4 39. The customer paid cash or was female. Write a linear profit function representing the profit for producing and selling x dozen cookies in a month. (2`, 2) ´ (3, `) d. Find (T + C)(6) and interpret its meaning in the context of this problem. This technique is called mathematical induction. 5 4 3 2 1 (0, 1) 25 24 23 22 21 21 22 1 2 3 4 5 23 x Then begin at the y-intercept, and use the slope to find a second point on the line. a (j 1 6) j51 40 58. 50 mph b. f (x) 5 0 x 0 b. (2`, 2) 73. (0, 17) 2 2 9 13 y e. 8. Suppose that 20 good batteries and 6 defective batteries are in a drawer. The fixed monthly cost of $680 includes telephone service and depreciation of equipment. Therefore, the bookstore's price to the student, P(x) (in $) after a 7.5% sales tax, is given by P(x) 5 1.075(x 1 0.40x), where x is the cost of the book from the publisher. To graph y 5 f(x 2 h) or y 5 f(x 1 h), shift the graph of y 5 f(x) horizontally in the opposite direction of the sign within parentheses. 4 29. The sum of the numbers on the dice is 4. m 5 21 6 Perpendicular 31. Therefore, it would have either 2 or 0 nonreal zeros, leaving room for either 1 or 3 real zeros. Use this scenario for Exercises 65–66. Show that 3 1 7 1 p 1 (4k 2 1) 1 [4(k 1 1) 2 1] 5 (k 1 1)[2(k 1 1) 1 1] 5 (k 1 1)(2k 1 3). Not applicable 35. 0, 8, 2 , 2.1, 20.4, 23 7 π 5 , 8, 2 , 2.1, 20.4, 23 6 7 SA-4 Student Answer Appendix 1 b. Thus, a1, a3, a5, ... False 2. Use this information and the table with Exercises 75–78 for Exercises 79–82. Shift y 5 x5 to the right 3 units. (See Example 1) For Exercises 9–10, evaluate the given expressions. The fundamental of indicates that if one event can occur in m different ways, and a second event different ways. For Exercises 65–76, refer to functions m, n, p, q, and r. x2 1 y2 1 10x 2 6y 1 25 5 0 Solution: x2 1 y2 1 10x 2 6y 1 25 5 0 (x 1 10x) 1 (y2 2 6y) 5 225 y 2 7 6 5 4 3 2 1 29 28 27 26 25 24 23 22 21 21 22 23 Figure 2-13 Answers 2 2 2. Therefore, every other term would differ by 2d units. x $ 0 y$0 x # 120 y # 90 240x 1 320y # 48,000 c. a b(x) 5 2 ; n x 29 Domain: [21, 3) ´ (3, `) f(x) Secant line y 5 f(x) Q(x 1 h, f(x 1 h)) P(x, f(x)) h x x1h x Figure 2-40 Figure 2-39 TIP (Figure 2-39) Now we look at a related idea. {(3, 24), (22, 0), (5, 3), (1, 0)} Domain: {3, 22, 5, 1} Range: {24, 0, 3} Yes b. Determine the number of ways that the letters in the word RIFFRAFF can be arranged. y will be 9 times its original value. Over what interval(s) does the depth increase? Predict the water level on day 30 if this trend continues. Solution: Given m 5 24 and (2, 23). T1 5 117. All rights reserved. y 5 2g(x) y y 51. r 5 54 $ 1, so the sum does not exist. At x 5 2, the function has a relative maximum of 2. 6.4 days b. Use the formula Sn 5 4 4 4 1 2 1 p using summation 3 5 7 notation with n as the index of summation. Let N be the event that the student answered "No." Let F be the event that the student is female. Domain: (25, 1]; Range: {21, 1, 3} 97. The y 5 21.5x 1 165 9 graph of the car's speed y (in mph) versus x 0 0 20 40 60 80 100 120 the time x (in sec) after leaving the first red Time (sec) light is shown in Figure 2-32. In a "Numbers" game, a player wins a prize for matching a 3-digit number from 000 to 999 with the number randomly selected during the drawing. Find a formula for the nth term of the sequence. Count Combinations 1 1,000,000 1 and getting all heads: Probability 5 16,777,216 1 insect or animal bite: Probability < 100,000 • A pedestrian being killed by a motor vehicle: Probability < • Flipping a coin 24 times • Dying from a venomous In this section and in Section 8.7, we present basic principles of counting and how these principles apply to probability. What is the slope of a line with equation x 5 22? 1 y52 x22 2 1 y5 x22 3 y50 106. £ 26 $ 5 59. 213w 1 16 R.2. x2 1 18x 1 81 R.3. (2p 2 5)(p 1 3) 42x R.5. (5n 2 2)(n 2 2)(n 1 7) R.6. (a 2 2)(a 2 5) linear 3. • Wolfram Alpha Activities have been added to the Instructor's Resource Manual to allow students to explore college algebra in greater depth. (2 1 i)3 54. (f + h)(21) 53. (317, 119) From the distance formula, d(A, B) 5 0 x 0 , d(A, C) 5 0 x 0 , and d(B, C) 5 0 x 0. Write a rule for a linear function y 5 g(x), given that g(0) 5 7 and g(22) 5 4. y 5 f (2x) 80. x2m17 115. an 5 100,000(0.85) or 85,000(0.85)n21 a2 b 3 4 128 b. We now look at nonrigid transformations. We show three such applications in Examples 4–6. Therefore, 3 7 A 2 B . If the slope of a line is how much vertical change will be present for a horizontal change of 52 ft? Expand (a 1 b)3. (0, 5) e. y 5 3.3x 1 8.5 b. (2`, 23) g. One solution Infinitely many solutions; The equations are dependent. 12! b. y 5 4 3 2 y 5 4 3 2 y 5 ln x 1 21 21 22 1 2 3 4 5 6 7 8 x 9 23 22 21 21 22 23 23 24 25 24 25 73. 532–535 y R.1. 1 2 3 4 5 x 27 26 25 24 23 22 21 21 23 1 2 x 3 22 24 25 b. binomial, trinomial 7. 2, 26, 18, 254, 162 5 n21 3. 21, 29, 6i 15. For example, 5x Z x is an even number between 0 and 106 The set of all x such that x is an even number between 0 and 10 In our study of college algebra, we will often refer to several important subsets (parts of) the set of real numbers (Table R-1). q(x) 5 2x 2 4 8 4 20. Then, P(E) 5 n(E) 3 1 5 5 n(S) 6 2 The value of a probability can be written as a fraction, as a decimal, or as a percent. Center: (25, 1); Radius: 3 17. (23, 22) and (2, 5) 5 b. a 7a b 3 i51 27 21. Suppose that a box contains 4 chocolate chip cookies, 8 molasses cookies, and 12 raisin cookies. 103 5 17,576,000 b. g(0) 5 (4)(24) 5 216 f (23) is undefined. Find (g 2 h)(x) and write the domain of g 2 h in interval notation. Graph f (x) 5 0 x 0 for x , 0. I. 85. f (x) 5 3 for all x on the interval [23, 1] and for x 5 145 . By Descartes' rule of signs, there are no positive or negative real zeros. 101. 462 243x5 1 405x4 1 270x3 1 90x2 1 15x 1 1 343x3 1 441x2 1 189x 1 27 16x4 2 160x3 1 600x2 2 1000x 1 625 32x15 2 80x12y 1 80x9y2 2 40x6y3 1 10x3y4 2 y5 p12 2 6p10w4 1 15p8w8 2 20p6w12 1 15p4w16 2 6p2w20 1 w24 0.0016 1 0.0032k 1 0.0024k2 1 0.0008k3 1 0.0001k4 1 3 3 2 3 c 2 c d 1 cd2 2 d3 29. See also Regression Multiplication associative property of, 10 commutative property of, 10 of complex numbers, 108–109 of conjugates, 40, 41, 109 distributive property of, over addition, 11, 12 identity element of, 10 identity property of, 10 inverse property of, 11 matrix, 590–593, 602–603 of polynomials, 39–40 of radicals, 32, 42–43, 74 of rational expressions, 61, 74 scalar, 588–589 Multiplication property, of radicals, 105 Multiplicative inverse of real numbers, 11 of square matrix, 602–603, 626 Multiplicities, of zeros, 303–306, 339–340 Multiplier effect, 718 Mutually exclusive events, 755, 767 N Natural exponential functions, 418 Natural logarithmic functions, 430–431, 483 Natural logarithms approximation of, 431 explanation of, 430–431 to express solution to exponential equation, 454 Natural numbers, 2, 73 Negative exponents factoring expressions containing, 55–56 simplifying expressions with, 18–20 Negative factors, 48 Nested radical property, 30 Newton, Isaac, 81 Nonlinear inequalities graphs of, 369, 539–540 procedure to solve, 369 Nonlinear systems of equations. 4 3 52 k k 111. (0, 26) f. 4 4 5 1 There are 4 kings in the deck out of 52 cards. A heart, club, or spade. h)(x) 5 x 5. 1000 b. Completing the square gives 31. How many codes can be made if a. Therefore, we need to compute the number of combinations of n 5 53 numbers taken r 5 6 at a time. 5.5% simple interest results in less interest. In such a case, are the events of selecting comedies on the first and second picks independent events? T(x) 5 0.019x 1 172 for x . y 5 7; m 5 0; y-intercept: (0, 7) y b. y 8 7 6 5 4 3 2 50 24 b. P1 is true because x1 . y 5 4 3 2 f(x) 524x 1 5 1 Substitute m 5 24 and b 5 5 into the equation y 5 mx 1 b. If three batteries are selected at random, determine the number of ways in which a. 25x # 20 and 32[2 2 (x 2 4)] , 2x 1 5 1. 266 The domain of f + g is the set of real numbers x in the domain of g such that g(x) is in the domain of f. Graph N 3 4. h 1x 1 h 1 3 1 1x 1 3 1 c. f (x) 5 2x 2 6 4 19 4 19 a. f (22) e. f (x) 5 e for x # 1 for x . Relative minimum of 27.825 at x 5 3.750 b. This is represented by y 5 3000 for 0 # x # 20,000 Answers 8. y 5 20 x 0 2 4 9. The function is written as f (x) 5 ax2 1 bx 1 c where a 5 21. To what basic function from Section 2.6 is the graph of f equivalent? 1 2 3 4 5 6 7 8 x g(x) 5 √x 2 2 Consider a function defined by y 5 f (x). 5 R.1. g(x) 5 ; g(15) R.2. f (x) 5 5; f (4) x R.3. h(x) 5 x2 1 3x; h(3) For Exercises R.4–R.5, simplify the rational expression. To Beth Clickner, many, many thanks for the beautiful and thorough PowerPoint presentations of our material. Find the average rate of change in speed between waves that are between 4 m and 9 m in length. See also specific geometric shapes analytic, 178 applying operations on polynomials to, 42 applying quadratic functions to, 292–293 Golden ratio, 132 Golden rectangle, 132 Graphing utilities binomial coefficients on, 734 change-of-base formula on, 449 circles on, 180 combinations on, 746 complex numbers on, 110 determinants on, 616 exponential equations on, 462 exponential functions on, 422 graphing equations with, 171–173 hyperbola on, 657 inconsistent systems on, 575 least-squares regression line on, 220–221 logarithmic equations on, 457, 462 logarithms on, 431, 457, 462 matrices on, 571, 590, 593, 605, 606 parabolas on, 672 permutations on, 744 piecewise-defined functions on, 248 polynomials on, 310, 340 quadratic equations on, 292 reduced row-echelon form on, 577 relative minima and relative maxima on, 254–255 scientific notation on, 24 sequences on, 691 systems of inequalities on, 537, 543 systems of linear equations on, 496 systems of nonlinear equations on, 530, 531 verifying solutions to equation on, 206 Graphs applying reflections across the x- and y-axes of, 234–236 of circles, 177–180 concave up and concave down, 261 of constant functions, 202 of ellipse, 637–640 of equations, 169–173, 276 of exponential functions, 415–418, 422, 433–434 of functions, 190–191, 202–204, 229–230, 270, 276 of greatest integer functions, 249–250, 277 horizontal translations of, 230–232, 236 of hyperbola, 651, 653–657 of inverse functions, 402, 404, 405, 408, 409 of linear equations in two variables, 197–202 of linear functions, 202 of linear inequalities, 536–539 of logarithmic functions, 432–435 of nonlinear inequalities, 369, 539–540 of piecewise-defined functions, 247–251, 276–277 plotting points on, 169–170 of quadratic functions, 229, 286–291 of rational functions, 353–360, 373 of relations, 185 symmetric, 243–245, 276 of systems of inequalities, 537, 542 transformations of, 230–238, 276 use of matrix operations to transform, 595 vertical and horizontal shrinking and stretching of, 232–234, 236 vertical translations of, 230–232, 236, 276 Greatest common factor (GCF), 47–48, 54 Greatest integer functions, 249–250, 277 Grouping, factoring by, 49 Grouping symbols, 9 Growth functions, exponential, 416 H Half-life, 421, 471 Horizontal asymptotes determining where graph crosses, 351–352 explanation of, 349, 393 method to identify, 349–351 Horizontal lines, slope of, 200, 201 Horizontal line test, 403, 404, 482 Horizontal shift, 230, 276 Horizontal shrink/stretch, 233–234, 236 Horizontal translations, of graphs, 231–232, 236, 276 Hyperbola in applications, 660–661 eccentricity of, 658–659, 682 explanation of, 651–652, 682 on graphing utility, 657 graphs of, 651, 653–657 latus rectum of, 666 standard form of equation of, 652–653, 657–658, 682 I Identities, 85, 86, 158 Identity element of addition, 10 Identity element of multiplication, 10 Identity functions, 229 Identity matrix, 602–603 Identity property of addition, 10 of matrix addition, 588 of multiplication, 10 Imaginary numbers (i). (See Example 9) Weight not Over Price 1 oz $0.44 2 oz $0.61 3 oz $0.78 3.5 oz $0.95 76. They can be easily skipped for those who do not encourage the use of calculators. a , 2 b 2 2 3 13. Use the graph of y 5 f (x) to c. If a statement is false, explain why. {13} d. 2 2 Label the points. y5x16 y 5 22x 1 6 y50 105. 1600π m2 b. An employee invests $500 per month in an ordinary annuity. (25 24 23 22 21 0 1 2 x x 14 Domain: (2`, `) 2 d. Milk has 300 mg per cup and spinach has 240 mg per cup. h(x) 5 e 22x for x , 0 1x for x $ 0 63. a b 6 734 Chapter 8 Sequences, Series, Induction, and Probability Solution: n n! For parts (a)–(d), apply a b 5 r r!(n 2 r)! 6 6! 6! 6! a. Skill Practice 9 Suppose the probability that a person will catch a winter "cold" is 0.16. The sum of the first n terms of a sequence is called the nth integers. x 2 2y 1 3z 5 21 y 1 4z 5 211 z 5 22; Solution set: {(21, 23, 22)} 3. r 5 π Aπ 12sg 2s or t 5 109. 5 3y 5 22x 1 6 x y 4 3 2 4 23 2x 1 3y 5 6 2 y52 x12 3 1 0 2 In the table we have selected convenient values of x that are multiples of 3. w 5 c 6 2c2 1 4kr 2k 2v0 6 2v02 1 2as 2CR 6 2C2R2 2 4CL 117. Therefore, P(E) 5 12 , or 0.5, or 50%. {(210, 3)} 6. bn 5 1n 2 1 2n 13. A bookstore marks up the price of a book by 40% of the cost from the publisher. Two events in a sample space are if they do not share any common elements. (Source: www.census.gov) The function defined by f (x) 5 9.4x 1 35.7 represents the amount spent f (x) (in $) x years since 2006. Graph F 12. 10 b. p logb x 5. Equation; {29} b. Then set the increment by which to increase x, in this case 1. 24 7 2 2 20. Find a8. {9} 9. 1 25 24 23 22 21 21 22 1 2 3 4 5 x 57. Ellipse b. Each croissant cost €2.4 (euros). Consider the function pictured in Figure 2-37. y 5 log3(x 1 2) 1 83. {0} c. A system of linear equations contains only linear equations, whereas a nonlinear system has one or more equations that are nonlinear. m 5 2 and the y-intercept is (0, 1). c d 18 45 64 b. Graph t (x) 5 • 2x 1 1 for x . The inequality 0 x 2 3 0 # 0 will be true only for values of x for which x 2 3 5 0 (the absolute value will never be less than 0). {63i, 62} {210} 81. Leading coefficient positive; degree odd c. 1 Fn 5 Fn+2 2 1 for positive integers n $ 3. 0 B 0 5 0 AB 0. Moving up the pyramid, the number of cups in each row decreases by 1. i51 i51 2 73. Every year thereafter, expenses increase by $1000 plus 3% of the cost of the prior year. (Informally, a line is tangent to a circle if it touches the circle in exactly one point.) 30. 0.03x 1 0.04y 5 0.12 57. s(x) 5 (x 1 2)2 2 3 75. TIP The Greek letter D ("delta") written before a variable represents an increment of change in that variable. c d a3 a4 ta3 ta4 sta2 a1 a2 d 5 (st) c d 5 (st)A sta4 a3 a4 93. If both sides of an inequality are multiplied or divided by a negative real number, then the direction of the inequality sign must be reversed. If one person from the study is chosen at random, find the probability of the given event. a i51 (i 1 1)! 7i 4 i3 b. If not, how are they different? If the interest rate is 6%, find the value of the annuity after 20 yr. Find the 30th term. • The deck consists of 52 cards. f (x) 5 23x 2 3 15. Show that a b and a b are equivalent. 61, 62, 64, 68 c. If the measure of one angle is x degrees, write a relationship representing the measure of the other angle S(x) as a function of x. 4 kg 97. a number that is a multiple of 5? 1?2 2?3 k(k 1 1) (k 1 1)[(k 1 1) 1 1] (k 1 1) 1 1 k12 (1) The left side of statement Pk11 can be written as Sum of first k terms (k 1 1)th term 1 1 1 1 1 1p1 1 1?2 2?3 k(k 1 1) (k 1 1)[(k 1 1) 1 1] 5 1 k 1 k11 (k 1 1)[(k 1 1) 1 1] 5 1 k 1 k11 (k 1 1)(k 1 2) 5 (k 1 2) 1 k ? £ 2 1 5 1 212 1 13. a5 5 2 and r 5 2 . {4, 8} e. h(1.02) 5 24.9(1.02)2 1 10(1.02) 1 100 Frac Notice that the terms of the sequence given in Example 1(b) alternate in signs. c1 5 4; cn 5 12 cn21 1 4 30. Would there be enough Social Security numbers for the population of China if the Chinese used the same system? AI2 5 c R.3. d 278 15 1 0 27(1) 1 15(0) dc d5c 8 5.1 8 0 1 5.1(1) 1 8(0) 5 c b. Find the number of terms in the geometric sequence. 0 AB 0 5 2130; 0 A 0 5 10 and 0 B 0 5 213. 8 29. 5 5 1 5 4 2 93. See Rectangular coordinate system Center of circle, 177 of ellipse, 635 of hyperbola, 651 Center-radius form, 178 Centroid, 504 Change-of-base formula, 448–449 Circle explanation of, 177, 634 general form of equation of, 179–180, 275 on graphing utility, 180 standard form of equation of, 177–179, 275, 634 Clearing fractions, 84, 213 Clearing parentheses, 12 Coefficient matrix, 607–608 Coefficients binomial, 732–734 leading, 38, 50 Cofactor of element of matrix, 615 Column matrix, 586 Combinations in applications, 745 explanation of, 744, 766 on graphing utility, 746 permutations vs., 744–745 Common logarithmic functions, 430–431, 454, 483 I-1 I-2 Subject Index Common logarithms approximation of, 431 explanation of, 430–431 to express solution to exponential equations, 454 Common ratio, 712–714, 765 Commutative property of addition, 10 of matrix addition, 588 of multiplication, 10 Complementary events, 753 Completing the square explanation of, 115–116 to graph parabolas, 286, 288 to solve quadratic equations, 116–118 Complex conjugates, 109, 158 Complex fractions explanation of, 64 method to simplify, 64–66 Complex numbers addition and subtraction of, 107–108 division of, 110 evaluating special products with, 109 explanation of, 105–106, 158 on graphing utility, 110 multiplication of, 108–109 real and imaginary parts of, 106 set of, 105, 333 simplifying powers of i and, 107 in standard form, 106 Complex polynomials, 321–322 Composition of functions, 266–270, 277 Compound fractions. Use Inequality Symbols and Interval Notation All real numbers can be located on the real number line. Section 2.3 Functions and Relations 183 The general form of an equation of a circle is (x 2 h)2 1 (y 2 k)2 5 r2. 3(3k) Since k $ 7, then (k 1 1) . 1 (2, 1) 1 2 (1, 0) 3 4 5 23 (0,21) 24 25 x2 1 y 5 4 x 170 Chapter 2 Functions and Relations The graph of an equation in the variables x and y represents a relationship between a real number x and a corresponding real number y. Provide an informal explanation of a relative maximum. 240 2 42i 17 2 i 15 65. The graph of an odd function is symmetric with respect to the origin. (1, `) b. P 5 a2t 27. The graph is not continuous. y 5 x2 23 3 22 y 5 √x 3 2 1 24 25 f (x) 5 0 x 0 g(x) 5 2 0 x 0 h(x) 5 12 0 x 0 6 3 2 4 1 double 4 23 22 21 21 22 x y 8 7 6 5 21 1 2 1 2 0 0 0 1 1 2 1 2 2 2 4 1 3 3 6 3 2 h(x) 5 1 1 2 g(x) 5 2|x| y f(x) 5 |x| 5 4 3 2 25 24 23 22 21 21 22 1 2 h(x) 5 1 1 2 3 4 5 |x| x 23 24 25 multiply by 12 g(x) 5 3x2 4 3 2 25 24 23 22 21 21 22 2 1 0x0 2 3 4 5 x 1 3 x2 For a given value of x, the value of g(x) is twice the value of f(x). Discriminant is 0; one x-intercept 67. 2! (30C6) ? Age 60 Height (in.) 63. c 24 212 216 24 13 2 36 3 1 43. 1 ? 3 3. By how much do the results of part (c) differ from the result of Exercise 61(c)? To further illustrate the rationale for the order of steps taken in Example 8, begin with the parent function y 5 1x. Determine the number of ways that 5 students can be selected from the class of 24 to play 5 different roles in a short play. 2x3 2 4x2 2 62x 2 56 The remainder is 39. 28a2b3 1 7.3ab2 2 2.9b 65. Yes 9. Is g a one-to-one function? Hundreds of text-specific, open-ended, and multiple-choice questions are included in the question bank. y 5 f (3x) 38. 4. The data in the graph show Dodger's weight y (in lb), x days after adoption. Week number 1 2 3 4 Number of participants 34 50 66 82 a. For example: ceil(3.1) 5 4. That is, R(x) . y 69. What is the probability that an individual from the population can donate blood to a person with type O2 blood. m 5 2 ; y-intercept: (0, 2) 2 y c. (0, 24) g. Using the formula for vn given in Exercise 29, a. The value of the series is the sixth partial sum of the sequence of terms. At x 5 22, the function has a relative minimum of 0. A 3-digit code is to be made from the set of digits {4, 5, 6, 7, 8}. (2`, 9] c. 78–79 1. (k 1 1)(3k) by the inductive hypothesis. The student answered "Yes" or had "No Opinion." b. (c 2 d)8; fourth term 32. by 16 in. There are 20 possible ways to select 2 people from 5 people in which the order of selection is relevant. C 5 0.12k 1 14.89 b. x51 f(x) 5 3x2 2 6x 1 1 f. a b 5 1! ? Use the binomial theorem to find (1.1)5. 1 1 1 2 Call this statement P2. Zeros: 3, 23, 1, 21 (each with multiplicity 1) c. A both zero. 22 2 59. E 17, 217F {4i, 24i} 25. a b 2a b 2 2 1 2x 5 [(e 1 2 1 e22x) 2 (e2x 2 2 1 e22x)] 4 1 5 (4) 5 1 4 ex(eh 2 1) 79. n(E2) 3 Therefore, P(E2) 5 5 . Solution: This situation can be thought of as a sequence of two events in which we apply the fundamental principle of counting. Passes through (0, 8) and (5, 0). If one marble is selected at random, find the probability of the event. EXAMPLE 8 Evaluating an Infinite Geometric Series Find the sum if possible. No 13. 235 ft b. 58.96 ft/sec d. 25.4800; 2 < 4.68 3 10 87. Given {W, X, Y, Z}, a. Singular matrix b. Section 8.7 EXAMPLE 7 757 Introduction to Probability Computing an Empirical Probability of (A or B) The safety and security department at a college asked a sample of 265 students to respond to the following question. (1, 22) 11 1 ,2 b 10 10 For Exercises 25–30, identify the set of values x for which y will be a real number. 211.2 2 4.6(c 2 3) 1 1.8c 5 0.4(c 1 2) b. (23, 0) and a , 0b 2 p(x) 52 1 2 3 4 d. Yes; d 5 k52 5 4 25. Such motion often produces motion sickness, thus earning the aircraft its name. 16 R.1. L 5 2 210 b. r(x) 5 400 2 x 117. The graph of y 5 f(x 2 h) is a shift in the positive x direction. (x 1 7)2 1 (y 2 5)2 5 4 b. She spent 4 nights in Washington, 2 nights in Atlanta, and 8 nights in Dallas. {(0, 0)} 1 2 3 4 5 6 7 8 9 10 Hours Studying Algebra 67. x2 1 y 5 1 a. (22, 23) d. The graphs have the shape of y 5 x2 but show a vertical shrink or stretch. {24, 7.8} 10 210 210 210 80 40 0 10 10 120 10 210 b. For Exercises 83–86, find the indicated functions. 2x 1 8 , 2 x 1 3 2 a. p3 a6 v4 37. 0 (multiplicity 3), 5 (multiplicity 2) 2 29. Yes 23. By how much do the results of part (d) differ from the result of Exercise 63(d)? cn 5 12A212 B n 8. Never increasing f. Yes 5 41. 294 ft 30. Solution: Because 3 is added to the x variable, we might expect the graph of g(x) 5 (x 1 3)2 to be the same as the graph of f (x) 5 x2, but shifted in the x direction (horizontally). 2 x 2 2 2 4 a 1 5b b. 6 b. Ex 0 x $ 256 F; C256, `B; 5 26 25. ¢C What does represent? 36 ft c. y 5 4 3 2 5 4 3 2 5 4 3 2 1 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 24 25 24. f (x) 5 11 2 5x2 61. (See Examples 1–2) 17. 12 10 8 6 4 2 9. and is often denoted by r. an 5 10n 2 3 b. Therefore, the domain is the set of all real numbers, x. 6 5 36 (Figure 8-11). (22, 8), (1, 2), and (4, 23) 78. Apply the Slope-Intercept Form of a Line The slope formula can be used to develop the slope-intercept form of a line. 2n 147. a 4a b 2 10 70. 0.2 b. y 5 4 3 2 1 2 3 4 5 x 25 24 23 22 21 21 22 3 4 x 5 24 25 24 25 24 25 1 2 3 4 5 3 4 5 x 23 24 25 24 25 y 1 2 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 25 24 23 22 21 21 22 3 4 5 y 5 t(x) 23 1 2 3 4 5 x 23 24 25 24 25 y 5 4 3 2 71. a500 5 156.6 52. on [0, 1] b. The value 5 is a zero with even multiplicity. Center: (0, 0) b. 7.75 mph 12 $11,145.60 49. Modeling and Applications One of the most important tools to motivate our students is to make the mathematics they learn meaningful in their lives. x is between 2 and 3. h(x) 5 1x 1 4 12. Constant. M 5 2J 109. Write the answer in slope-intercept form and in standard form. We write the sum of the first five terms of the sequence in both ascending and descending order. The line through the points represents all ordered pairs defined by this function. (2`, 0] c. Constant f(x) 5 4 3 2 1 25 24 23 22 21 21 22 23 Answers 10. We begin in Example 1, by using a figure called a tree diagram to organize different outcomes of a sequence of events. a20 5 75,000 1 (20 2 1)(4000) a20 5 151,000 n Sn 5 (a1 1 an) 2 20 S20 5 (75,000 1 151,000) 2 S20 5 2,260,000 Substitute a1 5 75,000 and d 5 4000. 22w 111. Figure 8-12 Let A be the event that an ace is drawn: {A ,A ,A ,A }. y 5 22 and y 5 14 63. P1 is true because a i2 5 (1)2 5 i51 k 2 2. 1 13 xb 67. 116 75. Write a piecewise-defined function to represent the salesperson's monthly income I(x) (in $) for x dollars in sales. True 91. (Source: American Cancer Society, www.cancer.org) If two women with stage I breast cancer are selected at random, what is the probability that they both survive 5 yr? [214, 10] 30. Assuming that the trend continues, find the value of the home 15 yr later. 2x 5 25y 208 Chapter 2 Functions and Relations Objective 2: Determine the Slope of a Line 21. a number that is divisible by 4? f 21(x) 5 log(x 2 1) 1 3 93. This is stated formally in the following definition. Check the result by graphing the line with the data points to verify that the line passes through or near the data points. Radical equation b. 12 yr Contradiction; { } 41. A 17, 2315B and A217, 15B . EXAMPLE 4 Using the Slope and y-Intercept to Graph a Line Given 3x 1 4y 5 4, a. For Exercises 9–16, determine the center and radius of the circle. f(x) 5 2 x b. Explain why a probability of 5 4 is impossible. In how many ways can 4 people who bought tickets be selected if each is to receive a $20 gift certificate to a restaurant? 2x 1 8 $ 2 x 1 3 2 f (x 1 h) 2 f (x) c. {(2z 1 4, 3z 1 1, z) 0 z is any real number} 1 22 3 8. Write an equation of the circle in standard form. 8P5 33. The horizontal asymptote is y 5 0 and means that the temperature will approach 08C as time increases without bound. 184 sec after launch f. z 5 24x 1 20y b. x 5 g. 174 Chapter 2 Functions and Relations For Exercises 19–22, determine if the given points form the vertices of a right triangle. How many possible routes are there? Determine the number of cookies (in dozens) that must be produced and sold for a monthly profit. y 5 x2 y 5 x4 y 5 x6 y 5 x3 y 5 x5 y 5 x7 c. [24, `) h. 20.24 ft/sec c1b2 5 1b 1 82 2 127. This image is symmetric with respect to the y-axis. x 1 4y 1 3z 5 8 y 1 2z 5 12 z56 23. • A Group Activity is available for each chapter of the book to promote classroom discussion and collaboration. 7! 5 5040 73. y 5 2x 2 5 for 0 # x # 4 {(2.359, 5.584)} {(1.538, 6.135), (21.538, 6.135), (3.693, 25.135), (23.693, 25.135)} {} x 23 x 22 2 12 y 1 4 # 5 1 22 21 21 22 2 1 3 4 y 5 4 3 2 5 4 3 2 2 5 23 25. [y 5 h(x) The domain is shown on the x-axis in green tint. 5 62. Write an equation that represents the set of points that are 9 units from (24, 16). 0 1050 850 900 950 1000 c. The graph of g(x) 5 12x 18. {1, 9} 51. If the probability of an event is 87 90 , is the event likely to occur or not likely to occur? x2 2 4 Vertices: (1, 25), (21, 25); Foci: A 15, 25B, A215, 25B Ax 2 32 B 2 (y 1 2)2 2 51 a. x8 c. (m ? 5! 6 6! 5 5 56 b. Geometric; r 5 15 8. 203 f (x2) 2 f (x1) x2 2 x 1 The x-coordinates of the points of intersection between the graphs of y 5 f (x) and y 5 g(x) are the solutions to the equation f (x) 5 g(x). 0.02x 1 0.05y 5 0.1 18. f (x) 5 b. 66. (2`, 26)) 26 31. Round to the nearest 100 people. 9 The solution set is e f . For example, the graph in Figure 2-18 shows the blood alcohol concentration (BAC) for an individual over a period of 9 hr. in. p 5 q2f 109. Even 7 7 9. R.1. x4 1 x2 R.2. 215r4 2 60r3 R.3. w2 1 4w 1 4 R.4. v2 2 9v 1 18 For Exercises R.5–R.6, simplify. Therefore, replacing x by 2x will result in the opposite of the original term. Determine the slope and y-intercept. k k c. A24 1 15, 0B and A24 2 15, 0B 24 25 1 CHAPTER 3 1 b. x2 1 y2 5 9 Solution: Answers 1. 2. y 11. The slope m of the line through the points is the ratio between the change in the y values (y2 2 y1) and the change in the x values (x2 2 x1). 5 9 b. 3 1 117 c. Write a formula for the nth term of the sequence representing the sum of the numbers in row n. Summation Notation Given a sequence a1, a2, a3, ... , the nth partial sum Sn is a finite series and is represented by n is the upper limit of summation. The command LinReg(ax 1 b) prompts the user to enter the list names (L1 and L 2) containing the x and y data values. 0 3x 25 0 5 0 2x 1 1 0 14. A 59. Y1 5 (first piece)/(first condition) Y2 5 (second piece)/(second condition) .. Assume that Pk is true. 23 y 5 f(x) 2 24 25 The graph of y 5 f A 12 xB is shown in red. a a b k51 2 ` 4 n21 68. 2.0 3 1010 Domain: (2`, 0]; Range: (2`, 1] b. R.3. y 5 2x 1 2 63 333 536 13 3 11 ,2 , bf 43. Reflection y 5 2f (x) y 5 f (2x) Reflection across the x-axis Reflection across the y-axis Replace (x, y) by (x, 2y). Geometric; r 5 4 b. The maximum value is 8. Assume that A 32 B k . In addition, suppose that each person spends an average of $10 on food, drinks, and rides. 12! 9! 39. 2p3q 2 6p2q3 3 p 1p 3 2 69. That is, there are 20 permutations of 5 people taken 2 at a time. Each swing (one way) thereafter makes an arc of 98% of the length of the previous swing. {(24, 3), (22, 23), (1, 4), (3, 22), (3, 1)} b. Evaluate (D + C)(12) and interpret the meaning in the context of this problem. A whose domain is the set of the first n positive integers. a 6a b 2 6 2 i21 42. 1 25a2b6 a. Count Permutations 3. R; (2`, `) 63. a1 2 ba1 2 ba1 2 b p a1 2 b 2 3 4 n11 1 5 n11 16. x2n 2 4xn 2 21 67. 4 Furthermore, from Section 2.6 we know that the graph 3 2 2 of f (x) 5 a(x 2 h) 1 k is related to the graph of 1 y 5 x2 by a vertical shrink or stretch determined by a, x 25 24 23 22 21 1 2 3 4 5 a horizontal shift determined by h, and a vertical shift 21 Vertex 22 determined by k. {(22, 28, 2)} 16. This has also been updated in all of the digital materials accompanying the text. Not geometric 2. Instead we can compute the coefficients of a binomial expansion using the following formula. No x-intercepts e. from each end. a b(x) n For Exercises 119–120, find two functions, f and g such that h(x) 5 (f + g)(x). y 5 2 x 1 1; x 1 3y 5 3 3 216 Chapter 2 Functions and Relations Solution: Avoiding Mistakes From the slope-intercept form, y 5 12x 2 4, the slope of given line is 12 . $364.80/yr b. 536: © Image Source/Getty RF; p. c 13 38 36 § 69 11 d 5 22 9 28 210 d 2173 8 2 13 2 45 0 47. Evaluate P(60) and interpret the meaning in the context of this problem. • f is the name of the function, • x is an input variable from the domain, • f(x) is the function value (or y value) corresponding to x. 1 R.2. Determine the slope and y-intercept of the line y 5 2 x 1 8. There is no way that this can be derived theoretically. 685–686 1. • Technology Connections require the use of a graphing utility and are found at the end of exercise sets. No 87. It follows that P(E) 1 P(E) 5 1. v2 1x2 v 32. Notice that one side is zero. y-axis y 13. How much money is initially infused into the local economy during the festival for admission, art, drinks, and food. {2} b. x 5 3 7 h. x2 1 y2 2 10x 1 4y 2 20 5 0 45. The maximum protein content is 1140 g. (See Example 2) f (x) 5 22x g(x) 5 0 x 1 4 0 h(x) 5 9. (f ? Write C as a function of d. e ax, b ` x is any real number} 4 4y 1 3 , yb ` y is any real number f ; or e a 10 The equations are dependent. 12`, 22 4 ´ a2 , `b 3 35. The exponent on b increases from 0 to n on sequential terms from left to right. [x 2 (11 2 i)][x 2 (11 1 i)]Ax 2 13B Ax 1 13B c. Barometric Pressure 61. a (3i 1 1) i51 Answers 6. Expand (ex 2 e2x)4. An estimated 150,000 people attended the Coconut Grove art festival over a 3-day period. For example, during the summer months, hot ocean temperatures in the Atlantic Ocean often produce breeding grounds for hurricanes off the coast of Africa or in the Caribbean. Decreasing Solution: a. 110. m 5 2 47. y2 5 216x 63. y 5 2f (x 1 1) 2 3 1 25 24 23 22 21 21 22 0 166 82. 2x 2 1 for x , 21 for 21 # x , 2 f(x) 5 • 23 1x 2 2 for x $ 2 5 25 5 25 Notice that the individual "pieces" of the graph do not "hook-up." For this reason, it is also a good practice to put the calculator in DOT mode in the menu. R 26. A(100) 5 0.909 means that after 100 yr, the amount of 90Sr remaining is approximately 0.909 µg. Determine the theoretical total amount spent from the initial $200 million if the money can be respent an infinite number of times. For Exercises 41–46, two terms of an arithmetic sequence are given. (x 2 4)2 1 (y 1 3)2 5 4 3 2 10. g(x) 5 4x3 2 x c. x 5 4, x 5 24 b. y 5 12x 2 2; m 5 12 ; y-intercept: (0, 22) y b. Sometimes, however, all passengers show up and there are more ticketed passengers than seats. 1T + C21182 5 $308.83; The total cost to buy 18 tubes of paint is $308.83. Round to the nearest year. 16C2 5 120 55. a , 3b 33. 1 2 3 4 5 x (1, 22) 24 25 f. The outer ellipse c. Suppose that a county fair has an estimated 50,000 people attend over a 2-week period. 1.392 71. x 5 or x 5 41t 62b b26 A 18 P5 89. (2`, `) 17 6 1 i 13 13 8. a1 12r Future value of an ordinary annuity: Suppose that P dollars is invested at the end of each compounding period n times per year at interest rate r. x 5 36, y 5 12 c. Use these data to find the least-squares regression line. An employee invests $100 per month in an ordinary annuity. 1 5 5040 Evaluating Expressions with Factorial Notation Evaluate. 5 4 3 2 y 107. k(25) 44. y 5 log2(x 1 3) 25. This is a point slightly to the right of the relative maximum. Circle; Center: (3, 27); Radius: 5 5. Odd 37. Rounding the values of a and b gives us y 5 0.511x 1 104. P(t) 5 320,000e0.01t b. All relations are functions. [H1] 5 102pH R.2. m 5 SA-29 Student Answer Appendix 39. f 21(x) 5 3 B x 5280 b. (21, 0) and (25, 0) f. 23 f. e f 10. Write a formula for the nth term of a sequence that represents the resale value of the tractor n years after purchase. S(8000) 5 1360 means that the salesperson will make $1360 if $8000 in merchandise is sold for the week. We have 5k11 1 1 5 5 ? Find the area of the triangle. origin 7. 2 58. Evaluate (d + r)(30) and interpret the meaning in the context of this problem. The center is in Quadrant II, the radius is 3, and the circle is tangent to both the x- and y-axes. 1 3 2 h(x) 5 2ln x 4 10. Explain how the distance formula is developed from the Pythagorean theorem. x2 1 y2 2 10x 2 22y 1 155 5 0 51. in any order in any order 5 8C3 ? Would it be reasonable to use the model from part (a) to estimate the wind speed for a hurricane with a pressure of 800 mb? f (x) 5 0.5x3 1 2.1x2 2 3x 2 7 135. Only numbers less than 23 are also guaranteed to be lower bounds. g(x) 5 5x 1 1 and f 1x2 5 1 x 12. In the event that the linear trend continues beyond the last observed data point, use the model in part (a) to predict the number of students enrolled in public colleges for the year 2020. {(x, 25x 2 6) 0 x is any real number} y16 or e a2 , yb ` y is any real number f 5 b. This correlates to between 50% and 85% of the individual's maximum heart rate (Source: American Heart Association, www.americanheart.org). v 5 12gh 123. particular order. Suppose that {an} is a sequence representing the sales person's total yearly income based on the number of units sold n. f(x) 5 x23 x24 b. Write the range in interval notation. The water level in a retention pond started at 5 ft (60 in.) and decreased at a rate of 2 in./day during a 14-day drought. 2 i 83. n Sn(1 2 r) 5 a1(1 2 r) Factor each side of the equation. The graph shows the cumulative number y of flu cases among passengers on a 25-day cruise, t days after the cruise began. 394–397 1. SmartBook breaks down the learning experience into four stages: Preview, Read, Practice, and Recharge. See also Polynomials Multiple regression, 516. P1 is true because 34 5 1 2 A 14 B 1. Identify the y-intercept. 4050 yd2 2 7. Intuitively, mathematical induction is similar to the sequential effect of falling dominos. A radar transmitter on a ship has a range of 20 nautical miles. y 5 4 3 2 b. Marta bicycles 18 mph and runs 6 mph. 695 Properties of summation: If {an} and {bn} are sequences, and c is a real number, then p. Evaluate 13P5 and 13C5. {0} 15. Finding Intercepts Using Function Notation Given a function defined by y 5 f (x), • The x-intercepts are the real solutions to the equation f (x) 5 0. perfect, (a 1 b)2 5c3(3c2 2 6c 1 1) 7. A jack or a diamond. The plane flies at a constant altitude for the next 1 hr 20 min, so we say that f is constant on the interval (40, 120). Assume that all distances on the map are represented in nautical miles. The clear, concise writing style and pedagogical features of our textbook continue throughout the online content in ConnectMath, in our instructional videos, and in the adaptive reading and learning experience of SmartBook. (3n 1 1)(3n) 3. EXAMPLE 9 Applying Multiple Principles of Counting Suppose that a committee of 3 women and 2 men must be formed from a group of 8 women and 7 men. Suppose that a circle is centered at the point (h, k) and has radius r (Figure 2-11). 4 2 81. [10, `) 31. B A line segment connecting any two nonadjacent vertices of a polygon is called a diagonal of the polygon. Domain: (2`, `); Range: (0, `) Range: (0, `) f(x) 5 !x 1 1 x 25 24 23 22 21 1 2 3 4 5 21 21 f (x) 5 x2 2 1; x $ 0 22 25 g. { }; The value 2223 does not check. It would take Michael Jordan 0.5 sec to reach his maximum height of 4 ft. EXAMPLE 7 Finding the x- and y-Intercepts of a Function Find the x- and y-intercepts of the function defined by f (x) 5 x2 2 4. If A is zero and B is not zero, then the equation can be written in the form y 5 k and the graph is a horizontal line. Determine the total number of seats in the theater. 64.8 in. Use a graphing utility to graph the function. The sample space has the following properties (Figure 8-12). $700 9. horizontal f (x2) 2 f (x1) 7. The speed of the sled s(t) (in ft/sec) at a time t (in sec) after movement begins can be approximated by: s(t) 5 • 257 Analyzing Graphs of Functions and Piecewise-Defined Functions , , , , x#1 x#2 x#3 x#4 b. The formal definition of a continuous function will be studied in calculus. Center: (23, 1); Vertices: A23 1 15, 1B, A23 2 15, 1B; Foci: A23 1 2 13, 1B, A23 2 2 13, 1B (y 2 4)2 (x 2 2)2 2 51 a. Pj is true, and 2. x 5 y2 2 4 x-axis. The first term is a1 5 8, and the 60th term is a60 5 185. (f + g + h)(x) 84. i51 n Answer 2. ceil(20.1) c. Find the difference quotient, 3. y 5 2 a. g(x) 5 2122x 1 5 62. A function that is symmetric with respect to the y-axis is called an even function. 1 Fk) 1 Fk11 5 (Fk12 2 1) 1 Fk11 by the inductive hypothesis. 2 2 12 2 6. Evaluate (T + C)(18) and interpret the meaning in context. [0, 2] c. (2`, 25) ª (25, `) e. Determine the horizontal or slant asymptote if either exist. Solution: In this example, we need to find two unknown quantities. a n51 n 1 1 4 1 n21 17. a2 , b 2 2 2 25 2 133 25 1 133 , 0b and a , 0b d. (See Example 1) 7. [24, 23] ´ [2, 3] 2 117. The value a b 5 1 is the 6 n coefficient of the last term of the expansion. {(1.6, 2.3)} 49. 1 2 y 32. 7 33. day 20? This conflicts with the definition of a one-to-one function. 5x 1 3 4x 2 9 1 x16 272 25x3 1 10x2 2 23x 1 38 1 x12 SA-20 Student Answer Appendix 4x4 2 13x3 2 97x2 2 59x 1 21 x4 2 2x3 1 4x2 2 8x 1 16 37. x 1 2 b. h For Exercises 102–103, identify the location and value of any relative maxima or minima of the function. C 5 15. 1)(5!) 1 n! 1 n! 5 5 b. 29 77. EXAMPLE 6 Graphing a Piecewise-Defined Function Graph the function defined by f (x) 5 e y Solution: 5 4 3 2 1 25 24 23 22 21 21 22 23x for x , 1 . Evaluate (g ? Write C as a function of A. (30, 252) and (222, 239) 31. 204 Reference The point-slope formula for a line is given by y 2 y1 5 m(x 2 x1) where m is the slope of the line and (x1, y1) is a point on the line. Isner and Mahut would meet in the first round at Wimbledon in any given year. a (3k 1 7) k51 4 17. a35 5 2460 35. 739 A permutation is an ordered arrangement of distinct items. 5 4 3 2 Determining x- and y-Intercepts from an Equation 1 27 26 25 24 23 22 21 21 22 23 24 25 1 2 3 x Given an equation in x and y, • Find the x-intercept(s) by substituting 0 for y in the equation and solving for x. (5)2 x 2 2 ? The domain of f + g is the set of real numbers x in the domain of g such that g(x) is in the domain of f. R(x) 5 px The product px represents the price per item p times the number of items sold x. (2, 21), (22, 21) 25 24 23 22 21 1 2 3 4 5 21 F d. {24, 22, 1, 3} c. Average rate of change 5 b. 547 1 0 2 47. Draw the circle through the points. Create Models Using Linear Regression y 2 y1 5m x 2 x1 a Slope formula y 2 y1 b(x 2 x1) 5 m(x 2 x1) Clear fractions. These may not include x values at the leftmost and rightmost points on the circle. loga z5 x 1y 3 b CHAPTER 7 Section 7.1 Practice Exercises, pp. [22, 4)) 22 4 b. v2 5 Chapter 1 Test, pp. Passes through (2.3, 5.1) and (1.9, 3.7). Evaluate P(189) and interpret the meaning in the context of this problem. Determine the Slopes of Parallel and Perpendicular Lines 3. Skill Practice 7 Given f (x) 5 3x 1 4 and g(x) 5 x 21 1 , write a rule for each function and write the domain in interval notation. Cash 30 # x , 60 a. Determine the interval(s) over which f is decreasing. 4 e. m 5 130 12 1 41. y 5 0 x 2 5 0 2 2 54. EXAMPLE 2 Writing Terms of a Sequence Defined Recursively Write the first five terms of the sequence defined by a1 5 4 and an 5 2an21 1 1 for n . 7 7 48. 5 3(x2 1 4x 1 4) 1 3(24) 1 5 Remove 24 from within parentheses, along with a factor of 3. x1 5 60 vehicles per hour; b. 9 2x or 9A 1 xB 2 7 7 c. None of these 25. CN1 5 £ $40 § ; The matrix CN1 represents the additional cost for $2.40 24 text messages and 100 extra minutes for each of the cell phone plans. x, x 1 2 24 0 8

5 64 13. (7x 1 3)3 18. The graph of the sequence from Example 3 is shown in Figure 8-4. If P(E) 5 0.73, what is the probability of P(E)? (4y 1 3)4 5 3 6 63. Given a geometric sequence with 0 r 0 , 1, the value of rn S as n S `. Determine if the relation defines y as a function of x. Expanding Your Skills 93. 1 40. All of you are amazing. The common difference is d 5 210. Find all the zeros of f (x). y 5 0 b. a2` , 2 b ´ (22, 2) 41. {32} 81. 1 3 3 3 3 The values of a b, a b, a b, and a b match the entries in the 0 1 2 3 fourth row of Pascal's triangle. Passes through a2 , b and the slope is undefined. (g + f)(x) for all functions f and g. 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 2 3 4 x 5 25 24 23 22 21 21 22 23 23 24 25 24 25 11. Assume that Pk is true; that is, assume that 3 is a factor of 4k 2 1. 23, x ? 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 h(x) 5 4 3 2 y 5 g(x) 1 1 25 24 23 22 21 21 22 g(x) 5 4 3 2 5 4 3 2 y 5 h(x) 1 x 25 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 x Section 2.3 Functions and Relations 189 Solution: a. For example, computer game developers use a rectangular coordinate system to define the locations of objects moving around the screen. The width is approximately 5.4 yd and the length is approximately 7.4 yd. a b 5 5 5 51 0 0! ? {22} 3 2 6 5 4 3 23 2 24 25 y 22 21 21 1 23 1 1 23 25 24 23 22 21 21 22 a. The principle of mathematical induction has us test the truth of a statement for n 5 1. f (x) 5 2b(x 1 c) 1 a 49. a (21)k(6k) 3 60. E2 6 5i, 617F 4 b. (See Example 2) For a given spin of the wheel, find the probability of the following events. While on vacation, Jim does not read email. 2, 15, 16, 17 1, 8, 27, 64 15. If a is b plus eight, and c is the square of a, write c as a function of b. f (x) 5 0 x 0 and g(x) 5 3 6. 5 25 x Relative minimum g(4) 522 24 25 26 For the graph shown, 3 25 5 25 x Section 2.7 The calculator asks for a guess. What is the probability that the jury will consist only of men? 1 4 3 b. • The graph of the equation is symmetric with respect to the origin if substituting 2x for x and 2y for y in the equation results in an equivalent equation. Foci: A24, 2 1 115 B, A24, 2 2 115 B y e. 2 23. 6 ? For example: 5. 6 5 4 Y1 5 2x2 2 3x 1 1 3 2 1 21 22 1 2 3 4 5 6 7 8 9 10 x 23 24 7 4 b. A1 2 17, 2B, A1 1 17, 2B 17 e. ln 1.5 < 0.4010 22 4 25 125. Suppose that an enthusiastic mathematics student makes a square dart board out of the portion of the rectangular coordinate system defined by 25 # x # 5 and 25 # y # 5. 6.3 1 1.4t c. The x-coordinate of the point of intersection is the solution to the equation 2x 2 1 5 x 1 5. 457 pixels b. n. 225 19. inequality 3. Write a relationship for a function whose f (x) value is 4 less than two times the square of x. That leaves 3 letters remaining for the second choice, followed by 2 letters for the third choice, and only 1 letter for the last choice. 56 3. 1 log x2 5 log(x2)1y2 5 log 2x2 5 log 0 x 0 2 7. x 1 2 1xy 1 y d. 64 64 x 64x2 5q2 5p3 1 b. 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 89. The numerator is 1 more than the term number: (i 1 1) The denominator is the square of the term number: i2 The odd-numbered terms are positive. The Parent 2 Y gene is dominant, and therefore a plant with genes YY will have yellow peas, a plant with genes Yy or yY will have yellow peas, and a plant with genes yy will have green peas. The graph of y 5 f (x 1 c) is the graph of y 5 f (x) shifted (up/down/left/right) c units. You're strong but not rude; kind, but not weak; humble, but not timid. Evaluate a (21)i if n is odd. y 5 25x 1 258 b. Take a logarithm of any base b on each side of the equation. f (x) 5 2 1 x 44. List all the combinations of two elements from the set. y4 5 2 1 x2 17. 0, 0 x 0 5 k is equivalent to x 5 k or x 5 2k. Such shifts are called translations. {(22, 23)} 43. False (27, `); {x 0 x . The width is 17 yd and the length is 37 yd. Show that 3(k 1 1) , 2k11. Objective 2: Determine Empirical Probabilities 45. m 5 23. For each birth, the probability that the child is born a boy is 12 . Zeros: 0 (with multiplicity 3) and 4 6 13 (each with multiplicity 1) c. 10 10 210 10 210 210 10 210 SA-12 Student Answer Appendix 5. At age 28, an employee begins investing $100 each pay period (twice per month) in an ordinary annuity. y12 32x3z6 16. x2 1 y2 2 20y 2 4 5 0 46. 719 PC A1 1 nr B nt 2 1D r n SECTION 8.4 Mathematical Induction Reference Mathematical induction is a technique of mathematical proof that is often used to prove that a statement is true for all positive integers. Explain the difference between the principle of mathematical induction and the extended principle of mathematical induction. 0, , 2 , 613; each of multiplicity 1 3 2 33. Graph Piecewise-Defined (x, y) (2x, y) Functions 4. Avoiding Mistakes boxes that fend off common mistakes. There are 100 members of the U.S. Senate. Not possible SA-38 Student Answer Appendix 1 11. A senior is selected. 0 b. Domain: (2`, `); Range: (2`, 0) c. Graph y 5 23f (2x). By the inductive hypothesis, [2 1 6 1 p 1 (4k 2 2)] 1 [4(k 1 1) 2 2] 5 2k2 1 (4k 1 2) 5 2(k2 1 2k 1 1) 5 2(k 1 1)2 as desired. The complement of E, denoted by E, is the set of outcomes in the sample space but not in event E. g(x) 5 2x2 2 5 and f (x) 5 0 x 0 h(x) 5 (f + g)(x) 5 f (g(x)) 5 0 g(x) 0 5 0 2x2 2 5 0 270 Chapter 2 Functions and Relations 3 Given m(x) 5 1 5x 1 1, find two functions f and g such that m(x) 5 (f + g)(x). 216w3 5 1 3 101. ` `50 23 4 1 20.4 1 23 7 b. c 4 3 2 1 22. Between months 4 and 6: 2683 cases/month; Between months 10 and 12: 2110/month c. Graph y 5 f (2x). 5 69. (0, 25) and (4, 3) b. Ocean: 93.8 m 77. Every player plays every other player exactly once. 2 4 8 16 a. This is the characteristic that makes this sequence arithmetic. m 5 kw 71. 21, 4, 29, 16 n11 odd-numbered terms, negative; even-numbered terms, positive odd-numbered terms, positive; even-numbered terms, negative 692 Chapter 8 Sequences, Series, Induction, and Probability Because a sequence is defined only for positive integers, its graph is a discrete set of points (the points are not connected). Parent function y 5 1 1. y 5 f(x) 25 24 23 22 21 21 22 25 26 27 23 y 5 4 3 2 g(x) 5 2 1 22 21 21 22 16. 23 m5 Move to the right 4 units. What is the probability that a jury of 9 people taken at random from the pool will consist only of women? Any point on the y-axis has an x-coordinate of zero. 5 2 117 63. 3.5 3 100 a. h(22.5) e. Assume that the money is respent an infinite number of times. Neither Neither 7. • To help students develop logical thinking and problem-solving skills that will benefit them in all aspects of life. f is increasing on the interval (2, 3). The force will be 16 times as great. Directrix: y 5 1; Axis of symmetry: x 5 23 y 6 5 4 3 F 2 1 21028 26 24 22 21 2 x 22 23 24 y 2 1 F 23 22 21 1 x 21 22 y 10 8 6 4 2 F 21028 26 24 22 22 24 26 28 210 2 4 6 8 10 2 3 4 x y 1 24 23 22 21 21 22 23 24 25 26 27 1 5 6 x F 28 29 c. Determine if the statement is true or false. 7 1 a2 , d 6 3 (23 ; {x 0 23 , x # 7} 7 ; {x 0 x # 6.7} 43. If a code for an alarm is a 4-digit sequence, determine the probability that someone guesses each digit correctly. Graph M 8. f(x) 5 0 x 0 b. (23, 26, 22) For example: (0, 6, 0), (4, 5, 1), (8, 4, 2) For example: (0, 0, 1), (0, 2, 0), (3, 0, 0) a. Assume that any player can play any other player in the first round (that is, disregard the fact that seeded players do not play one another in the first round). 6.9 b. 2 (9x)2 or A 1 9xB 2 43. x-axis The graph of x2 1 y2 5 9 is a circle with center at the origin and radius 3. x2 1 3x 1 9 2x 1 x 2 3 25 5 2 1 8 1 x 1 x1 1 2 4 8 2x 2 1 a. The difference in distances equals the length of the transverse axis. Cholesterol Amount vs. If 23 # If 22 # If 21 # If 0 # x If 1 # x If 2 # x ... x , 22, then x , 21, then x , 0, then , 1, then Œx œ , 2, then Œx œ , 3, then Œx œ Œx œ 5 23 Œx œ 5 22 Œx œ 5 21 50 51 52 y f(x) 5 vxb 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 23 24 25 Skill Practice 8 Evaluate f (x) 5 Œx œ for the given values of x. How long will it take to pay off a debt of $3960 if $50 is paid off the first month, $60 is paid off the second month, $70 is paid off the third month, and so on? Therefore, 2 and 24 are also eliminated from the list of possible rational zeros. v1x2 5 20.1436x2 2 0.4413x 1 195.7 d. Athlete (x) Number of Medals (y) Dara Torres (swimming) 12 Carl Lewis (track and field) 10 Bonnie Blair (speed skating) 6 Michael Phelps (swimming) 16 25 24 23 22 21 21 22 y 21. y 5 3x 1 1 b. Apply the equivalence property of exponential expressions. [225] c. 39 ? 2A 2C k k b. (0, 0), A4 1 13, 0B, A4 2 13, 0B d. A student studying to be a veterinarian's assistant keeps track of a kitten's weight each week for a 5-week period after birth. E1 5 {R1, R2} The number of red marbles is 2. 123 d. Next, assume that Pk is true and show that Pk11 is true: Assume that 4 is a factor of 9k 2 1. The base of the triangular portions is 5 ft and the height is 12 ft. Greatest integer less than or equal to 2.5 is 2. £ 4 2 5 22 1 6 2 23 † 10 § 5 1 1 31. P 5 $300, n 5 12, r 5 4%, t 5 32 yr 51. 25 21. 4 m5 24 25 3 24 Move up 3 units. Combine like terms. Let a1 represent the original amount in the account; that is, a1 5 500,000. None e. 2k11 where k $ 4. Center: (23, 5) e. p(x) 5 2x 1 12 81. Reciprocal function: f (x) 5 y x 2 24 25 24 25 24 25 22 21 0 1 2 1 x y 5 4 3 2 21 22 5 23 y 0 1 2 3 4 3 4 3 6. Vertices: A 52, 0B, A252, 0B d. f (3) d. 3 51. The width should be between 2 115 ft and 4 15 ft. 2x or A 1xB b. An equation of the form x 5 k where k is a constant represents the graph of a line. 194 Chapter 2 Functions and Relations Objective 3: Determine x- and y-Intercepts of a Function Defined by y 5 f(x) For Exercises 75–84, determine the x- and y-intercepts for the given function. {(24z, 23z 1 2, z) 0 z is any real number} 15. 377–382 8 R.1. a2` , 2 d 9 R.5. 7w 1 6 R.4. (w 1 2)(3w 1 2) d. 661–666 R.1. 7 R.2. y 5 28x 2 56 10 8 x2 9 9 5. SECTION 8.6 70. Undefined f. p^ 2 z p^ q^ Bn , p , p^ 1 z p^ q^ Bn Student Answer Appendix Problem Recognition Exercises, p. x 5 4, y 5 2, z 5 10 25. The code must represent a 3-digit number that is a multiple of 5. 5 4 3 2 (f 1 g)(1) (fg)(0) (g 2 f)(23) (f + g)(3) (g + f)(4) f (g(1)) y 5 f(x) 1 25 24 23 22 21 21 22 23 1 2 3 4 5 x y 5 g(x) 24 25 Solution: a. If the sales tax rate on a purchase is 6%, write a function to represent the total cost T(a) for a first-time visitor who buys a dollars in songs. 67 ft 2 15 452 x 1 2 3 4 5 b. 8 1 12 1 16 1 20 1 24 1 28 1 32 1 36 1 40 1 44 51. P(200) 5 2137; In the year 2210 the U.S population will be approximately 2.137 billion. Round to 3 decimal places if necessary. f (x) 5 45. 5p3, 25p5, 5p7, 25p9, ... 35. Determine the total number of ancestors that an individual has going back 12 generations. They are organized in Connect hosted by ALEKS by chapter and section. log 2 1 log x 1 8 log(x2 1 3) 2 log(4 2 3x) 2 1 1 41. She wants to get a head start by reading several of the books during the summer. The sum of the numbers on the dice is not 12. {25} d. e f ; The solution to r (x) 5 0 gives the x-coordinate of the point 3 where the graph of f crosses its slant asymptote. R; (2` , `) 65. 3.425 80. 5 5 20 b. (The match stretched over a 3-day period with Isner winning 70-68 in the fifth set.) In 2011, after a random draw, the two men met again in the first round of Wimbledon. The car will stop within 250 ft if the car is traveling less than 50 mph. Find the 19th term of an arithmetic sequence with a1 5 211 and a30 5 163. • The graph of f is a parabola with vertex (h, k). 0.5 7 6 5 4 3 x h(x) 5 ⎛ 13 ⎞ 2 ⎝ ⎠ 1 f(x) 5 3x 25 24 23 22 21 21 1 2 c. s(d) 5 or s(d) 5 e. For example, the following three series are all equivalent. octagon (8 sides) A C Diagonal D E For Exercises 73–78, consider the set of numbers {0, 1, 2, 3, 4, 5}. 25 73. E A 12, 1B F 27. EXAMPLE 12 Estimating Function Values from a Graph The graphs of f and g are shown. 12.5 sec b. (2` , 0) g. A 113, 0B, A2113, 0B 4 7. 744 n! . v(x) 5 2 0 x 0 2 78. (q + p)(x) 71. (25, 23); m 5 2 3 1 3 70. a 4a b 2 i51 6 ` 1 6 18. 1 2 log(a 1 b) 35. Show that [1 ? For Exercises 65–68, graph the equations. If neither A nor B is present, then the letter O is used. f (x) 5 x 1 1 for x , 2 54. Write an equation that represents the set of points that are 5 units from (8, 211). Exercise Sets The exercises at the end of each section are graded, varied, and carefully organized to maximize student learning: • Prerequisite Review Exercises begin the section-level exercises and ensure that students have the foundational skills to complete the homework sets successfully. Either point can be labeled (x1, y1). 0 2 i 5 5 173 173 41 41 13 13 i 89. {(213, 11, 10)} 65. Then by definition the distance between (h, k) and (x, y) must be r. 2270 65. rational 7. a (22j2) 5 1 j 61. 5 97. y 5 20.7 1 9.72 ln x t 0 k(x) 5 23x 1 1 c. formula defines the nth term of a sequence as a function of one or more terms preceding it. See Notation/symbols Symmetry axis of, 286 test for, 243–245 Synthetic division to determine slant asymptote, 352 to divide polynomials, 319–320 explanation of, 318 Systems of inequalities in applications, 543 on graphing utility, 537, 541 graphs of, 537, 542 methods to solve, 540–543 Systems of inequalities in two variables, on graphing utility, 537 Systems of linear equations Cramer's rule for, 619–620 explanation of, 492 Gaussian elimination to solve, 567–570, 625 on graphing utility, 496 homogeneous, 584 matrices to solve, 564–570, 625 solution set to, 492 solutions to, 492–493 Subject Index square, 578 substitution method to solve, 493–494 use of inverse matrix to solve, 608, 626 with no solution, 493, 497 Systems of linear equations in three variables in applications, 512 Cramer's rule for, 620 dependent equations to solve, 509, 577–579 determining number of solutions to, 510–511 explanation of, 506, 556 inconsistent, 509, 575 methods to solve, 507–509 modeling with, 513 ordered triple as solution to, 506–507 Systems of linear equations in two variables addition method to solve, 494–497 in applications, 498–500 Cramer's rule to solve, 618–619 dependent equations in, 493, 498, 556 dependent equations to solve, 575–577 explanation of, 492, 556 general solution to, 498 on graphing utility, 496 inconsistent, 493, 556, 575 Systems of nonlinear equations in two variables addition method to solve, 529–530 in applications, 531–532 explanation of, 527, 557 on graphing utility, 530, 531 substitution method to solve, 528–529 T Tartaglia, Niccolo, 344 Tax deferred, 720 Terms leading, 38 like, 11, 12, 39 Theoretical probability, 750–751, 766 Theory of relativity, 98 Third-degree polynomial functions, 301 Touch point, 305 Transformations explanation of, 235 of functions, 230–238, 276 to graph exponential functions, 417 to graph logarithmic functions, 434–435 to graph rational functions, 353–354 nonrigid, 232 rigid, 232 Translations explanation of, 230 horizontal, 231–232, 236 vertical, 230–232, 236 Transverse axis, of hyperbola, 651, 652, 655 Tree diagrams, 738, 739 Trial-and-error method, to factor trinomials, 51 Trinomials. Vertical asymptotes: x 5 , x 5 2 ; Horizontal asymptote: y 5 0 2 2 5 14. 24x 1 6y 5 11 23x 1 9y 5 1 21. x 5 7, y 5 5 b. {0, 17} a. {(3z, 22z 1 1, z) 0 z is any real number} 15. {3} e. This is demonstrated in Example 4. TIP The equation y 5 20.4x 1 109.6 can also be expressed in function notation. No 22 b. x2 1 y 5 9 52. 1 x23 2 10. g(x) 5 x2 1 2 c. Therefore, the order in which the 3 students are selected is not relevant. a 15. 6110, 63i 29. The animated content illustrates difficult concepts by leveraging the use of on-screen movement where static images in the text may fall short. x 1 y # 60,000 y e. e 6 , f 5 2 6. Directrix: x 5 22; Axis of symmetry: y 5 0 c. g(f (23)) 5 g(3) 5 21 c. EXAMPLE 4 Finding the Probability of an Event by Using Counting Techniques Suppose that 5 women and 3 men apply for 2 job openings. • The graph of the equation is symmetric to the x-axis if substituting 2y for y results in an equivalent equation. {81} 99. ent Male t is en Par is Female t is Male r Male Parent is 1 bee Female Pa Pa re 1 bee nt en is r Pa Female P 2 bees aren t is Female 3 bees Figure 8-3 3. The cost is $7.99 per shirt for 1 to 100 shirts, inclusive. 449–452 R.1. x9 R.2. y5 16z8 R.3. 6 R.4. n3 w 343k12 1. 15 2 2 5 11. {24} d. e f 3 23. Furthermore, 0 itself is not a zero of f(x) because x is not a factor of f(x). Find the sum of her yearly salaries over a 20-yr period. If two fair dice are thrown, find the probability that the sum is between 6 and 8, inclusive. However, we will work on the right side of the equation only. xk21 ? g(2) 5 5 The function values represent the ordered pairs (22, 23), (21, 21), (0, 1), (1, 3), and (2, 5). CHAPTER 8 Total 56 46. 11, 10.2, 9.4, 8.6, 7.8, ... 19. • The graph of the equation is symmetric with respect to the y-axis if substituting 2x for x in the equation results in an equivalent equation. 4k11 2 1 5 4 ? v(x) 5 2(x 1 2)2 1 1 64. 40,000 (25, 35,854) 30,000 (10, 14,577) 20,000 10,000 0 y 54. 5 as desired. Determine the time at which the stone will hit the ground. $36,000 b. 40,320 c. Gaynelle can travel one of 3 roads from her home to school. B > C For Exercises 19–20, solve the inequality and write the solution set in interval notation. (22, `) b. (0, `) c. The range is (2`, 5]. 5b w; w 99. 5, 1 6 15 13. Apply the Fundamental Principle of Counting 1. R.2. Solve for x. Section 8.1 Sequences and Series 695 In mathematics, the Greek letter S (sigma) is used to represent summations. Parent function: y 5 0 x 0 1. The systolic blood pressure for a healthy 55-year-old would be approximately 132 mmHg. Skill Practice 8 The data given represent the class averages for individual students based on the number of absences from class. C(225) 5 279; If the cost of the food is $225, then the total bill including tax and tip is $279. 23 83. Expression; 6x2 2 13x 2 5 2. The length is 9 ft. 9 8 7 6 5 4 Label the center (h, k) and the radius r. g)(4) 13. Five seeds are defective (will not germinate). In Example 2, we consider g(x) 5 (x 1 3)2. (See Example 5) 35. g(3) e. The graph is symmetric with respect to the y-axis only. If k $ 2, then (k 1 3) . Suppose that one flight has 160 passengers and only 156 seats. For Exercises 41–46, find the sum of the geometric series, if possible. 1 16. Yes 37. 1 2 3 4 131. EXAMPLE 5 Graphing a Function with a Horizontal Shrink or Stretch y The graph of y 5 f (x) is shown. {x 0 x . 596–601 R.1. 29 R.2. x 1 (29) R.3. {24} 1. h(x) 5 Solution: Answers y 3. By mathematical induction, we conclude that n! . Two adjacent angles form a straight angle (1808). 88. 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x The operation Œx œ may also be denoted as int(x) or by floor(x). 5! 5 5 5 8 ? These exercises are linked to examples in the text and direct students to similar problems whose solutions have been stepped-out in detail. and the length is 42.4 in. To find the relative minimum, repeat these steps using the Minimum feature. 44. The sequence is not geometric because the ratio between a4 and a3 is different than the ratio of other pairs of consecutive terms. 0 # 0 x 1 7 0 2 6 16. Directrix: y 5 24; Axis of symmetry: x 5 1 c. Identify the focus. y 5 24 2 (x 2 2)2 y50 107. Find a36. 1 1 15 < 1.62 b. (2`, `) 103. by 12 in. Given k(x) 5 28x5 2 6x3, find k(2x). Year (x 5 0 represents 1990) c. The height y (in meters) of a volcano in the southeast Pacific Ocean is recorded in the table for selected years since 1960. t2 5 2ta 2 t1 13. Use this data to inform your teaching, group students based on similar knowledge levels, and shape a meaningful learning experience for your students. 12z 1 32 12z 95. Yes 22 23 21 8 22 Chapter 6 Cumulative Review Exercises, pp. f (x) 5 1 x 3 b. D2 E2 24. 270–275 R.1. 12`, 222 ´ 122, `2 R.4. 12`, `2 1. Suppose that a jury pool consists of 18 women and 16 men. a 3 3 y e. y y 5 4 3 2 y 5 f(x) 1 25 24 23 22 21 21 22 y 5 4 3 2 5 4 3 2 y 5 f(x) 1 1 2 3 4 5 x 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 EXAMPLE 4 y 5 f(x) 1 2 3 4 5 x Identifying Even and Odd Functions Determine if the function is even, odd, or neither. { } a.{(3, 5, 0)} b. (2, 2), (4, 3), and (8, 5) 76. Graph p(x) 5 x 1 2 for x # 0. A face card or a red card. Students and instructors can enjoy access to SmartBook anywhere, anytime (now available offline) with a new and improved mobile interface. The point-slope formula is useful to build an equation of a line given a point on the line and the slope of the line. a (3i 2 7) i51 15 50 56. Determine Empirical Probabilities Suppose that the Centers for Disease Control wants to measure the 1-yr survival rates for Americans for specific ages. Write a linear function W that represents the water level W(t) (in ft) t days after a drought begins. $3563.16 7.2% simple interest results in less interest. Determine the slope of a line parallel to the given line, if possible. (r ? x-axis, y-axis, and origin 16. Horizontal asymptote: y 5 0 d. Figure 2-22 shows the graphs of the revenue and cost functions from Example 6. {100, 1} 121. The distance between two distinct points (x1, y1) and (x2, y2) is given by the formula . 70 True 23. 10 19 Section 8.7 753 Introduction to Probability Definition of Complementary Events Let E be an event relative to sample space S. 8 1 7.2 1 6.4 1 5.6 1 ... 1 (245.6) For Exercises 55–64, find the sum. Foci: A3, 113 B, A3, 2113 B d. For Exercises 37–38, find a counterexample to show that the given statement is not true. r (x) 5 12x 2 32 3 3 8 22. 9 The solution set is c , `b. In Examples 4 and 5, we practice evaluating the difference quotient for two functions. 81; (x 1 9)2 49. Domain: (22, `); Range: (2`, `) c. x bM x Then 5 N 5 bM2N . For a parabola opening upward, such as the graph of f (x) 5 x2, the minimum value is the y-coordinate of the vertex. Determine the number of ways that the letters in the word MICROSCOPIC can be arranged. 5x 0 x # 92 6 b. 11.6 yr 17. Such a sequence of fixed payments made (or received) by an individual over a fixed period of time is called an annuity. (See Example 4) b. This implies that 5k 2 3 5 2a and that 5k 5 2a 1 3 for some positive integer a. 2112 b. 1s 1 t2 1x2 30. a 10 10 3 33 y g. Yes 1. is needed. 29 11. TIP The decomposition of functions is not unique. The code may not contain repeated digits. Vertex: (0, 0); p 5 2; Focus: (2, 0); Focal diameter: 8 b. (2`, 3) h. Skill Practice 5 Find the number of terms of the finite arithmetic sequence 16, 11, 6, 1, ... , 2239. One scholarship is for $500 and the other is for $250. Even function y f. Use the points (4, 11.2) and (14, 13.0) to write a linear model 5 for these data. e 2 , 211 f 2 71. Vertical stretch/shrink y 5 a[f (x)] Vertical stretch (if a . For n $ 1, the expression Furthermore, by definition, 0! 5 represents the product of the first n positive integers n(n 2 1)(n 2 2) ... (2)(1). Then the price is decreased to $6.99 per shirt thereafter. (53 2 6)! 6! ? 25A 1 2B 21 3 D5 c 25 8 6 d 7 1 4 0 d 6 42. Yes; after 60 min, the cake will be approximately 95.28F. 4x2 2 7x 2 15 5 0 R.3. Solve. See also Systems of linear equations in three variables Linear equations in two variables. We can arrive at the same conclusion by applying the fundamental principle of counting. (2`, 12) 5 Quadratic equation b. 80, 20, 5, ... 4 b. In Example 2, we prove the statement introduced at the beginning of this section. Find the total income for an employee who works at the job for 30 yr. (0, 24); m 5 69. Write the answer in slope-intercept form (if possible). List all the permutations of three elements from the set. (6 2 5i)4 n n 58. (0, 215) y e. 0.10 36 6 36 12 SA-49 18C9 48,620 5 < 0.00093 C 52,451,256 34 9 11,440 16C9 b. f(x) 5 x2 2 4 0 5 x2 2 4 x2 5 4 x 5 62 The x-intercepts are (2, 0) and (22, 0). (225, `) 49. 1 71. x4 2 4x3y 1 6x2y2 2 4xy3 1 y4 a. Then write the equation using function notation. 36 b. P(E) 5 0.994 12. Chapter 5 Cumulative Review Exercises, pp. f (23) b. The function has a relative maximum of 4.5 ft at a time 12 days after recording began. Linear; {1} 77. 710 Chapter 8 Sequences, Series, Induction, and Probability For Exercises 35–38, find the number of terms of the finite arithmetic sequence. Domain: 12`, 232 ´ 123, 22 ´ 12, 32 ´ 13, `2 31. Identify the slope. 225 mg b. 53 5 125 b. Evaluate a (21)i11 if n is odd. R 17 6 D; 21. x # 6 61. 168 x 1 1 x2 y1 1 y2 , b. Assume that each employee is assigned to exactly one task. f 21(x) 5 3 2 x; x $ 3 x14 3 63. a b5 (n 2 r)! ? 36 2 57i 61. If the interest rate is 5.5%, find the value of the annuity when the employee retires at age 62. 6x 2 2(x 1 2) 2 5 5 0 6x 2 2x 2 4 2 5 5 0 4x 2 9 5 0 9 x5 4 To verify the solution graphically enter the left side of the equation as Y1 5 6x 2 2(x 1 2) 2 5. The S F2. 2 3 4 5 27 d 231 45. a2`, Linear Equations in Two Variables and Linear Functions 5 d 2 5 c. Next, assume that Pk is true. A graph is concave up on a given interval if it "bends" upward. Never constant a. z Expanding Your Skills A point in three-dimensional space can be represented in a three-dimensional coordinate system. What is the probability that a given outcome is bar-bar-bar? f 21(x) 5 x11 4 b. 2(x 1 c)2 1 y2 1 2(x 2 c)2 1 y2 5 2a c. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 13. It is also important to note that the center is not actually part of the graph of a circle. Geometric Sequence A geometric sequence {an} is a sequence of the form a1, a1r, a1r2, a1r3, a1r4, p • The value a1 is the first term, and r is called the common ratio of the sequence. 23.9c2d 2 16.5cd 19. y 5 123x 1 75 b. 2(x 2 4)(x 1 4x 1 16) 14. a23 5 103 27. ; x ? No doubt, many instructors and students thank you as well. 116,280 746 Chapter 8 Sequences, Series, Induction, and Probability TECHNOLOGY CONNECTIONS Evaluating a Number of Combinations, nCr Most graphing utilities can evaluate the number of combinations of n elements taken r at a time. f (a 1 h) 188 Chapter 2 Functions and Relations 3. In the end, scientists combine a series of simple curves to approximate weather patterns that closely fit complicated models. The billboard is 12 ft by 24 ft. 362,880 37. Denominator of the complex fraction is zero for x 5 3. 3 x 64. Show that Pn is true for n 5 1. On a graphing calculator hit the STAT button and select EDIT to enter the x and y data into two lists (shown here as L1 and L2). e 5 73. f (x) 5 and g(x) 5 x 1 4 99. k 5 23. Explain why this is not a sufficient proof that the expression is prime for all positive integers n. i 119 24i 13. 100. odd 7 216 2 213 17. 3 log x 2 5 log y 2 12 log z 33. A graph of an equation is symmetric with respect to -axis if replacing x by 2x results in the in an equivalent equation. The customer will wait less than 30 sec. formula 8. C 5 3.6s 1 50p 1 250n b. an 5 (21)n(n 1 4) n! b. 23x 1 1 5 2x 2 3 b. There are many other cases to consider regarding the number of male and female jurors: for example, 4 male, 5 female, etc. (See Example 4) 45. a , 5 d 23. Center: (23, 2); Radius: 4 19. (5, 0) and (11, 0) f. The corresponding points to the right of the axis of symmetry are (3, 22) and (4, 25). A Special Thanks to All of the Event Attendees Who Helped Shape College Algebra. At x 5 22, the function has a relative minimum of 24. Compute the sum of the first 60 positive integers that are exactly divisible by 4. x2 1 y2 5 28 3 2 3 2 81 15. 1 5 24 We generalize this as follows. Now suppose that we create two functions from the left and right sides of the equation. Vertex: A 14, 3B; p 5 274 ; Focus: A232, 3B; Focal diameter: 7 b. 1418 in.3 2000 1 2 3 4 5 x 24 25 65. A 13x2 1 y3 B 9; fourth term 38. Evaluate W(20) and interpret the meaning in the context of this problem. 2 1 3i 2 1 2 13i or 2 1 2i 13 7 14 9 9 39. m5 23 24 25 y b. The graphs match closely on the interval (0, 2). 4k 2 13 5 13(4 ? vertical shrink f(x) 5 |x| 1 1 1 10 5 25 24 23 22 21 21 22 23 19. 2 1 6 1 18 1 ... 1 13,122 8 3 243 121 1 p 1 3 2 512 1 1 1 2 2 2 p 2 8 32 63. Therefore, the function is neither even nor odd. 75% of 200 75% of 150 200 1 150 1 112.5 1 p We have a1 5 200 and r 5 0.75. Ex 0 x $ 275 F b. 1 5 48 85. dn 5 6n 1 7; find d204 For Exercises 21–24, match the sequence or function with its graph. 1 2 7 2 7 R.5. R.6. 2 c or A 1 cB 343 1. How many terms are in the binomial expansion? 1 23 100 Height vs. This is the graph of the function. Specifically, the element in row 1, column 3 should be 0. 0 6 2 2π 0 or 0 2π 2 6 0 ; 2π 2 6 75. an11 r5 an • The nth term of the sequence is given by an 5 a1r n21. The statement g(7) 5 25 corresponds to what ordered pair? The terms of the sequence defined by a1 5 x and an 5 aan21 1 b for n . In how many ways can the word SPACE be misspelled? not the same Replace y by 2y. f(x) 23 Answer 7. Absolute value function: f(x) 5 0 x 0 f(x) 2 1 0 1 2 3 4 5 2 3 4 5 2 3 4 5 5 4 3 2 1 25 24 23 22 21 21 22 x 23 24 25 5 4 3 2 1 25 24 23 22 21 21 22 1 x 23 8. 1?2 2?3 3?4 n(n 1 1) n11 1. temperature L(x) (in 8F) for day x. The statement that Pk is true is called the inductive We must show that Pk11 is true. (14, `) c. 106. (See Example 1) 5. (5x2 2 y3)(25x4 1 5x2y3 1 y6) 1 x13 9 18. If a polynomial has real coefficients, then all nonreal zeros must come in conjugate pairs. 5 4 3 2 1 25 24 23 22 21 21 22 y 70. y 1 1 1 2 3 4 x 5 25 24 23 22 21 21 22 y 5 2x 2 3 23 d. From Example 1, we see that a linear equation may represent the graph of a slanted line, a horizontal line, or a vertical line. {(2, 1), (5, 4)} 45,000 b. A set that contains no elements is called the empty set (or null set) and is denoted by { } or [. The number of participants for a 4-week period is given in the table. Suppose that a box containing music CDs has 4 with country music, 6 with rock music, 3 with jazz music, and 7 with rap music. Given f (x) 5 022x3 2 4 0 , define functions m, n, h, and k such that f (x) 5 (m + n + h + k)(x). 23 51. $129.60 an 5 20.8n 1 54.8 55 50 Water Level (in.) an 5 54 1 (n 2 1)(20.8) an 5 54 2 0.8n 1 0.8 an 5 20.8n 1 54.8 45 40 35 30 0 1 2 3 4 5 6 Day Figure 8-4 7 8 9 10 704 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 4 Finding a Specific Term of an Arithmetic Sequence Find the ninth term of the arithmetic sequence in which a1 5 24 and a22 5 164. The CD has classical music. Given an arithmetic sequence with a12 5 276 and a51 5 2193, find a1 and d. Then use the graph to find the solution set to the inequalities in parts (b) and (c). Section 8.4 EXAMPLE 1 Mathematical Induction 727 Using Mathematical Induction Use mathematical induction to prove that 1 1 3 1 5 1 7 1 p 1 (2n 2 1) 5 n2. x 5 0 y 0 Objective 2: Apply Function Notation 33. Evaluate the function at the given values of x, if possible. Skill Practice 10 a. A fire is located at distances of 17 km, 15 km, and 13 km, respectively, from the observation towers. All statements are true. Is k(2x) 5 2k(x)? b1 5 10; bn 5 2 1 bn21 32. BC 5 c 7 d 221 2 26 $7922 d ; QP is the matrix representing the total revenue from $9843 these four items for each theater. hyperbola; foci 3. Section 8.2 711 Arithmetic Sequences and Series 69. d(s) 5 12s 2 12 d2 g. 4 f. 61. • If P(E) 5 1, then the event E is called a certain event. This leads to the following result. E2 5 {B1, B2, B3} The number of blue marbles is 3. { } 6. This represents a vertical stretch. g, and f g p. i 26 7 38 2 34i 4. 13 b. In each case, the proof is concluded by showing that the truth of a statement for any other positive integer after the first allowable value of n follows directly from its predecessor. a1 5 3, d 5 10 16. Find the Probability of Sequential Independent Events TIP The word "die" is the singular of the word "dice." That is, we roll one die but we roll two dice. Graph q(x) 5 2x2 for x . 5 4 3 2 1 230 240 250 260 20. (21, 28) y 1 25 24 23 22 21 21 22 23 24 25 26 27 28 29 1 2 3 4 5 x h(x) 5 2(x 1 1)2 2 8 1 x 15. f(x) 5 1x 1 15 b. II b. 1 53. w(x) 5 Zx 1 1Z 1 4 b. 1 f + g21x2 5 9 25 2 x2 81. 3 0 6 22 The graph of a horizontal line will have no x-intercept unless the line is the x-axis itself. {(0, 2, 24)} 55. The population will reach 300,000 approximately 35 hr after the culture is started. y 2 2 y1 27 27 2 0 2 5 7 5 27 ? Use the second rule in the function: f (x) 5 23. h(x) 5 12 x15 a. If the sequence is arithmetic, determine d. In a group of ten 50-yr-olds, what is the probability that all ten survive to the age of 51? Given g(x) 5 2x8 1 0 3x 0, find g(2x). a2 5 21 and a7 5 5103 2243 8 48. y 5 g(2x) 1 39. More than 6 hr is required for the temperature to fall below 58C. y 5 2x 1 5 c. How many up/down sequences are possible in an arrangement of 10 switches? e a , b f 49 49 y 40. Center: (24, 1); Radius: 2 17. 5985; There are 5985 ways to select 4 distinct items in no specific order from a group of 21 items. The notes step through the material with a series of questions and exercises that can be used in conjunction with lecture. 41.6 ft 51. At a ballroom dance lesson, the instructor chooses 3 men and 3 women to demonstrate a new pattern. TIP In Example 8 there are 8 elements in the sample space: BBB, BBG, BGB, BGG, GBB, GBG, GGB, GGG The event BBB occurs 1 time. Write a piecewise-defined function to model the monthly cost C(x) (in $) as a function of the number of minutes used x for the month. R.1. f (2a) 5 27a 2 2 R.3. Interval notation: [22.4, 5.8) 1 24 25 y 5 f(x) x 5 4 3 2 1 23 x Section 2.7 Practice Exercises, pp. {5}; The value 2 does not check. (x 1 6)2 1 (y 2 2)2 5 9 b. e ax, , b ` x is any real number f or 2 2 22 2 2y 22y , y, b ` y is any real number f or ea 3 3 E(2z 1 6, 2 2 3z, z) @ z is any real numberF 16. Using function notation, these are the points (x1, f (x1)) and (x2, f (x2)). 3k for a positive integer k $ 7. False 53. (2) 1 2(1) 1 2A 12 B 1 2A 14 B p 5 4 1 4 1 2 1 1 1 12 1 p Vertical distance for each bounce is doubled Initial height Vertical Distance (ft) 96. y 5 4 6 5 4 x 8) 22.4 5.8 9 R.4. Interval notation: c 2 , `b 2 9 2 2 1. Solve the equation 6x 2 2(x 1 2) 2 5 5 0 and verify the solution graphically on a graphing utility. (2, `) b. They can graph many points quickly, and the more points that are plotted, the greater the likelihood that we see the key features of the graph. (n 1 2)! (n 1 2)(n 1 1)(n!) (n 1 2)(n 1 1) Skill Practice 3 Evaluate. Determine the solution set for the equation (x 2 17)2 1 (y 1 1)2 5 29. 14 15 1n 1 2 13 1 1 1p1 a. Rationalize the numerator of the expression in part (a) and simplify. C 23 D b. 239; Yes 25. Domain: (2`, `); Range: (2`, 1] y 3 2 1 29 28 27 26 25 24 23 22 21 21 22 23 24 1 2 p(x) 5 22(x 1 4) 1 1 5 25 26 27 c. h(k(3)) 100. bn 5 22n 1 8 d. [215, 211) ´ (211, `) 109. The points must all line up. This is motion followed by an object influenced by an initial force and by the force of gravity. Use the least-squares regression line to approximate the systolic blood pressure for a healthy 55-year-old. y The parent function for g(x) 5 0 x 0 2 3 is f (x) 5 0 x 0. Passes through (3, 24) and m 5 0. 5 4 3 2 25 24 23 22 21 21 22 1 2 3 4 5 25 24 23 22 21 21 22 3 4 5 1 2 3 4 5 x 5 4 3 2 1 x 2 y 110. In each case, replacing x by 2x results in an equivalent term. As x S 2`, f(x) S `, and as x S `, f(x) S `. The ball is equally likely to fall in any one of the 38 slots. Show that 2 is a factor of 5k11 1 1. y2 2 1 5 x Solution: y2 2 1 5 x y2 5 x 1 1 y 5 6 1x 1 1 Solve for y in terms of x. a2 1 2ab 1 b2 35. n(S) 10 c. In Example 8, we find the domain and range from the graph of a function. Find 2m(x). For Exercises 31–36, evaluate nPr. 31. The customer is female. Then hit the GRAPH key. y 5 22920t 1 29,200 b. Additional thanks to Julie Kennedy and Carey Lange for their tireless attention to detail proofreading pages. 6 5 4 5 4 3 2 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 22 23 24 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 3 1 5 1 19. (3.6, 5.1); m 5 1.2 3 2 67. P(x) 5 3x 119. The x-intercepts of the graph of f. TIP For an equation in standard form, the value of A, B, and C are usually taken to be integers where A, B, and C share no common factors. 23(x 1 2) 1 1 $ 2x 1 5 (2, 25) Y1 5 2x 2 3 96. For Exercises 75–86, write the sum using summation notation. $674 9. 0 v 2 16 0 , 0.01 or equivalently 0 16 2 v 0 , 0.01 b. 25 24 23 22 21 21 22 23 24 25 c. x2 1 ay 1 b 5 9 2 e. 2 5 (1)(1 1 1)(1 1 2) . The graphs have the shape of y 5 0 x 0 with a vertical shift. EXAMPLE 2 Write the standard form of an equation of the circle with endpoints of a diameter (21, 0) and (3, 4). t $ 0 c. The calculator asks for a left bound. (x 1 4)2 5 232(y 2 7) 41. f 21(x) 5 65. Perform Operations on Functions 1. From the slope formula, we have Formula 2. 2 4 26 29 23. (0, 0) d. For Exercises 26–27, expand the binomial by using the binomial theorem. 5zy7 2 2z2x 17. Graph C 9. The common ratio is r 5 13 . If one card is drawn at random from a standard deck, what is the probability that it is a red card or a 5? That is, the vertex of a parabola gives the maximum or minimum value of the dependent variable. 7 6 We can write f(x) 5 ax2 1 bx 1 c (a fi 0) in the f(x) 5 x2 5 form f (x) 5 a(x 2 h)2 1 k by completing the square. Not possible 83. Writing Linear Cost, Revenue, and Profit Functions At a summer art show a vendor sells lemonade for $2.00 per cup. P1 is true because for n 5 1, the sum is 2 which equals 1(1 1 1). If the vendor produces and sells 80 cups of lemonade, the cost and revenue will be equal, resulting in a profit of $0. 6 25 24 23 22 21 22 24 26 1 2 3 4 5 x 28 210 212 214 10 11 5 1 i 5. Approximate the value of log5 417 to 4 decimal places. • If m1 and m2 represent the slopes of two nonvertical perpendicular lines, 1 or equivalently m1m2 5 21. y 8 7 6 22 21 21 22 1 1 2 3 4 5 6 7 8 x 22 21 21 22 1 1 2 3 4 5 6 7 8 x 1 22 21 21 22 1 2 3 4 8 x Section 5.6 Practice Exercises, pp. The person has normal blood pressure or is a smoker. A ball rolling down an inclined plane rolls 4 in. < 83. [24, 1] ´ [3, `) 31. Use the data points (2, 308) and (6, 408) to write a linear equation relating y to x. In such a case, the outcomes are called combinations (rather than permutations). 16 c. 3 4 5 4 3 2 1 1 2 y 5 4 3 2 25 24 23 22 21 21 22 1 c. An "A." b. (1.4)3y2 [Hint: (1.4)3y2 5 (1 1 0.4)3y2] SECTION 8.6 4 66. x2 1 (y 2 2.5)2 5 6.25 12. 631–632 45. A 12, 3B 1 9 A 2, 2 B d. Area: 25 m2 Collinear 77. 2 97. {24} b. Then if the equation represents a circle, identify the center and radius. P(x) 5 R(x) 2 C(x) P(x) 5 2.00x 2 (0.50x 1 120) P(x) 5 1.50x 2 120 d. Yes c. (0, 23) e. {730} b. (2, 0), (4, 0) e. Determine the radius of the circle. For a certain district, a random sample of registered voters results in the distribution by political party given in the graph. Fixed cost: $2275 Variable cost per item: $34.50 Price at which the item is sold: $80.00 56. 2, 21, and 24 2. One makes $1200 and the other makes $1500. Show that 8 1 4 1 p 1 (24k 1 12) 1 [24(k 1 1) 1 12] 5 22(k 1 1)[(k 1 1) 2 5] 5 22k2 1 6k 1 8. Increasing. 1 1?2 1 n 5 2 1?2 1 n 5 3 1?2 1 n 5 4 1?2 n 5 1 TIP The proof of the statement 1 1 1 1 1p1 1?2 2?3 n(n 1 1) n 5 n11 is given in Example 2. P2 is true because 42 5 16 and (2 1 2)! 5 24. y 5 0 x 0 b. {ln 11}; x < 2.3979 e 3 ln 7 1 6 ln 2 R.1. {0} R.4. 1. See Stretch/shrink Simple interest application involving, 94–95 formula for, 95, 420 Simplification applying distributive property for, 12 of expressions of forms a1/n and am/n, 28–29 of expressions with exponents, 18–20 of imaginary numbers, 104–105 of nth roots, 28 of numerical expressions, 9–10 of radicals, 30–32 of rational expressions, 59–61 of special case products, 40–41 Singular matrix, 605, 606 Slant asymptotes, 352–353 Slope explanation of, 198–199, 201 formula for, 199 method to find, 199–200 of parallel lines, 214–215 of perpendicular lines, 214–216 writing equation of line given point and, 202 Slope-intercept form explanation of, 201, 275 to graph a line, 201–202 system of linear equations in, 497 use of, 213 Solutions to equations, 82, 86, 169 extraneous, 137 to inequalities in two variables, 536–539 to systems of linear equations, 492–493, 556 to systems of nonlinear equations, 527 Solution sets of equations, 86, 169 of inequalities, 145–151, 205 of linear inequalities, 536 of systems of linear equations, 492 Special case products identifying and simplifying, 40–41 involving complex numbers, 109 involving radicals, 43, 74 Square. Relation: {(8, 92), (3, 58), (11, 98), (5, 72), (8, 86)} b. f (x) 5 x 1 4 81. In an isosceles triangle, two angles are equal in measure. Center: (0, 25); a. 22 c. These operations cause a distortion of the graph (either an elongation or contraction in the horizontal or vertical direction). a 12a b 3 n51 5 ` 5 19. • The graph of the equation is symmetric with respect to the x-axis if substituting 2y for y in the equation results in an equivalent equation. Is n(2x) 5 2n(x)? 8 7 6 5 4 3 2 1 1 25 24 23 22 21 21 22 60,000 Amount in Bonds 3 4 Problem Recognition Exercises, p. 188.9 cm/sec 61. • The value of d is the difference of any term after the first and its predecessor. π 6 b. Vertical b. h b. Vertices: (1, 4), (21, 4) Foci: (3, 4), (23, 4) y 5 2 12x 1 4 and y 5 22 12x 1 4 85. 1, 28, 27, 264, ... 1?2 1?2?3 1?2?3?4 1?2?3?4?5 , , , , p 2 4 6 8 56. The height of the stone can be modeled by h(t) 5 24.9t2 1 10t 1 100, where h(t) is the height in meters and t is the time in seconds after the stone is released. The point (21, 2) is graphed as an open dot, because the point is not part of the function. a n b(3) 5 5 n(3) 03 2 3 0 5 1 4 0 b. 6 5 4 3 (4, 3) 6 5 4 3 (25, 3) 2 1 25 24 23 22 21 21 2 1 1 2 3 4 5 x 27 26 25 24 23 22 21 21 22 22 23 24 23 24 1 2 x 3 (2, 21) For Exercises 73–74, an isosceles triangle is shown. (2`, 213] ´ [25, `) 47. 2x 5 6 36. Make a scatter plot of the data using age as the independent variable x and systolic pressure as the dependent variable y. 5! 8! 5 5 56 a. 68–72 1. Evaluate a Finite Arithmetic Series Consider the finite arithmetic sequence 1, 4, 7, 10, 13. The population growth rate for Australia is greater. Passes through (4, 26) and m 5 3. $44,000 33. See Least common denominator (LCD) Leading coefficient explanation of, 38 factoring trinomials with, 50 Leading term, 38, 302, 303 Leading term test, 302 Least common denominator (LCD), 62, 65 Least-squares regression line, 220–221, 276 Leonardo of Pisa (Fibonacci), 692 Like terms, 11, 12, 39 Linear algebra, 497 Linear cost functions, 217–218 Linear equations. g(x) 5 1x 1 2 17. Dylan invested $3000 in the risky stock, $7000 in the second stock, and $5000 in the third stock. 2 r(x) 5 (x 2 4)2 3 2 1 27. A card numbered between 5 and 10, inclusive, or a black card. 12, `2 c. SECTION 2.4 s s d 126. Using the "Auto" setting means that the table of values for X and Y1 will be automatically generated. f (x) 5 2 x 1 3 3 3 3 3 m5 81. How many passwords can be made if no digit or letter may be repeated? 21000 d. We can also reverse this process. 24 69. e 15. 180 Chapter 2 Functions and Relations • If c . a5 5 n(n 1 1) 2n 1 1 315 n11 n c3 5 24,192 49. The domain is [1, `). (See Example 6 and Figure 8-12) Find the probability that the card drawn is 49. £ 0 1 21 † 30 § x2 2 x3 5 30 0 0 0 0 f. a 5(2)j j51 ` 1 n21 72. The odd-numbered terms are negative, and the even-numbered terms are positive. P(t) 5 19e0.01735t; P(t) 5 22.9e0.00343t b. g(3) 5 3 2 4 5 21 Evaluate g(0) first. No 232 d 2 0.08 0.00 20.07 20.06 73. In this case, the x values represent the number of years since 1990, and the y values represent the median income in dollars. 10C3 5 120 37. and 23 g. < 0.36264 455 455 15C3 15C3 c. Rocco borrowed $1500 at r 3% and $3500 at 2.5%. 3c 28c2d3 1 c2 250d3 2 2d22c4d 2u21 2 w21 4u22 2 w22 Polynomial and Rational Functions Chapter Outline 3.1 Quadratic Functions and Applications 286 3.2 Introduction to Polynomial Functions 300 3.3 Division of Polynomials and the Remainder and Factor Theorems 316 3.4 Zeros of Polynomials 329 3.5 Rational Functions 345 Problem Recognition Exercises: Polynomial and Rational Functions 368 3.6 Polynomial and Rational Inequalities 369 Problem Recognition Exercises: Solving Equations and Inequalities 382 3.7 Variation 383 M eteorology and the study of weather have a strong basis in mathematics. 3 1 6i b. (h + h)(24) 61. 8 13. Determine Empirical Probabilities 3. (Source: Stanford School of Medicine,) Refer to the table for Exercises 75–82. Up to the left and up to the right; As x S 2`, f(x) S `, and as x S `, f(x) S `. For example, suppose that two variables, x and y, are related such that y is 2 more than x. y 5 4 3 2 23 y 67. Write the range. x 1 7 for x , 22 f (x) 5 • x2 for 22 # x , 1 3 for x $ 1 5. 1x 1 h 1 1 t 2 51. From the graph, the data appear to follow a linear trend. Passes through (22, 3) and is perpendicular to the line defined by 5y 5 2x. These antigens are denoted by A, B, and Rh. If an individual's blood contains either the A or B antigen, these letters are listed in the blood type. No function defined by y 5 f (x) can have two y-intercepts because the graph would fail the vertical line test. f 21(1) 5 0; f 21(2) 5 1; x 25 24 23 22 21 1 2 3 4 5 21 f 21(4) 5 2 x11 f(x) 5 ⎛ 13 ⎞ 23 25 24 23 22 21 21 22 2x 1 t(x) 5 3 25 24 23 22 21 21 22 y 2 8 7 p(x) 5 3x 2 4 2 1 6 5 4 3 2 1 b. 167 d 5 2(x2 2 x1) 1 (y2 2 y1) . y 5 0x0 2 1 2 y 5 0 23 0 2 15 2 1 y 5 0 22 0 2 15 1 0 y 5 0 21 0 2 15 0 0 21 y 5 0 0 0 2 15 21 1 x2 y Solve for y in terms of x. (See Example 9) 73. No vertical line intersects the graph in more than one point. 156 71. 5 43. 5k(3k2 1 7)(2k 2 1) 2 a. 6 23 39. Center: (3, 2) b. That is, if two exponential expressions with the same base are equal, then their exponents are equal. x2 1 (x 1 2)2 5 (2x 2 2)2 b. 240, 20, 210, 5, ... For Exercises 37–39, find the indicated term of a geometric sequence from the given information. Write an equation for g21(x). Use slope-intercept form to write an equation of the line that passes through the two given points. 1 21 x12 x21 x 2x 1 3 x Ax 1 B Cx 1 D 5 2 1 2 29. 5 37. 1) Vertical shrink (if 0 , a , 1) • Horizontal stretch/shrink y 5 f (ax) Horizontal shrink (if a . 23 [N b. 25 45. y 5 4 3 60 119. Australia: 26.9 million; Taiwan: 24.5 million c. 45. P(x) 5 R(x) 2 C(x) EXAMPLE 6 Subtract the cost to produce x items from the revenue brought in from selling x items. t 5 119. The graph of y 5 2f (x) is the graph of y 5 f (x) -axis. 21 5 1176 Skill Practice 9 The coach of a co-ed softball team must select 4 women and 5 men from a group of 7 women and 10 men to play in a game. f (x) 5 2(x 2 3)2 2 2 b. (1, 0) d. 5 15 15 9 15 14 21 13C5 1287 < 0.000495 2,598,960 1287 13C5 < 0.001981 5 (4) b. The graph of y 5 f A 12xB is the graph of y 5 f (x) stretched horizontally. 3 3 61. y 9 8 7 6 5 1 2 3 x (22, 21) f. 2y 5 4 Solution: Avoiding Mistake The graph of a linear equation is a line. an 5 n 5 2 9. Estimate the times and values of any relative maxima or minima on the interval (0, 20). 2.32 b. None of these 15. Assume that a i 5 i51 k11 Show that a i2 5 i51 1(1 1 1)[2(1) 1 1] . 2 3 3 8 1 1 1 b. 18, 6, 2, , ... 3 Solution: 2 a. 21 77. 54 1 36 1 24 1 16 1 ... 27. 24 (odd multiplicity), 23 (odd multiplicity), 21 (even multiplicity), 2 (odd multiplicity), 72 (odd multiplicity) 51. The mother and father in turn each have two parents and so on. Objective 4: Find the Value of an Annuity For Exercises 85–86, find the value of an ordinary annuity in which regular payments of P dollars are made at the end of each compounding period, n times per year, at an interest rate r for t years. s1 5 s2 2 ¢s 2 1 3 5 77. (25i)2 1 25 5 0 ✓ 2 a. (x 1 5a)(y 1 2c) 29. l 5 13 w 7 73. m 2 n 7. Parallel 33. y¿ 5 2 7. Dividend: 22x4 1 x3 1 4x 2 1; Divisor: x2 1 x 2 3; Quotient: 22x2 1 3x 2 9; Remainder: 22x 2 28 249 21. {(3, 2), (5, 22)} {(22, 0), (0, 4), (2, 0)} 35. 22 1 10i 2 1 i 3 12 121 1 i 133 59. 1 9. (x 2 4)2 1 (y 2 1)2 5 25 y b. The numerator and denominator share a common factor of x 1 2. 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 1 y 5 f(x) 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 x Mixed Exercises For Exercises 115–122, write a function that represents the given statement. a i51 i! 9 87. f (x) 5 15x3 2 53x2 2 30x 1 8 11. R(x) 5 100x c. Given x 5 0 y 0 2 4, 8. Vertices: A 12, 2B, A 112, 2B c. x 5 2 g. Show that P7 is true. Therefore, we might restrict the domain to the set of integers greater than or equal to 2. This observation leads to the vertical line test. The blood alcohol concentration rose by an average of 0.06% per hour during the first hour. 9k11 2 1 5 5 5 5 5 9 ? i51 k11 Show that a 1 5 (k 1 1). Find a Specific Term in a Binomial Expansion Consider the first four terms of the binomial expansion of (a 1 b)n. 1. b32 5 2303, b54 5 2567; Find b214. The exact distance is 4 110 units. Use the graph to solve the equation and inequalities. {17} 23. C(x) 5 34.5x 1 2275 b. Find all x such that f (x) 5 0. $550 67. Create Linear Functions to Model Data In many day-to-day applications, two variables are related linearly. {(2, 0, 4)} 1.5 22 5 22 5. The common difference is 2. Center: (27, 5); Radius: 2 Yes 5. f (6) f (x) f (23) f (23) b. {8, 2} 117 1 if 31. 4 b. a 18a b 3 n53 n54 (Hint: Evaluate the infinite sum from n 5 1 to infinity. greater than 1 3 1 3 7. The proof involves the use of mathematics that did not exist in Fermat's time, and for this reason mathematicians believe that Fermat did not have a simpler proof. Assume that all distances are in miles. 3(k 1 1) 5 3k 1 3. a1 5 8 and an 5 an21 2 3 for n $ 2. The function has relative minima of 3 ft and 3.5 ft at approximately 8 days and 18 days after recording began. 4 units2 105. Domain: (2`, `); Range: (2`, 8] 2 4 3 2 1 25 24 23 22 21 21 1 2 2 3 4 5 x 2 3 4 5 x 11. Write an expression for the apparent nth term an for the sequence. r (x) 5 2 12x 1 1 70. Then the value A (in $) of the annuity after t years is given by A5 p. (See Example 3) 25. 9 ? 1 1 1 1 1 x x 1 2 (x 1 2)2 (x 1 2)3 x2 1 2x 1 7 (x2 1 2x 1 7)2 21. Determine the distance 23 between the hikers. d1 5 30; dn 5 13 dn21 2 1 29. 2 21. Determine the y-intercept and interpret its meaning in context. Find a43. 65 19. The tile costs $3.50/ft2 and labor is $4.00/ft2. 1 F 25 24 23 22 21 21 22 35. For example, explain why 4, 16, ... can be arithmetic, geometric, or neither. f (x) 5 ax2 1 bx 1 c (a fi 0) b b2 b2 5 a ax2 1 x 1 2 2 2 b 1 c a 4a 4a Factor out a from the x terms, and complete the square within parentheses. a 1 3b 2 771 27. 3 ai 5 i51 n(n 1 1) 2 n2(n 1 1)2 4 Section 8.4 Mathematical Induction 729 In Examples 3 and 4, we use mathematical induction to prove statements that do not involve a sum. Determine the total amount spent. Is f (2x) 5 f (x)? 220 Chapter 2 Functions and Relations 4. 0 71. What is the probability that a live birth will not be of twins? Assume that 5 1 8 1 p 1 (3k 1 2) 5 (3k 1 7) (Inductive 2 hypothesis). 5 4 3 2 1 22 21 21 22 23 1 2 3 4 5 6 7 8 x p(x) 5 √x¯¯¯¯¯¯¯¯ 2322 24 • The point (0, 0) on the graph of f corresponds to (0 1 3, 0 2 2) 5 (3, 22) on the graph of p. f(x) 5 4 f(x) 5 3 2 1 23 22 21 21 22 23 2 3 4 5 6 7 m(x) 5 1 2 (x 1 4) 55. h(22) b. Find the 500th term. Choose a different pair of two equations from the system and eliminate the same variable. b 65. No two ordered pairs have the same x value but different y values. 9 3 43. Identify Subsets of the Set of Real Numbers 1. For i 5 121, find the first eight terms of the sequence defined by an 5 1 2 in. The person is between 31 and 60, inclusive, or has elevated cholesterol. (g + f)(5) c. ft 16 8 6 4 21221028 26 24 22 22 F 24 26 2 F 4 3 2 1 11. Determine the maximum height of the object. 57. Skill Practice 2 Write an equation of the line passing through the points (2, 25) and (7, 23). y 5 x3 36. Count Combinations Consider the situation in Example 5 in which 5 students are selected for 2 scholarships. 23 24 17 y R.3. R.1. 1. f (x 1 4) 5 25 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 x22 x25 x 5 32. y $ 0 x 0 and y # 4 87. n(x) 5 x2 2 0 x 0 1 1 c. 387–391 A IR 3V R.2. h 5 2 R.3. E 5 R.4. {18} Pt K πr directly 3. The sum of the first n terms of the sequence is called the nth partial sum and is denoted by Sn. In this case, we have S1 5 1 51 S2 5 1 1 4 55 S3 5 1 1 4 1 7 5 12 S4 5 1 1 4 1 7 1 10 5 22 S5 5 1 1 4 1 7 1 10 1 13 5 35 TIP The sum of the first n terms of an arithmetic sequence is called a finite arithmetic series. i51 k 2. How many codes can be formed if the corresponding 3-digit number is to be a multiple of 5 and there can be no repetition of digits? x f (x) 5 Œ xœ 21.7 22 Greatest integer less than or equal to 21.7 is 22. Find the sum of the first 100 positive integers. p 5 6 b. 683–685 5. 5 6 6 2 21x2 2 12 Apply the distributive property. 4 c. Objective 2: Determine the Slopes of Parallel and Perpendicular Lines For Exercises 23–28, the slope of a line is given. For example, the expansion of (a 1 b)4 has five terms. f (24) d. e < 0.78 902 143.52 2 2 y x 1 51 d. Graph the line by using the slope and y-intercept. The composition of two functions creates a new function in which the output from one function becomes the input to the other. a (21)k a b 5 c (21)3 a b d 1 c (21)4 a b d 1 c (21)5 a b d 1 c (21)6 a b d k 3 4 5 6 k53 1 1 1 1 52 1 2 1 3 4 5 6 7 52 60 6 c. How many codes can be formed if the corresponding 3-digit number is to be an even number? 0.4(c 1 2) c. 4, 6, 9, 5. c(x) 5 22x 2 10x 1 4 y 2 2 18 15 h. 2 166 ft3 19. It appears that the triangle was rotated approximately 308 counterclockwise. 0 7. On a calculator or spreadsheet, the equation y^ 5 mx 1 b may be denoted as y 5 ax 1 b or as y 5 b0 1 b1x. EXAMPLE 9 Finding the Probability of Independent Events In baseball, a player's batting "average" is the quotient of the number of hits to the number of "at bats." It can also be interpreted as the probability that the player will get a hit on a given time at bat. Is the operation of function composition commutative? (2`, 23) ´ (4, `) (2`, 23] ´ [4, `) d. We use this important concept in Example 2. R.1. (5v 1 2)2 R.2. A8a2 2 9b3 B 2 2 1 R.4. a m 1 2b 5 R.5. (4a 2 3b)3 R.3. A4x 1 115B 2 Concept Connections 1. a2 , 2 b 2 4 2 4 29 1 213 29 2 213 c. Therefore, n(E3) 5 36 and n(E3) 36 18 5 5 < 0.9474. Kaplan RF. t(0.4) e. Square root function: f (x) 5 1x f(x) 2 y y 24 25 x 0 1 4 9 16 1 4. Piecing together the data requires a variety of techniques of mathematical modeling using powerful computers. 2i 13 a. (0, 25) 2 y e. This sequence is called a geometric sequence. m 5 and b 5 24 85. 0 x 0 5 0 y 0 2 57. The graph of f is shown in Figure 3-4. sum and is denoted by Sn. 6. p(x) 5 0 x 2 3 0 2 1 16. The data in the graph show the wind speed y (in mph) for 200 Hurricane Katrina versus the barometric pressure x (in millibars, mb). f (x) 5 (x 1 1) Ax 2 13B Ax 1 13B 105. 2 5 (3x 2 y) 15P3 59. This is called a counterexample. Write the first four terms of an arithmetic sequence with first term 8 and common difference 23. 7 and 3 2 2 1 1 21. Expression; 15y 2 38 5. Vertices: (0, 50), (10, 20), (20, 0) y y 60 50 Chapter 5 Review Exercises, pp. To find the number of terms n, substitute 5120 for an. Denominator always positive (never zero) c. The range is [21, `). x x13 b. A bicycle wheel turns at a rate of 80 revolutions per minute (rpm). an 5 e 14. We sketch this function only for x values on the interval 21 # x , 2. x 1 1 b. Will we approach some finite amount of pie? Equivalently, 5k 5 2a 2 1. 689: © Image Source/Getty RF; p. 5 4 3 2 Skill Practice 7 Graph the function. 243(right): © McGraw-Hill Education; p. Point of Interest boxes that offer interesting and historical mathematical facts. 2x 2 2 2x2 2 y2 97. 0 F1 0 5 50A 13 2 1B lb < 36.6 lb and 0 F2 0 5 25 12A3 2 13 B lb < 44.8 lb 97. Julie Miller donna gerken Dedications   o my parents Kent and Joanne Miller who have always taught me the value of education. 22 1 1 49. Another method to define this set is by using set-builder notation. c d 0 bd 0 14 97. is an arithmetic sequence with common difference 2d. 4 3 4 24 25 Skill Practice 5 Evaluate the function for the given values of x. C(x) 5 mx 1 b m is the variable cost per item. 3 good batteries can be selected. A(s) 5 s2 2 P P2 c. Slope-intercept form The slope is the coefficient on x. For Exercises 44–47, use the data in the table categorizing the type of payment used at a grocery store according to the gender of the customer. f (x) 5 2 1x 1 3 24 for x , 22 9. The graph in Figure 2-10 is shown between x and y values from 210 to 10. A slot machine in a casino has three wheels that all spin independently. 8 31. f (x) 5 2x3 1 1 101. If José anticipates working for the company for 6 yr, find the total amount he would earn from each job. Determine Theoretical Probabilities 1. (26C6) (30C6) ? Write the nth term of an arithmetic sequence with a1 5 4 and a5 5 28, and then find a2, a3, and a4.) 82. 10. (f + f)(21) 109. d1r2 5 2r b. y 9 8 7 6 5 4 3 2 x ⎝ ⎠ 1 x 3 4 5 x y 16 14 12 10 8 6 4 2 1 y 5 f21(x) 2 21. www.mhhe.com About the Authors Julie Miller is from Daytona State College where she has taught developmental and upper-level mathematics courses for 20 years. 17 3 111. {21.5} 63. Use a recursive formula to find the amount in the account an in terms of an–1 for each subsequent year, n $ 2. pp. 5 35. t $ 0 5. 10 210 210 1 1 1 2 5 x 25 24 23 22 21 21 22 3 y 5 5x 1 2 1 2 3 4 5 23 24 25 24 25 3. If the interest rate is 5%, find the value of the annuity after 18 yr. x 246 Chapter 2 Functions and Relations Skill Practice 3 Determine if the function is even, odd, or neither. a b 2 5 10. (8.5, 6.2) and (25.1, 7.9) 30. The series a ai 5 a1 1 a2 1 a3 1 p i51 is called an infinite series because there are an infinite number of terms. y 5 f (2x) 5 4 3 2 5 4 3 2 y 5 f(x) 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 x y 5 g(x) For Exercises 51–54, use the graphs of y 5 f (x) and y 5 g(x) to graph the given function. 237 265 b. As x S 2`, f(x) S `, and as x S `, f(x) S 2`. The graph of g(x) 5 20 x 0 has 14. y 5 23.27x 1 98.1 b. n p 1 can a cai 5 ca1 1 ca2 1 ca3 1 i51 5 c(a1 1 a2 1 a3 1 p 1 an) Expand the terms in the series. Minimum degree 6 b. Given m(x) 5 4x2 1 2x 2 3, find m(2x). The second part involves proving that if any statement Pk in the sequence is true, then the statement that follows is also true (Pk implies Pk11). X 5 c d 17. 5.01 3 1023 mol/L 83. 1506 11. Given g(x) 5 5x 2 1, a. The center is (4, 6) and the circle is tangent to the y-axis. If the sequence is geometric, find the common ratio r. {(1, 24, 3)} 9. {23, 4} 19. 4x 1 4h 2 2 b. The ball lands on a number that is a multiple of 5 (do not include 0 and 00). {(210, 1, 0, 1)} SA-36 Student Answer Appendix 61. x 5 2 y or y 5 2 x for 245 # x # 45 4 135 135 b. Then estimate the location of the fire. y 5 2t2 1 1 103. The shell will explode 6.75 sec after launch. The graph of y 5 f (3x) is the graph of y 5 f (x) with a (choose one: vertical stretch, vertical shrink, horizontal stretch, horizontal shrink). 9.7385 d. Endpoints of minor axis: (1, 22), (1, 210) d. (5c3 2 d2)4 D 81. ax 1 by 5 c Evaluate x2 1 4x 1 5 for x 5 25 Concept Connections 1. The solution set is {3}. A cable company advertises short wait times for customer service calls. x 5 2 or x 5 4 b. (2`, 28 4 ´ 3 2, `) 51. To find a9 substitute n 5 9. a10 5 3 6 2 27. Therefore, the sequence a1, a3, a5, ... is geometric with common ratio r 2. A 5 c 22 3 3 0 0 d b. 1 5 1 1 5 < 0.0000305 73. a , ha 2a 2a b. The yearly salary for job B is $56,000 for year 1 with an annual raise of 6%. The graphs have the shape of y 5 0 x 0 but show a vertical shrink or stretch. Yes d. Graph b 18. x2 1 (x 1 1)2; 2x2 1 2x 1 1 63. We have 1 1x 2 2 2 5 1 (m + p)(x) 5 1x 2 2 2 5 5 Answers 7. Putting the time and effort into the basics here in Chapter R will be your foundation for success in later chapters. However, if c 5 0, or if c , 0, the graph will be a single point or nonexistent. 60 p 1 [3(60) 1 5] a (3i 1 5) 5 [3(1) 1 5] 1 [3(2) 1 5] 1 [3(3) 1 5] 1 5 8 1 11 1 14 1 p 1 185 i51 The individual terms in the series: 8, 11, 14, ... , 185 form an arithmetic sequence {an} with a common difference of 3. Then highlight Calculate and hit ENTER. a a 2b2 . Finally, for each custard-syrup arrangement, there are 2 toppings. a4 2 b4 c. A pediatrician records the age x (in yr) and average height y (in inches) for girls between the ages of 2 and 10. 1 3 1 83. (See Examples 2–3) 37. x 3. 0 55 29. £ 1 0 1 5 1 4 22 23 † 1 § 1 2 0 2. y 5 13 6 x 2 13 2 and y 5 2 13 6 x 1 e. hexagon (6 sides) 72. How many 5-number groups are possible? Vertex: (26, 3); p 5 5; Focus: (26, 8); Focal diameter: 20 b. (m + n)(x) 68. {(1, 1)} {(0, 9), (23, 0), (3, 0)} 31. Given f 5 {(3, 21), (1, 5), (22, 4), (0, 4)}, a. cn 5 5n 2 4; find c157 20. 26 x 1 e. y 5 1x 34. Center: (0, 22); Vertices: (0, 4), (0, 28); Foci: (0, 8), (0, 212); Asymptotes: y 5 34x 2 2 and y 5 234x 2 2; Eccentricity: 53 1 2 3 4 5 6 7 x y 8 F 6 4 2 21028 26 24 22 22 24 26 28 210 212 2 C F 4 6 8 10 x SA-45 Student Answer Appendix y b. Section 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions Skill Practice 6 f (x2 5 e 249 Graph the function. (f 1 g)(4) 104. 10 8 6 4 5 4 3 2 2 1 2 3 4 5 6 7 8 9 x 2162142122102826 24 22 22 24 1 2 4 x 25 24 23 22 21 21 22 23 26 23 24 25 24 25 28 210 24 25 y 48. 0 1 8i 4 3 33. [220, 20, 2] by [240, 40, 10] b. With C 5 A and completing the square, the equation Ax2 1 Cy2 1 Dx 1 Ey 1 F 5 0 becomes Ax2 1 Ay2 1 Dx 1 Ey 1 F 5 0 D E F x2 1 y2 1 x 1 y 1 5 0 A A A E 2 D2 E2 F D 2 b 1 ay 1 b 5 21 22 ax 1 2A 2A A 4A 4A D 2 E 2 D2 1 E 2 2 4AF ax 1 b 1 ay 1 b 5 2A 2A 4A2 This is the standard form of an equation of circle with center D E 2D 2 1 E 2 2 4AF a2 , 2 b and radius provided 2A 2A 2A 2 2 D 1 E 2 4AF . An employee invests $400 per month in an ordinary annuity. an 5 a1 1 (n 2 1)d an 5 2 1 (n 2 1)(2) an 5 2n a50 5 2(50) a50 5 100 n (a1 1 an) 2 50 (2 1 100) S50 5 2 S50 5 2550 Sn 5 General expression for the nth term Substitute a1 5 2 and d 5 2. 12 people 32 A 41. a 10 10 10. a i 5 a (j 1 1) 5 a (k 2 1) 2i i51 i51 17. 50 b. 2 for x # 21 22x for x . Center: (0, 2.5); Radius: 2.5 3 3 9 13. Singular matrix 21 23 5 26 17. 21 2. 22(22x 1 3)2(4x2 2 5)(28x2 2 24x 2 15) 25. Assume that xk . e 0, 625 f 16 fq 103. In how many ways can four students be selected to take part in a survey? The expression n! (read as "n factorial") is defined as n! 5 (n)(n 2 1)(n 2 2) ??? Notice that each y value on f 1 g is the sum of the y values from the individual functions f and g. Quadratic function: f (x) 5 x2 (graph is a parabola) x 22 21 0 1 2 y y y x TIP 2. Write the solutions to the inequalities in interval notation. 21 23 3 Section 4.3 Practice Exercises, pp. If the leading coefficient is negative, the graph will be down to the far left and down to the far right. y 6 5 4 3 2 1 25 24 23 22 21 21 g(x) 5 2x 1 1 1 2 3 4 5 x 22 23 24 Skill Practice 5 Evaluate the function defined by h(x) 5 4x 2 3 for the given values of x. m(x) 5 • 2x for 21 # x , 3 1x 2 3 for x $ 3 24 for 23 , x , 21 for 21 # x , 2 70. These equations represent the top and bottom semicircles. f (x) 5 x3 2 2 43. Two adjacent angles form a right angle. 4C3 5 4 b. Explain the difference between the graph of an 5 n2 and f (x) 5 x2. Domain: (2`, `); 12 9 33 6 Range: a2`, d 3 2 x 27 26 25 24 23 22 21 1 2 3 2 3 26 29 212 7 49 7 2 49 b. P ¨ Q b. $1958.88 45. (3P3) 5 1728 Section 8.7 Practice Exercises, pp. 27 28 b. Male Female Total Yes No 92 7 4 103 36 102 24 162 128 109 28 265 P(N or F) 5 P(N) 1 P(F) 2 P(N ¨ F) 5 162 102 109 1 2 265 265 265 162 102 P(N) 5 109 265 , P(F) 5 265 , and P(N ¨ F) 5 265 5 169 265 The 102 females who answered "No" are the elements in the intersection of N and F. 6 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 1 25 24 23 22 21 21 22 23 2 3 4 5 1 2 3 4 5 x 23 24 25 24 y 89. 113. Relative maximum of 3.726 at x 5 0.667; Relative minimum of 22.625 at x 5 22.500 10 10 210 10 210 210 10 210 b. A molasses cookie is selected. 8t12 2 36t8 v 1 54t4 v2 2 27v3 From the observed pattern, the kth term has a factor of b raised to the k 2 1 power. { } (x 1 3)2 1 (y 2 1)2 5 4; Center: (23, 1); Radius: 2 1x 2 112 2 1 1y 1 32 2 5 1; Center: (11, –3); Radius: 1 x2 1 (y 2 10)2 5 104; Center: (0, 10); Radius: 2 126 (x 2 4)2 1 (y 1 10)2 5 24; Center: (4, 210); Radius: 2 16 (x 2 2)2 1 (y 2 9)2 5 24; Degenerate case: { } 5 2 5 51. There are no values for x, y, and z that can simultaneously meet the conditions of this problem. (x 1 12)2 1 (y 1 9)2 # 256 b. (3, 7, 22) and (0, 25, 1) d z2 – z1 P(x1, y1, z1) x2 – x1 86. Skill Practice 2 Determine whether the graph is symmetric with respect to the y-axis, x-axis, or origin. (23, 0) d. {(2, 23)} { }; The system is inconsistent. 2, x ? At x 5 22, the function has a relative maximum of 3. The graph defines the set of ordered pairs: {(23, 24), (21, 3), (0, 1), (2, 4), (4, 4)} Domain: {23, 21, 0, 2, 4} Range: {24, 1, 3, 4} The domain is the set of x values. • The graph of y 5 f (x) 1 k is the graph of y 5 f (x) shifted k units upward. The number of arrangements of letters and digits is given by the product of the number of outcomes for each character. Furthermore, since k $ 4, 3k . Point of Interest The movie Apollo 13 starring Tom Hanks was filmed in part in a "Vomit Comet," an aircraft that uses a parabolic flight trajectory to produce weightlessness. 188 • The x-intercepts are the real solutions to f (x) 5 0. {(5.35, 41.71, 4.45)} R.1. 1 4 3§ ✓ 24 15. Identify the x-intercepts of the graph of f. The annuity pays 6% annual interest compounded monthly. x 1 y # 9 b. Yes 69. 2 real solutions 1Aπ A or r 5 103. a , 6b and a , 1b 4 2 36. If the employee invests $100 per month in the annuity at 6% interest, find the value after 40 yr. 1 3 4 1 15. [21, `) a. Simplify the rational expression. Round to 3 decimal places when necessary. 2282242202162122824 26 212 218 x 230 236 5 4 3 2 5 4 3 2 3 4 5 224 17. 81 2 x2 23 7 222 161 94 3 75. Write the expression in terms of log x, log y, and log z. Apply the Binomial Theorem 3. g(t) 5 1 52t c. x 5 11.2 ft and y 5 7.5 cm 49. 3 129. [x 2 (23 1 2i)][x 2 (23 2 2i)](4x 1 1)(x 2 1)(x 1 4) 1 c. 5 4 3 2 2. Find the first eight Lucas numbers. x-intercept: (29, 0); y-intercepts: (0, 3), (0, 23) y 8. 16, 0, 28, 1.45, 19, 2 , 3π 3 3. The set of all possible outcomes of an experiment is called the sample space of the experiment. gA 13 B 42. 3(2x 1 1) 24x5 18. The ball lands on a black slot. Write an expression for the distance between t and 5 on the number line. 16 2 44. This implies that 7k 2 5 5 2a and that 7k 5 2a 1 5 for some positive integer a. Ax 2 15B Ax 1 15B Ax 1 17iB Ax 2 17iB 111. 491: © Michael Hitoshi/Getty RF; p. 4n for positive integers n $ 6. f (23) 5 (23)2 1 2(23) 5 3. There are 8 horses that can cross the finish line first. 5 4 3 2 The domain is shown on the x-axis in green tint. I 5 a 2CL The right side of the equation is not equal to zero. x11 3m4 47. 5 10 e. EXAMPLE 6 Using Summation Notation Write the terms for each series and evaluate the sum. Therefore, A 32 B k11 . No 1 c 16 212 1 6 5 d 12 0 5 £ 1 23 21 21 21 51. This is because the point (1, 2) is not included in the graph of the function as denoted by the open dot. That is, if domino 1 falls, and any falling domino makes the next domino in line fall, then all the dominos will fall. Round the slope to 2 decimal places and the y-intercept to 1 decimal place. Let Pn be the statement a 1 5 n. 14 30 420 ? h(x), the function is not even. (2`, 23] ´ [6, `) 59. 211 2 7i 67. a b 0 5 b. a 67. Suppose that a player is located at point A(460, 420) and must move in a direct line to point B(80, 210) and then in a direct line to point C(120, 60) to pick up prizes before a 5-sec timer runs out. If the interest rate is 5.2%, find the value of the annuity after 25 yr. y x 26 25 24 23 22 21 21 22 23 23 24 25 24 25 b. Center: (4, 22) e. 80 150 P(x) 5 1.50x 2 120 100 50 (80, 0) 0 40 80 120 160 250 Profit 5 0 2100 for x 5 80 2150 Number of Lemonades Produced and Sold Profit ($) Cost/Revenue ($) Revenue , Cost Revenue . 4 3 2 1 C(0, 21) 2 4 6 8 10 x 24 23 22 21 21 22 F F F C(3, 2) 1 2 3 4 5 6 x 23 24 25 (y 2 6)2 (x 1 2)2 1 51 5 3 Center: (22, 6); Vertices: A22 2 15, 6B; A22 1 15, 6B Endpoints of minor axis: A22, 6 1 13 B, A22, 6 2 13 B Foci: A22 2 12, 6B, A22 1 12, 6B (y 2 1)2 (x 2 5)2 1 51 6 9 Center: (5, 1) Vertices: (5, 4), (5, 22) Endpoints of minor axis: A5 1 16, 1B, A5 2 16, 1B Foci: A5, 1 1 13 B, A5, 1 2 13 B (y 1 7)2 51 x2 1 4 Center: (0, 27) Vertices: (0, 25), (0, 29) Endpoints of minor axis: (21, 27), (1, 27) Foci: A0, 27 1 13 B, A0, 27 2 13 B Ax 2 52 B 2 (y 1 4)2 1 51 25 9 5 Center: A 2, 24B Vertices: A 152, 24B , A252, 24B Endpoints of minor axis: A 52, 21B, A 52, 27B Foci: A 132, 24B , A232, 24B y2 (x 2 1)2 1 51 1 1 4 9 2 y x 1 51 16 7 (y (x 2 2)2 47. B ´ C 5 {x 0 x , 2 or x $ 4} f. a number that is a multiple of 10? Evaluate d(2) and interpret the meaning. 14 Section R.5 Practice Exercises, pp. Use the graph of y 5 f (x) to a. 10x2 1 10y2 2 80x 1 200y 1 920 5 0 (Hint: Divide by 10 to make the x2 and y2 term coefficients equal to 1.) 48. {21, 7} or P52 24. g(x) 5 1x 2 2 c. (2`, 22) ´ (2, `) b. y 5 x2 2 2x y 8. an 5 2n; 1 # n # 12 j50 19. and d. 23 5 28 1 b b55 y 5 mx 1 b y 5 24x 1 5 5 4 1 y 5 22 x 1 2 3 2 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x We need to find an equation of the form y 5 mx 1 b. For example: f(x) 5 x3 1 25 24 23 22 21 21 22 1 2 3 4 23 5 x The point (0, 0) on the graph of f (x) 5 x3 corresponds to (0, 2) on the graph of h(x) 5 x3 1 2. {(0, 1), (2, 5)} E(3, 1), 25. 3 3 3 3 (a 1 b)3 5 a ba3 1 a ba2b 1 a bab2 1 a bb3 0 1 2 3 3 3 3 3 [3x2 1 (25y)]3 5 a b(3x2)3 1 a b(3x2)2(25y) 1 a b(3x2)(25y)2 1 a b(25y)3 0 1 2 3 5 1(27x6) 1 3(9x4)(25y) 1 3(3x2)(25y2) 1 1(2125y3) 5 27x6 2 135x4y 1 225x2y2 2 125y3 Skill Practice 4 Expand by using the binomial theorem. 2 ; a ? 19 b. 4 2 2(x 1 1) 1 12 1 x . 924h24 4 1 13,608 p12q5 41. origin 9. 41 2 840i n n! and a b5 r! ? (p ? 2.3 , t , 17.7 sec 33. (21, 5), (0, 3), and (5, 213) Write About It 79. [21, `) 59. 575,757 b. e 1, 2 f 6 7 4 95. The center is (25, 3), and the radius is 19 5 3. Section 2.6 231 Transformations of Graphs y b. (See Examples 3–4) 37. 90 9 150 15 93. x2 1 y2 2 4x 2 18y 1 89 5 0 50. (15 2 3)! 3! ? No horizontal asymptote 4 b. n n n 95. The speed of the plane in still air is 420 mph and the speed of the wind is 60 mph. 101 The points M, P, and Q do not form the vertices of a right triangle. Write an expression S2(x) that x represents the area of the semicircle. 236 Horizontal translation (shift) Horizontal and vertical stretch and shrink Reflections across the x- and y-axes Vertical translation (shift) SECTION 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions Consider the graph of an equation in x and y. Does this relation define y as a function of T? 6 d 212 25 20 21. The weather was rainy during intervals of increasing depth. 1 1 2 b. 1 3. 16x2y 2 4xy2 2 85. g(x) 5 x (x13 2x 2 5 The variable x has the restriction that 2x 2 5 ? 6 Let Pn be the statement 2 is a factor of 5n 2 3. Doctors in a certain city report 24 confirmed cases of the flu to the health department. p(x) 5 2x 1 1 b. † 23 2 1 † 5 0 b. 24 hr b. The bottom row has 15 cups. Likewise, if we solve for y, we have y 5 k 6 2r 2 2 (x 2 h)2. Apply the quadratic formula. (2`, 2] ´ (3, `) 57. the truth of 2. For example, if an x-intercept is (24, 0), then the x-intercept may be stated simply as 24 (the y-coordinate is understood to be zero). Interchange rows 2 and 3. Az2 1 6B Az 1 16B Az 2 16B 2 Ax 2 15B 107. (22, 21) c. The value 1 is called the limit of i51 summation. Therefore, Y1 5 Y2 for x 5 2. f (6) 79. origin 5. 2n is true for all integers, n $ 4. (Hint: Refer to Figure 8-12 from page 755.) Student Answer Appendix CHAPTER R Section R.1 Practice Exercises, pp. a , b b. According to the Centers for Disease Control, the probability that a live birth will be of twins in the United States is 0.016. In each case, determine if the relation defines y as a function of x. 1, 22 (multiplicity 2) 4, 22, and 222 (1, 0) and (22, 0) 12. s(x) 5 2 12x 2 2 71. The bounding line would be 1 x dashed and the graph would be 24 23 22 21 1 2 3 4 5 6 21 shaded strictly below the line. 78.32 ft/sec c. Graph J Section 4.4 Practice Exercises, pp. 22 58. 2800 yr a. Graph y 5 2f(x 2 1) 1 2. f(x) 5 1x 2 2 84. A(23, 24) 5 7 Ba , b 3 4 C(21.2, 3.8) D(π, 25) E(0, 4.5) FA 15, 0B 10. (0.16)4 < 0.000655 SECTION 8.7 Practice Exercises Prerequisite Review R.1. Given: P 5 {a, b, c, d, e, f, g, h, i} and Q 5 {c, f, h, o, u} List the elements of the following sets. y 5 12x1 1 4x2 1 4000 d. a b(3) g f. Interpret the results from parts (a) and (b). (0.1 1 0.3m)4 3 c 27. This contradicts the definition of a function. The relation contains the ordered pairs (1, 2) and (1, 3). Time 0.10 f(x) (2.5, 0.095) BAC (%) 0.08 (2, 0.09) 0.06 (1, 0.06) 0.04 0.02 (0, 0) (8, 0.02) 1 3 2 4 5 Time (hr) 6 7 8 x 9 Figure 2-18 A line drawn through two points on a curve is called a secant line. Positive: 3 or 1; Negative: 2 or 0 12. a2`, d ´ [5, `) 5 3 2 2 3 3 47. 361–367 R.1. R.3. 1. 1 5 6 EXAMPLE 3 4! 5 4 ? an 5 5(20.8)n c. We can use a similar process to find the sum Sn of the first n terms of an arithmetic sequence: a1 1 a2 1 a3 1 ... 1 an21 1 an. Sn 5 EXAMPLE 6 Evaluating a Finite Geometric Series 1 i21 4a a 2b i51 6 Find the sum. [(3P3) ? (8, 40) 33. 2053 yr 25. 36 1 29 1 22 1 15 1 ... 1 (2419) 41 4 16. y 5 f 1 12x2 81. n i51 n 103. x 5 y 2 1 58. Find the value(s) of x for which f (x) 5 6. Recall that the Fibonacci sequence can be defined recursively as F1 5 1, F2 5 1, and Fn 5 Fn21 1 Fn22 for n $ 3. 16 9 , 24, 3, 2 , ... 3 4 1 1 27. 585 (computer): © Jeffrey Coolidge/Photodisc/Getty RF; p. (2x 2 3)5 B A F E 62. abc 73. f (x2) for all x1 , x2 on I. 1 15! 15 ? Round the slope to 1 decimal place and the y-intercept to the nearest whole unit. (7, 23) and (4, 1) 78. {7, 21} 59. 7 1 1 a. If f is defined on the interval [x1, x2], then the average rate of change of f on the interval [x1, x2] is given by the . If the applicants are equally qualified, find the probability that both positions are filled by women. Day Number d 2 24 25 103. The statement f (4) 5 1 corresponds to what ordered pair? g(x) 5 2 1x 43. h(t) 5 12 2 t Solution: The domain is all real numbers except those that make the denominator zero. The graphs have the shape of 12. a aibi 5 a ai a bi i51 i51 i51 a ai i51 n a bi i51 99. 1 2 3 4 5 1 20.05 14 25 24 23 22 21 22 21 Section 3.3 Practice Exercises, pp. m(x) 5 1x a. The intercepts (1, 0), (21, 0), and (0, 21) are consistent with the graph of the equation y 5 0 x 0 2 1 found in Example 4 (Figure 2-8). Explain how the fundamental principle of counting or the permutation rule can be used to determine the number of first-, second-, and third-place arrangements. h(x) 5 (x 2 4)2 120. y 5 f(x) 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 y 5 2f(x) 5 x 236 Chapter 2 Functions and Relations Transformations of Functions Consider a function defined by y 5 f (x). (0, 0), (4, 0) b. Not a real number 77. successinmath.com xii Quality Content For Today's Online Learners Why SmartBook? Use the points (21, 118) and (51, 130) to write a linear model relating y as a function of x. (2`, 24) ´ (21, `) d. By the inductive hypothesis, [1 1 5 1 p 1 5k21] 1 5(k11)21 5 14(5k 2 1) 1 5k 5 145k 2 14 1 5k 5 54 ? Find (T + C)(x). 0 A 0 5 0. Evaluate (T + C)(10) and interpret the meaning in context. r k ! p. • The Classroom Activities using Wolfram Alpha promote active learning in the classroom by using a powerful online resource. a 22a b 4 n51 ` 1 n 24. SA-41 Student Answer Appendix 79. No. There is no guarantee that the linear trend continues outside the interval of the observed data points. 21 3 1 f. A5, 52 B, A25, 52 B d. So one natural choice for g and f would be: g(x) 5 x 2 3 Function g subtracts 3 from the input value. In how many different ways can a student fill out the answers to the quiz? {x 0 22 # x , 7} c. Refer to the data given in Exercise 66. Compose and Decompose Functions P(x) 5 R(x) 2 C(x) As this example illustrates, the difference of two functions makes up a new function. Show that this sequence is arithmetic. Positive: 0; Negative: 4, 2, or 0 Positive: 0; Negative: 0 57. The function given by y 5 f(x) shows the average monthly temperature (in 8F) for Cedar Key. Use the model from part (a) to approximate the average for a student who misses 6 classes. [0, 730) c. False 105. Directrix: y 5 1; 22 23 Axis of symmetry: x 5 0 24 x 25 26 27 29. 3 1 7 1 11 1 p 1 (4n 2 1) 5 n(2n 1 1) n 54. {Dara Torres, Carl Lewis, Bonnie Blair,

Michael Phelps} c. 69 min (1 hr 9 min) 79. The first expression simplifies to 6, and the second expression simplifies to 1. Note: C 12(10)D 2 5 25, C 12(26)D 2 5 9 Factor. 26 0 31. 2h(x) 5 24x3 1 2x c. 1 1 1 1 2 1 1 3 3 1 1 4 6 4 1 1p p. Find (g + h)(x) and state the domain in interval notation. If P(A) 5 0.431, what is the value of P(A)? Assume that 2 is a factor of 5k 1 1. 0 2 3 4 5 x 81. The sum of the numbers on the dice is 12. Finally, the plane's altitude decreases for the last 40 min, so we say that f is decreasing on the interval (120, 160). Assume that 2 1 6 1 p 1 (4k 2 2) 5 2k2 (Inductive hypothesis). Skill Practice 11 In Example 12, we have the graphs of two functions, and we apply function addition, subtraction, multiplication, and composition for selected values of x. Window b is better. r(t) 5 80t b. Suppose you are helping a friend with the homework for this section. (0, 12) ´ (68, 184) b. While on vacation in France, Sadie bought a box of almond croissants. Identify x- and y-Intercepts y When analyzing graphs, we want to examine their most important features. 1, 8, 64, 640, ... Example 2 illustrates the fundamental characteristic of a geometric sequence; that is, each term of a geometric sequence is a constant multiple of the preceding term. C 5 7x b. Vertex: (2, 0); Focus: (2, 24); Endpoints of latus rectum: (10, 24), (26, 24) Directrix: y 5 4; Axis of symmetry: x 5 2 12 10 F y 8 7 6 5 x y C(23, 2) p 5 32 b. n 5 1 1 2 ; am 1 b 81 9 41. Find (f + g)(x). 3 47. Center: (26, 2); Radius: 3 1 3. Therefore, the total number of passwords is given by There are 26 choices for each letter. A probability computed in this way is called an empirical probability. (x 1 3)2 1 (y 2 5)2 5 0 18. False 15. The minimum value is 21. R 35. Maximum: e. x11 3x 2 2 A C D Gx 1 H B Ex 1 F 23. An ace or a 2. First, the equation is not necessarily unique. (See Example 8) 72. (n 2 m)(x) 117. common, natural 5. The first is called an arithmetic sequence. k(x) 5 x16 x22 b. 76 b. different y values This relation is not a function. Then, n 1. Write the range of the relation. Write A as a function of s. Show that Pk11 is true; that is, show that F1 1 F2 1 ... 24 0 x 6 2 § £ y § 5 £ 23 § 5 z 213 Chapter 6 Test, pp. 1 8! 8! 8 ? The nth term is 2113. 3n , 2n 28. 184 The vertical line test tells us that the graph of a relation defines y as a function of x if no vertical line intersects the graph in more than one point. Find the value(s) of x for which f (x) 5 23. 4 x 26. What does a 2 116. Find (g + f)(x) and write the domain in interval notation. 3 1 p 1 k(k 1 1)] 1 (k 1 1)[(k 1 1) 1 1] (k 1 1)[(k 1 1) 1 1][(k 1 1) 1 2] k3 1 6k2 1 11k 1 6 5 5 . 2 (6y)4 or A 2 6yB 4 11 4 11 b. Determine the y-intercept of the graph of f. 3n , 2n for positive integers n $ 4. 1x 2 2 Chapter R Test, pp. Determine f(2). Using calculus, we can show that the series k n k21 (0.5) (21) approaches ln 1.5 as n approaches a k k51 infinity. e f ; The value 2 does not check. Shift downward 3 units. (27, 24) and (2, 5) 14. A(n) its predecessor. Find the Vertex of a Parabola by Using the Vertex Formula Completing the square and writing a quadratic function in the form f (x) 5 a(x 2 h)2 1 k is one method to find the vertex of a parabola. For example: an 5 (21)n bn 5 (21) Answers 1. on [1, 2] 88. (See Example 4) 33. (x 2 2)2 1 (y 2 1)2 5 25 y b. Notice that the slope-intercept form of a line y 5 mx 1 b has the y variable isolated and defines y in terms of x. 0.066 b. AB 5 £ 10 5 41. Suppose that 61 people bought tickets for a flight that has 60 seats. 751 Let E be an event relative to sample space S. x2 1 y2 5 3 12. 768 Chapter 8 Sequences, Series, Induction, and Probability 23. 0 (the company makes a profit) y 58. Row 2 of matrix B is the same as the sum of 3 times row 1 of A and row 2 of A. Foci: A 121, 0B, A2121, 0B f. Yes 20.10 0.12 0.00 0.03 Section 6.5 Practice Exercises, pp. Conditional equation; {28} 3 x ? 678: NASA/GSFC RF; p. Evaluate f (2). 1 22.7x 2 4.1 for x # 21 130. Domain: (2`, `); Range: [3, `) 1 2 3 4 5 x 28 210 y 10 8 6 4 2 25 24 23 22 21 22 24 1 2 3 4 5 x 26 28 210 5 4 3 2 1 25 24 23 22 21 21 1 2 3 4 39. Show that Pk11 is true; that is, show that 2 is a factor of 5k11 2 3. Choose a variable such as i for the index of summation. Find 1V + r2 1d2 and interpret its meaning. P(t) 5 4.3e0.01341t; P(t) 5 4.6e0.00618t; 4.3 million; 4.6 million b. f (0) 5 220 3 21 R.5. Domain (24, 4]; Range [21, 4] R.3. {22, 26} R.4. 2 4 1. Section 8.7 Introduction to Probability 761 Scientist Gregor Mendel (1822–1884) is often called the "father of modern genetics" and is famous for his work involving the inheritance of certain traits in pea plants. (See Example 6) 50. Suppose that a die is rolled followed by the flip of a coin. Fermat included a comment that he had "found a remarkable proof of this fact, but there is not enough space in the margin to write it." Proof of this theorem eluded mathematicians for over 350 yr until Andrew Wiles of Princeton University announced in June of 1993 that he had solved the problem. 5P5 5 5! 5 120 65. Write 0.34 as a fraction. Find an equation of the median of a triangle drawn from vertex A(6, 25) to the side formed by B(24, 1) and C(12, 3). a m b(0) When combining two or more functions to create a new function, always be sure to determine the domain of the new function. a 2i 53 10. Vertices: (9, 21), (29, 21) c. f (x) 5 2 1 1 x13 y b. P ´ Q R.2. Given: M 5 {24, 22, 1, 3, 5} and N 5 {25, 24, 23, 22, 21} List the elements of the following sets. 3.16 3 10 mol/L b. Each multiple-choice question has four possible choices (for example: a, b, c, or d). $8780 127. Assume that 1 1 k 1 1 1p1 5 . 81. n(x) 5 1 1 x 64. Graphing utilities can help with both of these weaknesses. 75–78 1. That is, for x 5 8, there are two different y values. 8! b. A set is a collection of items called elements. 184 Chapter 2 Functions and Relations EXAMPLE 1 Avoiding Mistakes Do not list the elements in a set more than once. ln 4y 47. 0 t 1 2 0 . Center: (24, 23); Radius: 111 22. 449: © Julie Miller; p. 5 xm14 113. 1600 ft 13. 23 y 7 6 5 4 3 2 1 Y1 5 2x 2 1 (23, 2) Y1 5 Y2 for x 5 23 27 26 25 24 23 22 21 21 Y2 5 x 1 5 1 2 3 x 22 23 Figure 2-19 The graphs Y1 5 2x 2 1 and Y2 5 x 1 5 can also be used to find the solution sets to the related inequalities. A 5 c 1 c. $39,000 b. (4y 1 5)4 In Example 4, we expand a difference of terms. 500 mi 33. 1 1 1)(2k 1 3) 1 1) D 1 [2(k 1 1 1) 2 1][2(k 1 1) 1 1] 5 2 3k 1 1 (2k 1 1)(k 1 1) k 1 1 5 (2k2k 111)(2k 1 3) 5 (2k 1 1)(2k 1 3) 5 2k 1 3 as Answers 3 Let Pn be the statement that 2 is a factor of 5n 1 1. If a couple plans to have three children, the probability that all three will be boys is 0.125. {10,000} 123. 1 1 1 1 1 1 1 1 p 5 25 125 1 1 2 2 p 5 25 55. Neither y 5 22x 1 9; 2x 1 y 5 9 39. In Example 6(b) for instance, the index of summation ranges from 3 to 6. For example, consider the points (1, 5) and (4, 9). {0.05} 14. [29, `) h. The intersection of their domains is [1, `). a 1 11a 1 28 53. Another method is to use the vertex formula. Therefore, at x 5 21, the function has a relative minimum of 25. Show that 2 1 4 1 ... 1 2k 1 2(k 1 1) 5 (k 1 1)[(k 1 1) 1 1] 5 (k 1 1)(k 1 2). 73. How much will the individual earn on day 10? This implies that 9k 2 1 5 4a or equivalently 9k 5 4a 1 1. f (x) 5 x2 1 4x 36. True 89. b 5 5 d. h(f (1)) 50. With a1 5 5, r 5 2, and n 5 11, we have Sn 5 a1(1 2 r n) 5(1 2 211) 5 5 10,235 12r 122 Skill Practice 7 Find the sum of the finite geometric series. A graph of an equation is symmetric with respect to the if replacing x by 2x and y by 2y results in an equivalent equation. t(x) 5 1 0x 0 3 28. 1 1 x23 x15 (x 2 3)2 3 24 1 a. 10 2 6) 5 log4 64 5 3 ✓ 1 1 105. e , 2 , 22 f 69. £ 0.2 223 7 7 6 6 1 12 § 31. In any event, the coefficient of x is the slope of the line, and the constant gives us the y-intercept. Determine f (2). 4, 6, 7, 152 , 314 5, 15 , 5, 15 , 5 31. Domain: (2`, `); 6 4 33 2 Range: c 2 , `b x 24 23 22 21 1 2 3 4 5 6 4 22 35. There are many other cases to consider regarding the number of defective and good lightbulbs: for example, 2 good, 1 defective, etc. g(3) 40. a30 5 54 1 (30 2 1)(20.8) 5 30.8 To find a30, substitute 30 for n. The value 8 is listed in the domain one time only. The sum of the numbers showing on the dice is 7. 6 5 4 3 2 5 b(x) 5 ⎛ 23 ⎞ 25 24 23 22 21 21 1 2 25. a i2 5 a u 5 a u i51 j50 u u 88. Graph m(x) 5 x 2 2 for x # 22. Positive: 6, 4, 2, or 0; Negative: 1 53. Therefore, the exponent on a must be 3 so that the sum of the exponents is 10. (x 1 8i)(x 2 8i) a. 36.8020 d. h(x) 5 6 x k(x) 5 24 25 8 7 y 12 5x r(x) 5 x 2 2 x 2 6 21028 26 24 22 21 22 23 h(x) 1 x 23 77. y 9 8 7 6 5 4 3 2 an 5 8 ⎛ 12 ⎞ 9 8 7 6 5 4 3 2 n ⎝ ⎠ 1 22 21 21 f(x) 5 8 ⎛ 12 ⎞ x ⎝ ⎠ 1 1 2 3 4 5 6 7 8 n Figure 8-1 22 21 21 1 2 3 4 5 6 7 8 x Figure 8-2 The graph of {an} consists of a discrete set of points that correspond to points on the graph of f (x) 5 8A 12 B x for positive integers x. y 5 21028 26 24 22 22 y 91. 743 • The number of permutations of n elements taken r at a time is given by nP r 5 n! or equivalently, nPr 5 n(n 2 1)(n 2 2) p (n 2 r 1 1) (n 2 r)! A combination is a collection of distinct items taken without regard to order. Domain: (2`, `); Range: [23, `) 95. 22 21 The domain is 12`, 222 ´ 122, 212 ´ 121, 12 ´ 11, 22 ´ 12, `2. 27 1 (211) 1 (215) 1 ... 1 (239) 64. (2`, `) 3 c. 720–724 5 R.1. 2 4 R.2. {4} 1 1 R.3. g(0) 5 1, g(1) 5 , g(2) 5 , g(21) 5 4, g(22) 5 16 4 16 1 R.4. h(0) 5 1, h(1) 5 16, h(21) 5 16 R.5. a. 10 3 4 5 x 25 24 23 22 21 21 19. {24} 19. If 150 dozen cookies are sold in a given month, how much money will the business make or lose? Source: Internal Revenue Service, www.irs.gov 165 166 Chapter 2 Functions and Relations SECTION 2.1 OBJECTIVES The Rectangular Coordinate System and Graphing Utilities Websites, newspapers, sporting events, and the workplace all utilize graphs and tables to present data. The maximum value of f is 21. p)(x) b. Then hit ENTER. b 5 2 b. (x 2 18)2 1 (y 1 20)2 5 80 74. 22 21 21 22 47. e 5 71. A committee of 4 men and 4 women is to be made from a group of 12 men and 9 women. 7! 5 5040 5. y d. 35, 25, 15, 5, 25, ... a2 2 a1 5 25 2 35 5 210 a3 2 a2 5 15 2 25 5 210 a4 2 a3 5 5 2 15 5 210 a5 2 a4 5 25 2 5 5 210 b. Each condition in parentheses is an inequality and the calculator assigns it a value of 1 or 0 depending on whether the inequality is true or false. a2`, 2 b ´ a0, b ´ a , 4b 43. 0 C 0 45. 3, 13, 23, 33, 43 b. (f + g)(x) 5 2x2 1 4 b. Explain why the function is discontinuous at x 5 1. logarithmic Section 4.5 Practice Exercises, pp. 22x 2 h 1 3 6. The game "Florida Lotto" for example, pays a grand prize to players who choose six distinct numbers from 1 to 53 (in any order) that match the same group of six numbers in the drawing. 23.9069 < 15 81. 3x 1 14 12x 2 10 11. V(t) 5 20.0406t 1 0.154t2 1 0.173t 2 0.0024 1 25 24 23 22 21 21 22 215 SA-19 1 2 3 4 5 x 1 230 240 250 260 270 69. (A21)21 5 A 5 c 1 3 2 0 d 63. (m 1 p)(1) b. y y 5 4 3 2 y 5 f(x) y 5 f(2x) 1 25 24 23 22 21 21 22 x y 5 f(x) 1 TIP For a given point (x, y), notice that (2x, y) is on the opposite side of and equidistant to the y-axis. 183 Given a relation in x and y, we say that y is a function of x if for each value of x in the domain, there is exactly one value of y in the range. (2`, 26] ´ c , `b 2 101. an11 2 an 5 log a1r n 2 log a1r n21 5 (log a1 1 log r n) 2 (log a1 1 log rn21) 5 (log a1 1 n log r) 2 [log a1 1 (n 2 1) log r] 5 log r The common difference is log r. lna 2 59. f (22) b. At x 5 0, the function has a relative maximum of 0. The number of such permutations is given by 6! 5 720 There are 720 ways in which 6 people can be arranged in line. (h, k 1 a); (h, k 2 a); 37 13 (h 1 b, k); (h 2 b, k) 9. P1 is true because a1 2 b 5 . 1 1 x12 (x 1 2)2 (x 1 2)3 47. 120. [2, 4] (Hint: t 5 2 and h 5 2) d. Is (x 1 3) a factor of f (x)? 1 1 1 5 1 1 1 5 2?3 3?4 4?5 2 6 12 20 5 1 For the first four terms, the numerator is the same as the term number n and the denominator is one more than the term number. If three bulbs are chosen at random, 93. Find the Probability of the Union of Two Events 4. 25 24 23 22 21 21 22 25 2 24 f(x) 5 26 28 210 3 2 1 24 53. True d. H HH 103. Endpoints of minor axis: (0, 5), (0, 25) (5, 0), (25, 0) f. e , 5 f 5 Sign of (x 2 a)2: 1 1 1 1 Sign of (b 2 x): 1 1 2 2 Sign of (x 2 c)3: 2 2 2 1 3 2 2 a 1. (x 1 2)2 1 (y 2 5)2 5 1 19. (25, 22) ´ (2, `) x y 5 f 21(x) 24 25 4. 8 7 22 23 a(x) 5 !x 1 1 2 3 10 8 6 4 16. f 21(x) 5 x2 2 5; x $ 0 Domain: [0, `); Range: [25, `) y y 9. 25m2 2 30m 1 9 25 9 45. 48 hr c. By 2012, the population reached 360,800. a b represents r the number of ways we can choose a group of r items in any order from a group of n items. Skill Practice 3 A homeowner has kept records of the average monthly electric bill for 4 yr. The Instructor's Resource Manual (IRM) is a printable electronic supplement put together by the author team. The distance between the points is 5 units. x2 1 y2 5 4 5 4.7 in.; Minor axis: 4 in. Proof by mathematical indicates that Pn is true for all positive integers n if (1) is true, and (2) the truth of Pk implies . 252 • f is increasing on I if f (x1) , f (x2) for all x1 , x2 on I. Write a function that represents the cost C(x) (in euros) for x croissants. 0, the graph of y 5 f (x) has two x-intercepts. 14. No 23. Find the sum of the first 30 terms. 5 k11 as desired. Relative minimum 123. 5 4 3 2 21 21 22 8 7 6 y 5 |x| 2 2 2 1 73. TIP In part 2 of Example 4, we manipulate the expression (k 1 1)! on the left side to show that it is greater than the expression on the right side for k $ 4. Write About It 39. 0.12 e. The IRM includes Guided Lecture Notes, Classroom Activities using Wolfram Alpha, and Group Activities. (a 1 b) 8y3y20 d. 717 p. If the slope of one line is the opposite of the reciprocal of the slope of the other line, then the lines are perpendicular. Increasing Graph b 93. 6 5 4 3 h(x) 5 √x 1 3 y 5 √x 2 1 22 21 21 22 Using similar logic as in Example 2, we can show that the graph of h(x) 5 (x 2 3)2 is the graph of f(x) 5 x2 translated to the right 3 units. F 23 24 23 1 b. Therefore, x 5 0 and y 5 7. x 5 22, x 5 1, and x 5 3 7. The sum of all terms in the sequence is an infinite series and is given by ` p a ai 5 a1 1 a2 1 a3 1 i 51 Any letter such as i, j, k, and n may be used for the index of summation. 2 2 • To find an x-intercept (a, 0) of the graph of an equation, substitute 0 for y and solve for x. {x 0 x $ 10} 29. 6 9 12 15 5 4 F 2 x 15 e. First show that Pn is true for n 5 4. See Quadratic equations Semimajor axis, of ellipse, 636 Semiminor axis, of ellipse, 636 Sequences alternating, 691, 764 in applications, 702–703, 718–720 arithmetic, 701–705, 765 common difference of, 701, 702 explanation of, 690, 692, 764 Fibonacci, 692–693 finite, 690 geometric, 712–715, 765 on graphing utility, 691 graphs of, 692 infinite, 690, 694, 764 nth partial sum of, 694 nth term of, 690–692, 694, 702 Series in applications, 707–708, 718 arithmetic, 707–708 finite, 690, 694, 695 infinite, 694, 695 in summation notation, 695–697 Set-builder notation, 2, 4–5, 145 Sets of complex numbers, 105, 333 empty, 2, 85 explanation of, 2, 73 identifying elements of, 3 in interval notation, 4–5 of real numbers, 2–3 union and intersection of, 5–6, 73 Shrink. Maximum: 7 4 8 6 h. The number of elements in E is the number of possible ways to select 2 women from a group of 5 women without regard to order. This will help you to identify common mistakes and understand their behavior pattern, such as when they study and how frequently. k 5 2.4 75. Evaluate the greatest integer function for the following values of x. 3 2 32 x 4. Average Rate of Change of a Function Suppose that the points (x1, y1) and (x2, y2) are points on the graph of a function f. Passes through a 3 5 , 2 b and is perpendicular to the 11 4 y-axis. (3, 0), (23, 0), (1, 0), (21, 0) d. q(x) 5 2 2x For Exercises 47–50, use the graphs of y 5 f (x) and y 5 g(x) to graph the given function. What is the probability that a person selected from the viewing audience was undecided? The values of x for which f (x) 5 2. Suppose that x represents the age of an adult (in yr), and y represents the systolic blood pressure (in mmHg). This is consistent with the solution x 5 94 . Graph the line. To show that 4 is a factor of any expression, we need to write the expression as the product of 4 and some positive integer that we call a. 0 0 10 20 30 40 Time (sec) 50 60 70 t a. 736 Finding the kth term of a binomial expansion: n Let n and k be positive integers with k # n 1 1. The transverse axis is vertical if the coefficient of the y2 term is positive. 7 Alternatively, we can apply the formula for the kth term of a binomial expansion with n 5 10, k 5 8, a 5 2x, and b 5 y4. Instructors can then use this information to make more informed decisions on what topics to cover in more detail with the class. b214 5 22487 a1 5 44; d 5 8 c400 5 104 47. First and foremost, we want to thank our editor Emily Windelborn who started with us on this project when it was just idea, and then lent her unwavering, day-to-day support through final publication. x 5 0 3 2 b. $40 c. 12.0 # x # 15.2 g/dL 71. The following related statement is also true: If a2 1 b2 5 c2, then a triangle with sides of lengths a, b, and c is a right triangle. g(c) 5 1c 1 20 2 1 c. Decreasing. An exponential growth model has unbounded growth, whereas a logistic growth model imposes a limiting value on the dependent variable. 3y z 2 2xz 51. 60 19. 182 Chapter 2 Functions and Relations Objective 2: Write the General Form of an Equation of a Circle 37. Learn More: Successinmath.com xi Connect Math Hosted by ALEKS Built By Today's Educators, For Today's Students Fewer clicks means more time for you... 477: © Julie Miller; p. Determine the nth term of the arithmetic sequence whose nth partial sum is n2 1 2n. y2 (x 1 4)2 1 51 9 4 1 2 3 4 5 x 23 24 25 SECTION 2.2 For Exercises 9–10, determine the center and radius of the circle. 5P2 2! 5 20 5 10 2 To generalize, suppose that n represents the number of distinct elements in a group from which r elements will be chosen in no particular order. 1 2. (6C3) ? 6 V; Even for large values of x, the total resistance will always be less than 6 V. No 6. 2 2. However, in the case of the Pythagorean theorem, the converse is a true statement. b2x2 1 a2y2 5 a2b2 a2y2 b2x2 a2b2 1 2 25 2 2 2 2 ab ab ab y2 x2 1 251 a2 b 101. TIP The linear equation found in Example 7 was based on two data points. Suppose that an object starts with an initial velocity of v0 (in ft/sec) and moves under a constant acceleration a (in ft/sec2). 21 7. c(x) 5 1 11 x23 26. a a b j51 3 ` 3 i21 66. 28 d. Number of Permutations of n Elements, Some Indistinguishable Consider a set of n elements with r1 duplicates of one kind, r2 duplicates of a second kind, ... , rk duplicates of a kth kind. y 5 3.01x 1 1 114. (n ? e , 21 f 27. a (3i 1 5) i51 Solution: Avoiding Mistakes When we apply the formula n Sn 5 (a1 1 an) to find the 2 n sum a an, the index of i51 summation, i, must begin at 1. Write a formula for the nth term of an arithmetic sequence that represents the distance dn (in ft) that the object will fall in the nth second. The region outside the circle would be shaded. a (j 1 1)(j 2 1) j51 n n 71. 216 2 30i 5. "My father is a medical researcher, and I got hooked on math and science when I was young and would visit his laboratory. EXAMPLE 8 Solving Equations and Inequalities Graphically Solve the equations and inequalities graphically. 4 To write an equation in slope-intercept form, isolate the y variable. y 19. m(x) 5 12x 1 5 For Exercises 79–84, use the graph of y 5 f (x) to graph y the given function. A freshman is selected. Solution: 6 1 i21 1 1 1 a 4a 2 b 5 4 1 2 1 1 1 2 1 4 1 8 i51 The individual terms in the series form a geometric sequence with a1 5 4 and r 5 12 . T(x) 5 24x 1 108 b. To put this in perspective, the following events are more likely to happen than winning the grand prize in "Florida Lotto." Principle of Counting 2. 7C2 5 56 ? 4x 1 2y 5 2 5 4 3 2 y51 1 25 24 23 22 21 21 22 23 23x 5 12 24 25 1 2 3 4 5 x 4x 1 2y 5 2 b. EXAMPLE 3 Writing the nth Term of a Geometric Sequence 9 27 Write a formula for the nth term of the geometric sequence. Reflect over x-axis n(0) 5 212 (0 2 2)2 1 3 5 1 ✓ n(2) 5 212 (2 2 2)2 1 3 5 3 ✓ n(4) 5 212 (4 2 2)2 1 3 5 1 ✓ 1 2 3 4 5 x 6 (4, 22) Shift upward 3 units 5 4 3 24 23 22 21 21 22 25 24 25 y 1 (2, 3) n(x) 5 2 2 (x 2 2)2 1 3 2 (0, 1) 1 23 24 25 4 5 6 x (4, 1) 1 2 3 4 5 6 x 1 y 5 2 2 (x 2 2)2 1 3 (2, 3) 2 (0, 1) 1 23 (x 2 2) 24 24 23 22 21 21 22 3 24 25 23 5 4 3 1 2 y 2 1 2 24 23 22 21 21 22 23 y 5 4 3 1 22 (4, 2) 1 Shift right 2 units 24 25 24 23 22 21 21 (0, 22)22 5 4 1 2 y 5 2 (x 2 2) 3 (0, 2) 2 (4, 1) 1 2 3 4 5 6 x 238 Chapter 2 Functions and Relations Skill Practice 7 Use transformations to graph the function defined by m(x) 5 23 0 x 2 2 0 2 4. y 5 4 g(x) 5 ! x 1 5 3 2 13. 1 x 1. Notice that a point (x, y) on the image has a corresponding point (2x, 2y) on the image. Evaluate C(4) and interpret the meaning in the context of this problem. In this case, exclude x 5 0 and x 5 4. (23, 9) 5 4 3 2 13. Undefined 5 x SA-16 49. Apply Vertical and Horizontal Shrinking and Stretching 4. 773 Cumulative Review Exercises 21. (g + g)(6) 108. Answers 5. 3.5 3 1025 c. 52 6 5i6 d. 2000 10 23 11. f (2) 25 24 23 22 21 21 22 b. {24, 3, 22, 1} 4 e 6, f 14. What is the total amount earned in 30 days? s(x) 5 x2 2 4x 2 12 x11 c. Vertices: (4, 0), (24, 0) 8 6 c. x 1 a. A 5 A5 r n 150C A1 1 0.06 (12)(34) 12 B 0.06 12 2 1D A 5 199,548.50 P 5 $150 r 5 0.06 n 5 12 (the money is invested monthly) t 5 62 2 28 5 34 yr The annuity will be worth $199,548.50 when the employee reaches age 62. 12 b. In the event that the linear trend continues, use the model from part (a) to predict the height of the volcano in the year 2030. Maximum: 15,000 5 0 (20, 0) 3 6 9 12 15 18 21 24 27 30 x b. Write the first five terms of an arithmetic sequence with first term 25 and common difference 4. Figure 8-7 Example 4 illustrates that a geometric sequence with a negative common ratio is an alternating sequence. a2 5 26 and r 5 . 2264.9364 c. Write a linear profit function representing the profit P(x) for holding x private lessons for the month. Determine the number of lawn maintenance calls needed per month for the company to make money. a (j 2 3) 57. (See Example 5) 29. (22, 2) 13 3 3 m 15. Objective 1: Determine Theoretical Probabilities 9. an 5 2n2 1 3 9. Section 8.7 755 Introduction to Probability 3. Endpoints of minor axis: (0, 2), (0, 24) d. y $ 2x y b. Skill Practice 3 Write the equation of the circle in standard form. The horizontal line is called the x-axis and the vertical line is called the y-axis. 9 12 The viewing window is part of the Cartesian plane shown in the display screen of a calculator. The difference quotient: . (f + g)(5) 110. $0.27 per mile c. Informally, this means that f (b) is the smallest function value relative to other points on the function nearby. 169 Thus, P(N ´ F) 5 265 . The value of x is the month number and x 5 1 represents January. Write the answer in slope-intercept form. e 59. Suppose that a tennis tournament has 64 players. 2x 2 3 , x 2 1 c. 3 4 of its height. For a trip from Houston, Texas, to Dallas, Texas, a motorist travels 36 mi of city driving and 91 mi of highway driving. Answers 9. 5 4 3 2 1 2 3 4 5 25 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 y 3 1 x 5 x 1 x 23 21. Write a function that represents the cost C(x) (in $) for x boxes of stationery. 5 4 3 2 1 25 24 23 22 21 21 22 23 24 25 1 2 x SA-9 Student Answer Appendix 25. y 5 2f (x) 50. 2 nonreal solutions 57. Given an equation in the variables x and y, find the y-intercept by substituting for x and solving for Objective 1: Plot Points on a Rectangular Coordinate System For Exercises 9–10, plot the points on a rectangular coordinate system. With each bounce, the ball rebounds to vertical distance traveled by the ball. Endpoint of minor axis: (0, 2), (0, 22) (1, 0), (21, 0) f. EXAMPLE 4 Finding a Specific Term of a Sequence Given the sequence defined by bn 5 n2 , find b6. The value 2 is a factor of 2(5a 2 2), and therefore a factor of 5k11 1 1 as desired. 6 a 2 b 2 1x 2 12 x 21 ? 2x 1 1 $1 x14 19. 9 36 2 2 y z 1 5 1; This represents the graph of an ellipse in the yz-plane. 5 23 g(22) 5 23 b. 4 ? m(x) 5 41 x 30. By the intermediate value theorem, because f (3) 5 2 and f (4) 5 6, then f must take on every value between 2 and 6 on the interval [3, 4]. Identify the center and radius. The tree diagram shows 16 different sundaes: Mi nt ch ip Ho Butters Hot cotch e fudg Butters cotch t nu number of syrups late oco dg t fu a Pe number of custards cotch e Ch VHN, VHG, VBN, VBG, CHN, CHG, CBN, CBG, MHN, MHG, MBN, MBG, PHN, PHG, PBN, and PBG. 544 105. p(1) 1 5 4(1) ? Three fire observation towers are located at points A(26, 214), B(14, 10), and C(23, 13) on a map where all units are in kilometers. is a subset of the sample space of an event E. 0, 28, 19 2 d. For Exercises 72–80, evaluate the step function defined by f (x) 5 Œxœ for the given values of x. substitution; addition 5. End-of-Chapter Materials The textbook has the following end-of-chapter materials for students to review before test time: • • • • Brief summary with references to key concepts. A3 1 117, 3 1 117B and A3 2 117, 3 2 117B y y 65. Based on the given data, does the water level follow an arithmetic progression? Passes through (2, 26) and is parallel to the line defined by 2x 2 y 5 4. 25 81. Dividend: 6x2 1 9x 1 5; 2x 2 5 Divisor: 2x 2 5; Quotient: 3x 1 12; Remainder: 65 c. (5n 1 m 1 6)(5n 2 m 2 6) 89. Center: (2, 0); Vertices: (21, 0), (5, 0); 3 2 Foci: (23, 0), (7, 0); 1 C F F Asymptotes: x 23 22 21 1 2 3 4 5 6 7 21 y 5 43x 2 83 and y 5 243x 1 83 ; 22 5 23 Eccentricity: 3 24 25 y 6 4 2 28 26 24 22 22 24 26 28 210 2 4 6 8 10 12 212 214 2 2 4 6 8 x 12. EXAMPLE 1 Translating a Graph Vertically Use translations to graph the given functions. True SA-28 Student Answer Appendix 99. Suppose that a line has a slope m and y-intercept (0, b). For Exercises 35–37, solve the system of equations. To meet the graduation requirements, a student must take 2 English classes out of 10 available, 3 math classes out of 6 available, and 2 history classes out of 7 available. x 5 26 14. Horizontal asymptote: y 5 2 10 8 6 x 4 6 4 2 x y 83. Write a function to represent the cost C(x) (in $) for a first-time visitor to purchase x songs. Find the sum of the first 35 terms of the arithmetic sequence 21, 29, 217, 225, ... Skill Practice 9 Given r1x2 5 1 2 x 5 and t1x2 5 2 , find 1r + t2 1x2 x11 x 29 and write the domain in interval notation. What are the advantages of writing an equation of a circle in standard form? 11 1 13 2 9 3 27. ,4 ,5 ,6 ,7 ,8 , a. EXAMPLE 10 Investigating an Application of an Infinite Geometric Series—The Multiplier Effect Suppose that $200 million is spent annually by tourists in a certain state. a (ai 6 bi) 5 a ai 6 a bi i51 i51 i51 A single sum or difference can be regrouped as two sums or differences. Y Parent 1 y b. f (x) 5 e 0x 0 for x , 2 2x 1 4 for x $ 2 62. Find the average amount earned per year between the 5th year and 10th year. (6 2 0)! 0! ? e4x 2 4e2x 1 6 2 2x 1 4x e e x3 1 3x2y 1 3xy2 1 y3 2 3x2z 2 6xyz 2 3y2z 1 3xz2 1 3yz2 2 z3 1.04060401 47. 10 g. Yes 61. 2a 4a 4ac 2 b2 and is often hard to remember. Therefore, the graph of g is the graph of f reflected across the x-axis. 2 (2, 22) becomes A 2, 22B 5 (1, 22). (1, 3), (3, 1), and (0, 22) 20. y 5 2x 2 4x 1 1 1 22. Determine the x-intercept(s). (37.1, 224.7) and (31.1, 232.7) 17. a b(x) 5 q 21 2 x 21 ; 27. 0, 8 f. {6}; The value 1 does not check. a (21)i11 i51 2651 14. If so, find the value of r. x F 67. h 5 2 d5 n n rr 5 2 ay ay 2 5 6 x5 85. Figure 2-32 Notice that the graph can be segmented into three pieces. At a restaurant, if a party has eight or more people, the gratuity is automatically added to the bill. (d + r)(30) 5 17,280 means that the bicycle will travel 17,280 ft (approximately 3.27 mi) in 3 30 min. {x 0 x $ 24} b. R 93. y 5 274x 1 7; m 5 274 ; y-intercept: (0, 7) y b. A5 c 4 5 23 d 9 21 C5 £ 3 2 B5 c 4 6 25 0 1§ 7 41. A course in early civilization has 6 freshmen, 8 sophomores, and 16 juniors. How much will the annuity be worth by the time the employee reaches age 62? y 5 1400x2 2 1200x on [25, 5, 1] by [21000, 2000, 500] 92. e a22, b f 4 22 2 3x x 2 6 15. a , 0b 2 d. Solve for y. 1 28 27 26 25 24 23 22 21 21 22 y 5 f(2x) 23 24 25 26 1 2 3 4 x (24, 22) becomes A 24 2 , 22B 5 (22, 22). x-intercept: (0, 0); y-intercept: (0, 0) y 1 25 24 23 22 21 21 22 7 6 5 4 3 2 1 1 2 3 4 5 2 3 4 5 x 61. y 5 0 y 33. Verify that the points A(0, 0), B(x, 0), and C a x, 2 2 make up the vertices of an equilateral triangle. • To motivate students by demonstrating the significance of mathematics in their lives through practical applications. y (f 1 g)(x) 5 Î 25 2 x2 1 5 g(x) 5 5 f(x) 5 Î 25 2 x2 10 9 8 7 6 5 4 3 2 f(4) 5 3 1 26 25 24 23 22 21 21 1 2 g(4) 5 5 3 4 5 22 Answer 1. (g + f)(x) 5 10x2 2 15x 1 1 10. (2`, 4) ´ (4,`) b. 5 57. < 58 in. Let Pn be the statement that 2 is a factor of 7n 2 5. y 5 a. h(x) 5 1 9x 2 5 98. y y 5 61x 1 1 21 0 y 5 61(21) 1 1 5 0 0 61 y 5 61(0) 1 1 5 61 (21, 0) (0, 1), (0, 21) 1 612 y 5 61(1) 1 1 5 612 (1, 12), (1, 2 12) < 1.4 5 4 3 2 y2 2 1 5 x 1 22 21 21 22 3 62 y 5 61(3) 1 1 5 62 (3, 2), (3, 22) 23 8 63 y 5 61(8) 1 1 5 63 (8, 3), (8, 23) 24 25 Skill Practice 5 Graph the equation by plotting points. {5} 75. If the sequence is arithmetic, find d. 12, $12,209.97 d. 2 n n12 1 1 1 1 1 1 1 1 1 1 b. a 2 b 9. Y1 . 702: © Julie Miller; p. b30 5 252 32,686 75. 1 1 13. f(x) 5 3x2 2 2 SA-10 Student Answer Appendix 123. 715 nth partial sum of a geometric sequence: n a1(1 2 r) 12r where a1 is the first term of the sequence and r is the common ratio, r fi 1. Then the probability of event E, denoted by P(E), is given by n(E) P(E) 5 n(S) p. 6a 1 5ab 2 4b 2a2 b. For Exercises 94–99, use the data in the table categorizing smokers and nonsmokers according to their blood pressure (BP) levels. y 24 23 22 21 21 22 3 4 22 23 24 25 4 87. Write a formula for the nth term of a sequence that gives the payment (in $) on day n. Find the Value of an Annuity Geometric Sequences and Series 1. Foci: A 17, 0B, A217, 0B g. an 5 2 n 2 5 3 n21 3. Note: For any point (x, y) on the graph of y 5 f (x), the point (x, ay) is on the graph of y 5 af (x). Substituting 0 for g(x), we have: 0 5 (x 1 3)2 x 5 23 y 6 5 4 3 2 g(x) 5 (x 1 3)2 f(x) 5 x2 1 26 25 24 23 22 21 21 22 1 2 3 4 x 23 The x-intercept is (23, 0). p1x2 5 ax 1 b 2 b. 4.444 3 109 km 19. To find the y-intercept, substitute 0 for x and solve the equation for y. 333.2 ft b. That is, prove that P1 is true. Combining Functions and Determining Domain Given g(x) 5 2x, h(x) 5 x2 2 4x, and k(x) 5 1x 2 1, a. Section 2.6 SECTION 2.6 239 Transformations of Graphs Practice Exercises Prerequisite Review For Exercises R.1–R.3, graph each equation. (2, 0), (21, 0), and (24, 0) 6. scientific 5. m(a) 5 0 4 1 a 0 Domain: (2`, `) 4 5 The expression x2 $ 0 for all real numbers x. (x 2 h)2 1 (y 2 k)2 5 r2 5. What does this mean for you? f (0) d. f (x 1 h). A disc jockey has 7 songs that he must play in a halfhour period. 50.6826 < 3 83. Find the y-intercept. P1 is true because 5 5 [3(1) 1 7]. y 5 20.000838t2 1 0.0812t 1 0.040 b. The quadrants are labeled counterclockwise as I, II, III, and IV (Figure 2-1). Write an expression for the nth term of the sequence where n represents the day number. 0 15. Find (T + C)(4) and interpret its meaning in the context of this problem. Find a1. 22x 1 2h 1 22x 22x 1/2 x (5x 1 3) 13. f (g(6)) 5 f (2) 58 Evaluate g(6) first. Using function notation, y 5 f(x), this is equivalent to finding the real solutions of the equation f (x) 5 0. {17} 2 {223} 53. (f 1 g)(2) 23 for x , 22 98. 2 is a factor of 7n 2 5. (0, 0), (2, 0) f. Z2n 1 5Z 5 2 R.5. Given 2x 2 5y 5 20, a. g)(x) 5 f (x) ? The golfer would need to score less than 84. Vertices: (0, 0), (20, 40), (60, 0) 15. g(2) Solution: a. 20 5 1 b. 84. The recursive formula for an arithmetic sequence is a1, an 5 an21 1 d for n $ 2. 45 c. a b(23) f c. Up to the left and down to the right; As x S 2`, f (x) S `, and as x S `, f (x) S 2`. 4x3 2 20x2 1 13x 1 4 x24 5x 15. Find the indicated term. The nth partial sum Sn of the first n terms of a geometric sequence is a (finite/infinite) geometric series. (2`, 0) ´ a , 2b 5 120 1 15x 67. P1 is true because 8 5 4 ? x 5 0 12. y 5 mx 1 b 26 5 258 (4) 1 b 26 5 232 5 1 b 26 1 32 5 5 b 2 5 5 b Therefore, y 5 mx 1 b is y 5 258 x 1 25 . (n 2 r)! r n! n n! 5 . P(A) 5 4 1A 4 16 d d 12 f. So, 0 A 0 ? a1 5 3 45. Round the slope and y-intercept to 1 decimal place. {22} 93. The sum of the first n terms of the sequence is called the nth partial sum of the sequence and is denoted by Sn. The nth partial sum of a sequence is a finite series. Give an example of two events that are not mutually exclusive. 1 i 35. f (x) 5 x 1 1 for x $ 2 y c. f (x 1 h) 5 22(x 1 h)2 1 4(x 1 h) 2 1 5 22(x2 1 2xh 1 h2) 1 4x 1 4h 2 1 5 22x2 2 4xh 2 2h2 1 4x 1 4h 2 1 f (x 1 h) b. a (26i 2 4) i51 n51 n51 125 ... 1 6 26. Point of Interest As mentioned in the section opener, the probability of winning the grand prize in "Florida Lotto" for a player who plays 1 combination 1 of 6 numbers is 22,957,480 . In how many ways can 4 more senators be selected to serve on the committee? 283 d. ea 5 x 1 y 17. (10, 32] 19. F1 5 1, F2 5 1, F3 5 2 33. (See Example 8) y y 88. 3x for x , 1 f (x) 5 e 3 for x . ` d. { } 103. The extended principle of mathematical induction has us test the truth of a statement for the first allowable value of n. Absolute value equation b. 1 51 5 16 2 2 1) 51 57. C(x) 5 mx 1 b C(x) 5 12.99x 1 99 b. 8820 SECTION 8.6 Practice Exercises Prerequisite Review For Exercises R.1–R.4, evaluate the expression. 9P9 36. The value of the common difference is negative (d 5 20.8), indicating that the progression of points slopes downward. 72–73 0 y 2 L 0 , ε or 0 L 2 y 0 , ε 0 x 2 c 0 , δ or 0 c 2 x 0 , δ a. {(1.028, 15.772)} 0.1 24 30 4 20.1 210 10 210 51. 5 2 21 2 x Vertical asymptote: x 5 0; Slant asymptote: y 5 2x Vertical asymptote: x 5 26; Slant asymptote: y 5 23x 1 22 Vertical asymptotes: x 5 15 and x 5 215; Slant asymptote: y5x15 45. 2 3 4 5 x 23 22 21 21 22 3 4 5 4 5 6 7 x 5 4 3 2 1 1 2 y 50. 23x 2 11 x 1 7 e ax, , b ` x is any real number f or 2 2 52y 22y 2 11 , y, b ` y is any real number f or ea 3 3 5(2z 2 7, 23z 1 5, z) 0 z is any real number6 R.1. $120 1. 5 2 6 1x 2 12 a 2 2 2b x 21 Therefore, x fi 61. y 106. Major axis: 12 ft; Minor axis: 10 ft b. After a 5-yr slump in the real estate market, housing prices stabilize and even begin to appreciate in value. 2 29. 12. The number of new flu cases dropped slowly during the first two months. 2 x(x 1 h) 4 1x 1 h 2 4 1x b. (4C1) 5 480 67. a (21)i i 5 i51 SECTION 8.1 Write the sum using summation notation. The triangular front has a base of 6 ft and a height of 4 ft. 736–738 R.1. 25v2 1 20v 1 4 R.3. R.5. 1. Yes 11x 2 9 6. (2P2)] ? 1 5 1 3 4 For Exercises 63–64, determine if the function is linear, constant, or neither. 43. 0.01 or 0 22 2 t 0 . 5 4 3 2 25 24 23 22 21 21 22 y 1 25 24 23 22 21 21 22 1 2 3 4 5 1 2 3 4 5 53. 0.000 007 m 8 3 105 85. $289,993 103. 3 5 90 79. In how many ways can 4 people who bought tickets be selected if the first person wins a $10 gift certificate, the second person wins a $25 gift certificate, the third person wins a $50 gift certificate, and the fourth person wins a $200 camera? Liza is a basketball coach and must select 5 players out of 12 players to start a game. at c 5 c sta1 sta3 b2 1 a2 d b4 1 a4 c 0 0 0 d 50 0 ta1 ta2 a1 a2 db 5 s ? dn 5 32n 2 16 b. a q b(x) For Exercises 27–32, refer to functions s, t, and v. Calories b. 121 b. The graph of y 5 f A 13 xB is the graph of y 5 f (x) with a (choose one: vertical stretch, vertical shrink, horizontal stretch, horizontal shrink). 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 b. Shift upward 1 unit. 1000 0 0 69. { } 5 4 3 2 y 23 1 25 24 23 22 21 21 22 x 4 8 12 5 4 3 2 5x # 6y 25 24 23 22 21 21 22 5 4 3 2 5 19. h(x) 5 x2 2 4 1 25 24 23 22 21 21 22 24 TIP g(x) 5 x2 1 2 5 4 3 2 1 2 3 4 5 x 23 24 25 Figure 2-25 The graphs of g and h both resemble the graph of f(x) 5 x2, but are shifted vertically upward or downward. 5 5 4 3 2 0 4 8 12 Day Number 16 20 t a. x2 2 6x 2 1 d. y y 23. TIP 24 23 22 21 21 22 2y 5 4 1 2 3 4 5 x 23 24 25 Skill Practice 1 Graph the line represented by each equation. f (x) 5 8x 1 4 35. 2 210 28 26 24 22 22 24 2 4 6 8 10 x 25 24 23 22 21 21 22 28 210 57. Show that a (ai 2 a) 5 0. Avoiding Mistakes The roles of the men and women on the committee are indistinguishable. y2 x2 1 51 64 289 81. Is there inconsistency between homework and test scores? an 5 (22)n 7. In Example 7, we use the formula for the nth partial sum of an arithmetic sequence to find the sum of the first 50 positive even integers. 5 63. f (x) 5 22x4 1 5 0 x 0 f (2x) 5 22(2x)4 1 5 0 2x 0 f (2x) 5 22x4 1 5 0 x 0 Determine whether the function is even. y 23 22 21 21 22 23 10 25 210 5 1 2 3 4 5 6 7 x y 21028 26 24 22 22 24 210 25 22 5 2 4 6 8 10 x r(x) 5 1 2 x2 2 33. a (21)k a b k a. Yes; r 5 2 13. Graph iii 113. (See Examples 6–7) b. Compare the results to the fifth and sixth rows of Pascal's triangle. 2 5 29. Solve for x. { } 12 4 53. The expansion of (a 1 b)n is given by n n n n n (a 1 b)n 5 a ban 1 ban21b 1 a ban22b2 1 p 1 a babn21 1 a bbn 0 1 2 n21 n n n 5 a a ban2rbr r50 r Answers b. a 5 5 12 12 d ´ c , `b 33. 3 4 23 24 25 23 77. on [1, 3] c. (4, 2) and (0, 26) 76. TIP a. On a computer, 1 bit is a single binary digit and has two possible outcomes: either 1 or 0. (See Example 12) 99. (2`, 24) b. A B 2 21. The domain of f has no restrictions. Although the exact keystrokes on different calculators and graphing utilities may vary, we will use the following guidelines to find the least-squares regression line. No f(x) 5 x 2 2 read as "f of x equals x 2 2." Section 2.3 187 Functions and Relations With function notation, Avoiding Mistakes The notation f (x) does not imply multiplication of f and x. Because it's more than just words on a page. (See Example 6) 57. (29, 1) Radical equation and an equation in quadratic form b. E1: A red marble is selected. Creating a Linear Regression Model 1. 5 23 24 25 59. 5 1 8 1 11 1 p 1 (3n 1 2) 5 (3n 1 7) 2 ... 7. Rows 1 and 2 are interchanged between matrix A and matrix B. f (x) 5 5x 1 9 b. (See Example 4) 3 27. (f + g)(x) EXAMPLE 8 ? 9C9 44. Determine the maximum height. 53C6 5 53! 53! 5 5 22,957,480 6! ? Given a circle with radius r, diameter d, circumference C, and area A, a. g(f (25)) c. (n 1 1)! . (k 1 2)! by the inductive hypothesis. (1, 21), (1, 5) d. x 5 1; 24 57. 2x 1 3y 5 7 3 1 5 4x 5 26y 1 2 2 3 y52 x17 2x 5 y 1 1 y52 x15 2 4 4 35. 15.9% 105. It costs the farmer $84,800 to run the tractor for 800 hr during the first year. w(x) 5 3 21 x 2 x 11 44. y 111. Write the equation in slope-intercept form and determine the slope and y-intercept 3x 2 5y 5 215. (23, 0), (5, 0), A 2, 0B c. h(x) 5 6 3 4 Section 8.1 Practice Exercises, pp. The domain is (2`, `). For Exercise 49–50, find the value of an ordinary annuity in which regular payments of P dollars are made at the end of each compounding period, n times per year, at an interest rate r for t years. a7 5 1 1 and r 5 2 . 2A 115 1 111B x11 5 1 4 12 10 13x 1x 2 15 79. (3y2 2 z)5 23. 22 23 24 F F 2 39. 8 y 52 3 x 1 1 1 1 x 23 22 21 21 22 7 y 524 x 1 7 1 2 3 4 5 6 7 x d. 9 19. Dividend: 2x4 2 4x3 1 x 2 5; Divisor: x2 2 3x 1 1; Quotient: 2x2 1 2x 1 4; Remainder: 11x 2 9 7. gA 12 B e. Write the answer in slope-intercept form if possible. 2k By the inductive hypothesis, k! . P1 is true because 1 5 14(51 2 1). The shaded region would contain points on the circle (solid curve) and points outside the circle. e 23 6 2i, 2 , 1, 24 f 4 f (x) 5 5x3 2 4x2 1 180x 2 144 f (x) 5 25x4 1 10x3 1 60x2 2 200x 1 160 f (x) 5 18x3 1 39x2 1 8x 2 16 f (x) 5 x6 2 14x5 1 65x4 f(x) 5 x4 2 12x3 1 62x2 2 300x 1 925 Positive: 3 or 1; Negative: 3 or 1 51. y 5 1.2x 2 1.48 11. 22x2 1 3x 2 9 1 2 x 1x23 b. $238,884.21 b. 2110 2n 15 29 63. a 4 k51 696 Chapter 8 Sequences, Series, Induction, and Probability TECHNOLOGY CONNECTIONS Evaluating a Finite Series A graphing utility can be used to evaluate a finite series if the nth term of the corresponding sequence is known. Skill Practice 5 A speeding ticket is $100 plus $5 for every 1 mph over the speed limit. Determine Whether a Relation Is a Function 1. (f + g)(x) 5 x23 x24 1x 2 1 2 2 b. 2 (2, 22) becomes a 1 , 22b 5 (4, 22). [0.48, 0.54]; The candidate is expected to receive between 48% of the vote and 54% of the vote, inclusive. Over what interval(s) does the height decrease? 4 5 20. q(x) 5 20 x 0 94. Graph a 19. Use the nth term to find a20. Cumulative Number of Flu Cases 25 (4, 33) Number of Cases 30 Number (1000s) 2 x y 100. 16. Skill Practice 1 Use mathematical induction to prove Pn: 2 1 4 1 6 1 8 1 p 1 2n 5 n(n 1 1). In how many ways can a statistician select a sample of 15 people from a population of 90 people? No 7. f (5.5) c. 1 5 1; This represents the graph of an ellipse in the xy-plane. {(1600, 40)} b. The Daytona 500 auto race has 40 cars that initially start the race. 21 1 2 3 4 5 x 258 Chapter 2 Functions and Relations 23 for 24 # x , 22 67. The of an experiment is the set of all possible outcomes. 4, $12,201.90 c. y 5 0.4x 1 109.6 y 5 0.4(55) 1 109.6 y 5 131.6 Substitute 55 for x. 5 4 3 2 Horizontal Translations of Graphs g(x) 5 |x 1 2| • The graph of y 5 f (x 2 h) is the graph of y 5 f (x) shifted h units to the right. Evaluate P(1.6) and interpret the meaning in the context of this problem. E3 5 { } Therefore, P(E3) 5 The probability of selecting a red marble is 15 . 5y 5 2x 7 55y 5 x51 x 2 3y 5 0 x2y50 2 2 Section 2.5 Applications of Linear Equations and Modeling 223 For Exercises 37–44, write an equation of the line satisfying the given conditions. • The company breaks even if exactly 80 cups of lemonade are produced and sold. {254} 29. (27, 7) c. Section 8.4 Skill Practice Answers 1 Let Pn denote the statement that 2 1 4 1 ... 1 2n 5 n(n 1 1). 256y4 1 1280y3 1 2400y2 1 2000y 1 625 4. S5 5 45 9. 22 1 43. Graph the functions on the viewing window [25, 5, 1] by [22, 8, 1]. [1, 41] Radical equation b. If the money is later respent in the community over and over again at a rate of 70%, determine the total amount spent. {(x, 4x 2 2) 0 x is any real number} y12 or e a , yb ` y is any real number f 4 47. Therefore, events A and S are not mutually exclusive, meaning that they overlap. a1 5 15 Because 0 r 0 5 @ 213 @ , 1, we have S 5 5 . (2`, 21] ´ [0, `) 7 7 21. Find 2n(x). 6 1 10 1 14 1 ... 1 (4n 1 2) 5 n(2n 1 4) 24. 50P4 5 5,527,200 36,000 32 43 5 1 5 0.00012 40. ` c. y (2x, y) (x, y) 25 24 23 22 21 21 22 1 2 3 4 x 5 23 24 25 Solution: a. The graph of the first 10 terms of the sequence is shown in Figure 8-7. SECTION 8.2 For Exercises 18–20, determine whether the sequence is arithmetic. q(x) 5 2 1x 1 2 For Exercises 17–18, determine the solution set to the equation. Center: (0, 0) 15. Therefore, the sum is cn. False c. x2 1 y2 # 9 764 Chapter 8 Sequences, Series, Induction, and Probability Write About It 89. The graph of y 5 f (2x) is the graph of y 5 f (x) horizontally compressed. A21 5 c 2 5§ 1 2 21 3d 252 2 28. p2(p 2 6)5 (r 2 2)2(2r 2 1)4 R.4. R.5. 5 4 (r 2 2) (2r 2 1) p (p 2 6)2 Concept Connections 1. (25, 22) c. If one sock is selected at random, find the probability of the event. f(c) 5 1c 1 20 b. 7! 5 5040 11! b. 1.39 m; murky b. 3 5 6. Section 2.4 197 Linear Equations in Two Variables and Linear Functions Expanding Your Skills 125. Compute the actual value of the expression. 24 25 y y 5 2Î2x 1 2 1 24 23 22 21 21 1 2 3 4 5 6 x 22 23 m(x) 5 23|x 2 2| 2 4 24 25 26 2 3 4 (2, 0) 5 x 23 y y 5 4 3 2 Reflect over the x-axis 1 7. {8} c. k(x) 5 2x 1x 2 1 The domain of g is (2`, `). If the second and third terms of a geometric sequence are 15 and 75, what is the first term? Hamburger Calories Cholesterol (mg) 220 35 420 50 460 50 480 60 560 70 590 105 610 65 680 80 720 90 Animal Gestation Period (days) Longevity (yr) Rabbit 33 7.0 Squirrel 44 8.5 Fox 57 9.0 Cat 60 11.0 Dog 62 11.0 Lion 109 10.0 Pig 115 10.0 Goat 148 12.0 Horse 337 23.0 Elephant 620 35.0 226 Chapter 2 Functions and Relations Objective 4: Create Models Using Linear Regression For Exercises 67–70, use the scatter plot to determine if a linear regression model appears to be appropriate. Suppose that n represents the number of elements in a group from which r elements will be selected in no particular order. 103. { } 2) 2 6 5 5 13 41. Let Pn be the statement 1 ? Starting with an easily viewable, intuitive interface, students will be able to access key information, complete homework assignments, and utilize an integrated, mediarich eBook. 12r 12r 12r Section 8.3 Geometric Sequences and Series 717 Sum of an Infinite Geometric Series Given an infinite geometric series a1 1 a1r 1 a1r2 1 a1r3 1 ... , with 0 r 0 , 1, the sum S of all terms in the series is given by a1 S5 12r Note: If 0 r 0 $ 1, then the sum does not exist. (2`, `) b. The graph of a constant function is a horizontal line. 4 9 (y 1 2)2 5 0; The graph is a pair of intersecting lines: 19. 5 4 3 2 b. 5 3(x 1 2)2 2 7 (vertex form) b. • f is an odd function if f (2x) 5 2f (x) for all x in the domain of f. However, the median income for individuals with a bachelor's degree is consistently greater than for individuals whose highest level of education is a high school degree or equivalent (Figure 2-15). y 25 24 23 22 21 21 22 1 2 3 4 5 x 1 24 23 22 21 21 22 25 26 27 28 33. The card is an ace or a king. Since f (2) and f (3) have opposite signs, the intermediate value theorem guarantees that f has at least one real zero between 2 and 3. 3 1 10 1 17 1 24 1 ... 1 437 36 68 29. Find the length of the 5 diagonal shown. Write A as a function of P. The function is written as f (x) 5 a(x 2 h)2 1 k, where a 5 22, h 5 1, and k 5 8. 5 4 3 2 1 25 24 23 22 21 21 22 y 49. f)(21) g d. an 5 2(1.2)n b. y 5 2log3 x 1 2 3 4 5 6 7 8 9 x 23 103. c 3 d 25 21 27 23 27. 189 • Values of x that make the denominator zero. The value 1206! is too large to evaluate on most calculators. How many license plates can be made if there are no restrictions on the letters or digits? c 223 6 9 d 62 c. Assume that 1 1 5 1 p 1 5k21 5 14(5k 2 1) (Inductive hypothesis). Identify the vertex. y 5 2 40. latus; rectum 9. a c 5 cn Adding a constant c a total of n times equals cn. h(t) 5 12 2 t 22t$0 2t $ 22 t#2 Domain: (2`, 2] 3 5 2 5 5 Domain: a2`, b ´ a , `b 2 2 b. Equivalently, a e n(n 1 1) n11 n11 i51 i(i 1 1) We have shown that the statement Pn is true for n 5 1, 2, 3, and 4, but what about values of n thereafter? 58. 3 2 127. 5 (k 1 1) 1 1 k12 By the inductive hypothesis, 1 1 1 1 b d c1 2 d c a1 2 b a1 2 b p a1 2 2 3 k11 (k 1 1) 1 1 5 1 1 1 k11 1 ? 3k11. (2`, 23) f. d 5 2(x2 2 x1)2 1 (y2 2 y1)2 1. The x- and y-axes are called asymptotes of f and will be studied in detail in Section 3.5. 2. y2 x2 405,500 km 77. quadrilateral (4 sides) 70. y y 5 4 3 2 y 5 f(x) 1 25 24 23 22 21 21 22 2. Amount Spent on Video Games per Person by Year 140 Amount Owed on Vehicle after t Months 120 12,000 Amount Spent ($) Amount Owed ($) 15,000 A(t) 5 14,820 2 247t 9,000 6,000 3,000 0 0 10 20 30 40 Number of Months, t 50 100 80 60 f(x) 5 9.4x 1 35.7 40 20 60 0 0 2 4 6 8 Year (x 5 0 represents 2006) Objective 4: Determine Domain and Range of a Function For Exercises 87–96, determine the domain and range of the function. Given a ai, the variable i is called the of . a1 5 4 a2 5 2a1 1 1 5 2(4) 1 1 5 9 Substitute a1 5 4. E A212, 1B F 2 21. horizontal shrink 11. The point (2, 4) is displayed as an open dot to indicate that it is not part of the function. Show that 1 1 4 1 p 1 4k21 1 4(k11)21 5 13 (4k11 2 1). Further suppose that an expensive 8 ft by 10 ft oriental rug is placed on the floor. Yes 11. (g + f)(x) 5 g(f (x)) 5 1 f (x) 1 4 1 f (x) ? This mapping defines the set of ordered pairs: {(1, 2), (3, 2), (5, 4)}. d(x) 5 1 22 x 1 21 x14 240 Chapter 2 Functions and Relations Objective 3: Apply Vertical and Horizontal Shrinking and Stretching For Exercises 27–32, use transformations to graph the functions. The easement is 8 ft. y 5 2g(x) y 5 f(x) 2 37. y 1 2 3 4 5 25 24 23 22 21 21 22 3 4 5 1 2 3 4 5 x y 1 1 x 2 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 26. $20.80 f. A number between 2 and 7, inclusive, is rolled. 230 ft b. • If 0 , a , 1, then the graph of y 5 af (x) is the graph of y 5 f (x) shrunk vertically by a factor of a. 178 lb 29. k(x) 5 1 31x 5 b. v(x) 5 2x5 0x 0 1 2 43. 23 for x $ 1 1 2 3 4 y 5 f(x) 23 24 25 Figure 2-33 5 x • The first rule f (x) 5 23x defines a line with slope 23 and y-intercept (0, 0). 243(middle): © Julie Miller; p. 22, 21, 2 , 2 , ... 2 4 18 6 2 2 30. 81t2 2 16 69. The expression a3 1 3a2b 1 3ab2 1 b3 is called the expansion of (a 1 b)3. e f 2 4 6 113 f { }; The value 23 does not check. t(3t 1 4)3(t 2 2) 29. x 25 24 23 22 21 21 22 Chapter 7 Test, pp. n(x) 5 • x 2x2 1 4 for x $ 2 71. 6575 95. Then back substitute to find the third variable. x 5 19. (2, 0) and (22, 0) b. The person has elevated cholesterol. Determine the number of head/tail arrangements if a fair coin is flipped 3 times, 4 times, and 5 times. 4 6 i, 3 1 4 37. h(t) 5 5 102. Therefore, the graph of g is the graph of f reflected across the y-axis. 4 2 2(x 1 1) 1 12 1 x 5 0 b. g(x) 5 x4 1 x3 1 x 20. (1, 7); 3 55. The center is in Quadrant IV, the radius is 5, and the circle is tangent to both the x- and y-axes. The solution set consists of the ordered pair representing that point. Increasing 2 a. ` 3 i21 a. 7 6 5 4 F 3 2 1 C 24 23 22 21 21 F 1 2 3 4 5 6 x 22 23 y2 51 b. y 5 6 3 49. y 6 5 8 7 6 5 4 3 2 4 3 2 8 7 1 c. These exercises are highlighted with blue circles in the exercise sets and mirror the related examples. 45c3 x22 2x 39. dn 5 64A214 B n 11. 2 2 log(c 1 10) 51. How many codes can be formed if there are no restrictions? h(x) 5 x23 x2 1 4 98. y 5 f(x) 2 3 4 5 x y 114. 212,639 1. If the sequence is arithmetic, find the common difference d. 0.231 c. Stretch vertically by a factor of 2. See Empty sets Number line. The price P(x) (in $) to a customer after a 6.5% sales tax is given by P(x) 5 1.065(x 1 0.32x), where x is the cost of the drill from the manufacturer. A(P) 5 a b or A(P) 5 d. 97. The person has elevated blood pressure. 6.1% 10. 7 5 504 51. Given f (x) 5 41x, a. For Exercises 53–56, match the function with its graph. x18 (x 1 4) 1x 1 4(x 2 3) 3(x 2 4)2/3 1 2 19. y 5 2x 1 2 17 17 2 7. ` 1 i21 a. h1x2 5 22ax 2 b 1 4 8 4 8 7 d. Detailed Chapter Summaries are available at www.mhhe.com/millercollegealgebra. Solution: 1 p(x) 2 5 First note that function p has the restriction that x $ 2. 0 x 2 1.7 0 1 4.95 $ 11.15 c. AB BA AC CA AD DA AE EA BC CB BD DB BE EB CD DC CE EC DE ED To find the number of combinations, we divide the number of permutations (in this case 20) by 2! because there are 2! ways in which two letters can be arranged in order. Between 3 and 4 b. y 5 2x 2 4 21. (0, 0) c. (y 2 k) 5 4p(x 2 h) y 9. f(x) 5 2x17 x 13 7 6 5 4 3 2 1 27 26 25 24 23 22 21 21 22 23 1 2 3 x 105. n p 1 c 5 cn ac5c1c1c1 12 5. Which of the following can represent the probability of an event? The sum of the numbers showing on the dice is 8. If the scaling is the same on the x- and y-axes, the graph will appear elongated horizontally. Then use the symmetry of the curve to find additional points on the graph. {24, 22} b. A function is decreasing on an interval in its domain if the graph "falls" from left to right. 6 The parent function for h(x) 5 x3 1 2 is f (x) 5 x3. h(0) 5 23 h(1) 5 1 e. 6744.25 157. 15,000 cases d. Cube function: f (x) 5 x3 5 4 3 2 f(x) x 5 4 3 2 y 5 4 3 2 x 1 25 24 23 22 21 21 22 23 24 25 1 x 1 2 3 4 5 x f(x) 22 2½ 21 21 2½ 22 ½ 2 1 1 2 ½ 5 4 3 2 1 25 24 23 22 21 21 22 23 24 25 1 x 230 Chapter 2 Functions and Relations Notice that the graph of f (x) 5 1x gets close to (but never touches) the y-axis as x gets close to zero. Future Value of an Ordinary Annuity Suppose that P dollars is invested at the end of each compounding period n times per year at interest rate r. log5 x 1 3 6 1 43. can occur in n different ways, then the two events can occur in sequence in 2. C(x) 5 1.49x 2 1.00; x $ 1 The cost function is a linear function with $1.49 as the variable rate per song. Average rate of change: m 5 EXAMPLE 6 x m5 f(x2) 2 f(x1) x2 2 x1 Computing Average Rate of Change Blood Alcohol Concentration vs. The vertex is (22, 27). The weather was dry on the intervals of decreasing depth and water from the pond evaporated. Therefore, as n approaches infinity Sn 5 Answer 7. Domain: (2`, `); Range: [219, `) 12 2 Section 3.1 Practice Exercises, pp. None of these 13. Find a12. y 5 4 15. (4, 217) 1 3 c. 24(x 2 5) 1 3x # 23x 1 1 c. loga b 5 7 2 27. These consist of: • • • • Tip boxes that offer additional insight to a concept or procedure. The only real solution to the equation x3 2 27 5 0 is x 5 3. a b 3 C For Exercises 60–64, expand the binomial by using the binomial theorem. Event E is somewhat likely to happen. 5 xkx21 ? 1 1?2 1?2?3 1?2?3?4 , , , , p 3 9 27 81 4. 2.26 73. More than 8.36 in. The product is 5 ? f 4 2 7 16 8 17. p(x) 5 2x2 1 3x b. y will be 14 its original value. [23, 9] 20. The graph shows the height h (in meters) of a roller coaster t seconds after the ride starts. y (x2, y2) x1 1 x2 , y1 1 y2 2 2 (x1, y1) Now suppose that we want to find the midpoint of the line segment between the distinct points (x1, y1) and (x2, y2). f(x) 5 1.2x 1 0.78 a. 9.3 hr 127. If your taxable income is In Chapter 2, we will look at over— but not over— The tax is of the amount over— mathematical relationships involving $0 $8925 $0 $0 1 10% two or more variables, including $8925 $36,250 $8925 $892.50 1 15% the relationship between taxable $36,250 $87,850 $36,250 income and federal income tax. 2.61 a. g(22) Section 2.7 2 for 23 # x 1 for 22 # x 49. Foci: A0, 5 13 B, A0, 25 13 B g. e f 2 71. h Solution: a. f (x) 5 x2 and g(x) 5 x 2 4 d 15t 121. Evaluate: g(2x) g(2x) 5 4(2x)3 2 (2x) 5 24x3 1 x Same Evaluate: 2g(x) 2g(x) 5 2(4x3 2 x) 5 24x3 1 x Since g(2x) 5 2g(x), the function g is an odd function. Endpoints of a diameter (7, 5) and (1, 23) 14. Decreasing c. This line should be graphed only for x , 21 (that is to the left of x 5 21). In Example 4, we find specific terms of an arithmetic sequence given information about the sequence. 111. 0 83. 1 1 1 1 Show that a1 2 b a1 2 b p a1 2 b c1 2 d 2 3 k11 (k 1 1) 1 1 1 1 5 . 21 b. 8u 1 2u v 2 15v 31. Solution: x 1 4y 5 3 4y 5 2x 1 3 1 3 y52 x1 4 4 y 2 y1 5 m(x 2 x1) 1 y 2 1 5 2 [x 2 (24)] 4 1 y 2 1 5 2 (x 1 4) 4 1 y2152 x21 4 The slope of the given line can be found from its slope-intercept form. {(1, 21, 0, 2)} 2 False. Write the first six terms of the sequence defined by a1 5 22, a2 5 3, an 5 an22 1 an21 for n $ 3. Assume that 3k , 2k for a positive integer k $ 4. 1, 2, 4, 8, 16, 32, 64, 128, 256 b. 10 8 6 4 10 8 F 6 4 2 F F 21028 26 24 22 22 24 2 4 6 8 10 x 26 4 6 8 10 28 F 210 5 4 3 5 4 3 2 1 2 3 4 x 5 25 24 23 22 21 21 22 1 24 25 b. a , 0b, a , 0b 2 2 11. polynomial 3. 212 27. For a recent year, the federal income tax owed by a taxpayer (single—no dependents) was based on the individual's taxable income. A 12u3 1 v4 B 8; third term 37. 0 t 2 5 0 or 0 5 2 t 0 3. y 5 1x 1 11 2 x17 27. a 4 69. C(x) 5 0.50x 1 120 The fixed cost is $120 because it does not change relative to the number of cups of lemonade produced. Add and subtract C 12(4)D 2 5 4 within parentheses. a y 17. Systolic Blood Pressure by Age 180 (51, 130) (21, 118) 140 100 60 20 0 10 20 30 40 50 Age (yr) 60 70 80 a. The point (4, 22) is the lowest point in a small interval surrounding x 5 4. k(8) 46. (x 1 5)2 1 (y 2 3)2 5 9 (y 2 3)2 5 9 2 (x 1 5)2 y 2 3 5 6 29 2 (x 1 5)2 y 5 3 6 29 2 (x 1 5)2 Notice that the graph looks more oval-shaped than circular. c d 22 41 26 55. 5 103. (g ? R(x) 5 80x c. Use the data points (44, 8.5) and (620, 35) to write a linear function that defines longevity L(x) as a linear function of the length of the gestation period x. (g + f)(x) 5 ; Domain: (2`, 0) ´ (0, 3) ´ (3, `) 2x2 1 3x 1x 1 2 ; Domain: 3 22, 0) ´ (0, `) 4. P1 is true because 3 5 1[2(1) 1 1]. To find the sum of the first 50 terms, we need to know the values of a1 and a50. 64 4 40. Since the x-coordinate is multiplied by the reciprocal of a, values of a greater than 1 actually compress (shrink) the graph horizontally toward the y-axis. Its converse is the statement "if q, then p." The converse of a statement is not necessarily true. From the table, we see a pattern and from the pattern, we form the graph. $81,007.17 PC A1 1 nr B nt 2 1D b. 0 2x 2 3.8 0 2 4.6 $ 7.2 c. 0, d ? g(x) 5 (x 2 2)2 c. form of an Objective 1: Write an Equation of a Circle in Standard Form 5. 3 y 2 1 26 25 24 23 22 21 21 22 79. 5 2(2k) 5 2k11 Therefore, 3(k 1 1) , 2k11 as desired. Never decreasing f. How many 3-digit codes can be formed with the given restrictions? 19,682 9. 178 Chapter 2 Functions and Relations Standard Form of an Equation of a Circle Given a circle centered at (h, k) with radius r, the standard form of an equation of the circle (also called center-radius form) is given by (x 2 h)2 1 (y 2 k)2 5 r2 where r . If the hikers want to meet for lunch, determine the location of the midpoint between the hikers. The y-coordinate of the vertex is f (4). (f + g)(0) 107. The customer is male or paid by check. The minimum value is 27. If she has time in the summer to read 5 of the 8 books, in how many ways can she select 5 books from 8 books? Stretch horizontally by a factor of 4. Minimum value: 29 e. The function h first evaluates the expression 2x2 2 5, and then takes the absolute value. a3 5 72 and a6 5 722 Chapter 8 Sequences, Series, Induction, and Probability Objectives 2–3: Evaluate Finite and Infinite Geometric Series For Exercises 49–72, find the sum of the geometric series, if possible. (m 1 n)10; seventh term 30. x2 1 (x 1 1)2 5 113 b. m 5 1 8 y 5 4 3 2 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 43. 22 14. f 21(x) 5 21x 1 3 y f. See also Polynomials explanation of, 38 factoring quadratic, 49–51 perfect square, 51–52, 115–116 substitution method to factor, 55 Turning points, of polynomial functions, 307 U Undefined rational expressions, 373 Uniform motion applications, 97, 134–135, 499–500 Union of sets, 5–6, 73 of two events, 755–757 Upper and lower bound theorem, 338–339 Upper bounds, 337–340 V Variables, 2 Variation in applications, 385–387 constant of, 383, 384, 393 direct, 383, 385–386 inverse, 383, 386 joint, 384, 387 review of, 393 Variation models, 383–384 Vertex form explanation of, 286 quadratic function written in, 287–288, 391 Vertex formula, 289–290 Vertical asymptotes explanation of, 236–237, 393 method to identify, 347–348 Vertical lines equation of, 201 slope of, 200, 201 Vertical line test, 185, 275 Vertical shifts, 276 Vertical shrink/stretch, 232–233, 236 Vertical translations, of graphs, 230–232, 236, 276 Vertices of ellipse, 635 of feasible region, 549 I-9 of hyperbola, 651 of parabola, 289–290, 667–672 Volume application involving, 126 of cube, 42 W Wallis, John, 4 Whole numbers, 2, 73 Wiles, Andrew, 730 Work applications, 98 X x-axis explanation of, 166 reflections across, 234–236, 276 x-coordinate, 166, 276 x-intercepts explanation of, 170 of function defined by y 5 f(x), 171, 188 method to find, 171, 188, 275, 290 Y y-axis explanation of, 166 reflections across, 234–236, 276 y-coordinate, 166 y-intercepts explanation of, 170 of function defined by y 5 f(x), 171, 188 graphs of line and, 201–202 method to find, 171, 188, 275 Z Zero exponents, 18–20 Zero product property to solve polynomial equations, 133 to solve quadratic equations, 113–114, 120, 158 Zeros division involving, 10 irrational, 329 of multiplicity, 305, 339–340 nonreal, 336 of polynomial functions, 303–306, 391–392 of polynomials, 321–324, 329–340, 392 rational, 329–332 rational expressions equal to, 373 simplifying expressions with, 18–20 0 1 59. 3 0 1 214 For example: c d 61. Horizontal 13. There are 18 odd numbers. (0, 3) f. Count Permutations We now look at a situation in which n items are to be arranged in order. an 6 4 2 1 2 3 4 5 6 7 8 9 n an 9 8 7 6 5 4 3 2 1 21 21 22 23 24 94. {5}; The value 22 does not check. (See Example 2) 15. y 93. a (2i 1 3) 5 [2(1) 1 3] 1 [2(2) 1 3] 1 [2(3) 1 3] 1 [2(4) 1 3] 1 [2(5) 1 3] i51 5 5 1 7 1 9 1 11 1 13 5 45 5 6 1 1 1 1 1 b. The sum of the numbers on the dice is greater than or equal to 8. False b. For an integer k, if k $ j, the truth of Pk implies the truth of Pk11. 6x f. [5, 10] Section 2.4 211 Linear Equations in Two Variables and Linear Functions Objective 5: Solve Equations and Inequalities Graphically For Exercises 91–98, use the graph to solve the equation and inequalities. 270 mg c. 2 (1.3)3 Principles of Counting OBJECTIVES 1. Graph the solution set. p)(x) and write the domain of m ? a (2i 1 3) i51 k53 6 c. Use the points (0, 11) and (40, 22) to write a linear model for these data. Write a formula for the nth term of an arithmetic sequence that represents the distance dn (in inches) that the ball will roll in the nth second. Use the graph to find the solution set to the inequality 3x 2 (x 1 4) 2 1 # 0. Yes No No Opinion Total Male 92 7 4 103 Female 36 102 24 162 128 109 28 265 Total If one student is selected at random from the group, find the probability that a. 65. Airlines often overbook flights because a small percentage of passengers do not show up (perhaps due to missed connections). x1 1 x2 5 b. (23, 3) 119. 368 1. 0.552x3 1 4.13x2 2 1.84x 2 10.2 , 0 b. How many different meals can be formed if a patient chooses one item from each category? False 5. 3 10. T(a) 5 a 1 0.06a 5 1.06a The total cost is the sum of the cost of the songs plus the sales tax. 0 y 1 1 0 5 x c. 1 g. 59. Graph three circles whose centers are located at the observation towers and whose radii are the given distances to the fire. e 2 3 f ; x < 20.5331 e2 f 3 ln 5 ln 2 7 ln 2 2 3 ln 3 f ; c < 1.0346 30. maximum x value minimum y value maximum y value 10 [210, 10, 1] 210 by [210, 10, 1]. Complete the square: C 12(214)D 2 5 49. 4k 2 1 5 4 ? Figure 2-9 The table shows eleven x-y pairs but more can be accessed by using the up and down arrow keys on the keypad. (x2 1 9)(x 2 3)(x 1 3)(x 1 2) 30. a 23a b 3 ` 1 n 23. How many identification codes are possible if both letters and digits may be repeated? 5 4 3 2 h(x) 5 x3 1 2 The graph of h (shown in blue) is the graph of f shifted upward 2 units. y 5 3x2 2 6x 1 1 B A B C A 1 25. Vertex: (3, 21); Focus: (3, 0); Focal diameter: 4 47. Focus groups and symposia were conducted with instructors from around the country to provide feedback to editors and the authors and ensure the direction of the text was meeting the needs of students and instructors. [4, 6] e. Therefore, the function is an odd function. R.1. 10. For a recent year, approximately 36,000 people were killed in the United States in motor vehicle accidents. Identity function: f (x) 5 x Constant functions f(x) 5 b 4 1 0 1 4 f(x) 22 21 0 1 2 22 21 0 1 2 1 25 24 23 22 21 21 22 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 x f(x) 22 21 0 1 2 28 21 0 1 8 1 1 2 3 4 5 6 7 8 9 x 23 x f(x) 28 21 0 1 8 22 21 0 1 2 7. Find all values of x such that the distance between (x, 21) and (4, 2) is 5 units. {1, 6, 11, 16, ...} (See Example 7) 53. Evaluate (f + f)(21). By contrast, the graph of g is the graph of y 5 0 x 0 with a horizontal shift to the right 3 units and a vertical shift downward 2 units. This line should be graphed only to the left of x 5 1. m 1 3 43. x 2 1 Solution: TIP The solution set to the inequality 2x 2 3 # x 2 1 includes equality, so the right endpoint would be included: (2`, 2]. a , 3b 2 5. Number of Permutations of n Distinguishable Elements The number of permutations of n distinct elements is n!. (22, 7) and (24, 11) 12. {2} 4 67. Real part: 0; Imaginary part: 2 1 1 1 i 33. Sets and the Real Number Line 3 TECHNOLOGY CONNECTIONS Approximating Rational and Irrational Numbers The number 2116 is a rational number, and the number π is an irrational number. 282–283 y 79. Not arithmetic 2. y 5 4 3 2 x y 22 2 0 2 1 2 2 4 2 25 24 23 22 21 21 22 x can be y must any real be 2. 12 y2 y2 x2 c2 c2 2 5 1 2 51 y5b 21 2 2 2 2 B a b a b a2 c2 2 a2 b y5b y 5 2c2 2 a2 a B a2 Recall that c2 5 a2 1 b2 or equivalently b2 5 c2 2 a2 and b . $8260 17. Lily borrowed $1000 from her friend, $7000 from the credit union, and $2000 from the bank. (2`, 2) ´ (2, `) i. 1533 a1(1 2 rn) a1(1 2 0) a1 approaches 5 . 24 yr c. These are the points where a graph intersects the x- and y-axes. 1 5 720 7! 5 7 ? f (x) 5 3x2 1 12x 1 5 0 5 3x2 1 12x 1 5 212 6 2(12)2 2 4(3)(5) x5 2(3) 5 212 6 184 6 Answers e. Given an infinite geometric series with first term a1 and common ratio r, if 0 r 0 , 1, then the sum S is given by the . • A function defined by f (x) 5 b is a constant function. [22, 3) b. 126. Based on the data given, does the number of participants follow an arithmetic progression? Find the sum. TIP It is important to note that the notation 1f + g21x2 represents the composition of functions, not multiplication of f, g, and x. e a 2 113 {(x, y, z) 0 2x 2 3y 1 z 5 6} 47. P1 is true because 3 is a factor of (4)1 2 1 5 3. Find a6. As the story goes, Gauss returned the correct sum of 5050 within minutes by taking the product of 50(101). 3 5 4 3 20. 2 (multiplicity 2), , 24 25. {2}; The value 24 does not check. The closed dot from the red segment of the graph "overrides" the open dot from the blue segment. The sum of the numbers on the dice is not 4. Write the nth term of a sequence representing the cost to tile an n by n square foot area where n is an integer and n $ 1 ft. 5 4 3 2 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 y 18. 10 2 10i 47. The range is (2`, 8]. That is, Y1 5 Y2 when x 5 23. Write the General Form of an Equation of a Circle Definition of a Circle A circle is the set of all points in a plane that are equidistant from a fixed point called the center. For example, the following ordered pairs are solutions to the equation y 5 x 1 2. 5 83. The frequency for middle C on a piano is 256 Hz. The C above middle C (one octave above) is 512 Hz. The frequencies of musical notes follow a geometric progression. 3 5 75 c. [0, 7) 111. New functions can also be formed from the sum, product, and quotient of two functions. Neither 33. 2A 2C 16.1 210 Problem Recognition Exercises, pp. A(d) 5 2 Section 2.4 Practice Exercises, pp. 6 3 24. i. In each case, add like terms or like radicals by using the distributive property. (0.2 1 0.1k)4 26. 154 ft2 c. y 5 x 1 5 5 75. k in interval notation. No, eventually the number of cases would exceed the human 11,731 population. The vertex is (h, k), which is (1, 8). Center: (0, 0) Vertices: A 17, 0B, A217, 0B Foci: A2 13, 0B, A22 13, 0B 135 y 5 135 7 x and y 5 2 7 x b. Horizontal asymptote: y 5 2 2. E4 6 2i 12F 43. 3! Skill Practice 4 a. Real part: 0; Imaginary part: 19 Real part: 214 ; Imaginary part: 0 29. 723 Geometric Sequences and Series 88. 10 units2 A C A C a. a 5 4, v0 5 18, and s0 5 10 55. If an ordered pair (a, f(a)) corresponds to a relative minimum or relative maximum, we interpret the coordinates of the ordered pair as follows. 0 21. 224x2 2 16x 1 8 15 2 4 109. The y-intercept is (0, 5). Geometric; r 5 22 5. No restricted values x23 13. n! is true for all positive integers n. For Exercises 1–2, simplify the expression. An object is launched straight upward with an initial speed of 400 ft/sec from a height of 4 ft. Focus: (0, 6.3); Place the receiver 6.3 in. x n xn 33. Write a rule for the graph of the function. This can be generated by the factor (21)i 1 1. We can check the solution graphically by determining where the related function Y1 5 6x 2 2(x 1 2) 2 5 intersects the x-axis. $51,007.17 SECTION 8.3 Practice Exercises Prerequisite Review 5 2 2 4 6 3 1 x R.3. For g(x) 5 a b find g(0), 4 g(1), g(2), g(21), and g(22). Our heartfelt gratitude goes to the production manager Peggy Selle for steering the ship and keeping us all on task. y 22 21 21 22 1 2 3 4 5 1 25 24 23 22 21 21 22 1 23 6 7 8 2 3 4 5 x k(x) 5 23x 24 25 26 x b. 9! 5 362,880 33. 1 49 43. Therefore, n(E2) 5 2 and n(E2) 2 1 5 5 < 0.0526. V 5 lwh 1. a6 5 and r 5 2 . A > B 5 B 4. Vertex: (0, 0); p 5 21; c. 8 g. 26.4 yr a. Elliptical c. x 25 24 23 22 21 21 22 1 2 3 4 5 x 24 25 23. d1 5 4 234 b. This is done so that the seats for the few passengers that are no-shows will still have been sold. P1 is true because 2 is a factor of (7)1 2 5 5 2. 2.1} 2.1 (2`, 4] {x 0 4 $ x} 4 5. Therefore, there are no real zeros of f(x). —Donna Gerken iii Table of Contents Index of Applications CHAPTER R xvii Review of Prerequisites 1 Section R.1 Sets and the Real Number Line 2 Section R.2 Integer Exponents and Scientific Notation 18 Section R.3 Rational Exponents and Radicals 27 Section R.4 Polynomials and Multiplication of Radicals 38 Problem Recognition Exercises: Simplifying Algebraic Expressions 47 Section R.5 Factoring 47 Section R.6 Rational Expressions and More Operations on Radicals 59 Algebra for Calculus 72 Key Concepts 73 Review Exercises 75 Test 78 CHAPTER 1 Equations and Inequalities 81 Section 1.1 Linear Equations and Rational Equations 82 Section 1.2 Applications with Linear and Rational Equations 94 Section 1.3 Complex Numbers 104 Section 1.4 Quadratic Equations 113 Problem Recognition Exercises: Simplifying Expressions Versus Solving Equations 125 Section 1.5 Applications of Quadratic Equations 126 Section 1.6 More Equations and Applications 133 Section 1.7 Linear, Compound, and Absolute Value Inequalities 144 Problem Recognition Exercises: Recognizing and Solving Equations and Inequalities 156 Equations and Inequalities for Calculus 157 Key Concepts 158 Review Exercises 160 Test 163 Cumulative Review Exercises CHAPTER 2 164 Functions and Relations 165 Section 2.1 The Rectangular Coordinate System and Graphing Utilities 166 Section 2.2 Circles 177 Section 2.3 Functions and Relations 183 Section 2.4 Linear Equations in Two Variables and Linear Functions 197 Section 2.5 Applications of Linear Equations and Modeling 213 Problem Recognition Exercises: Comparing Graphs of Equations 228 Section 2.6 Transformations of Graphs 229 iv v Table of Contents Section 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions 243 Section 2.8 Algebra of Functions and Function Composition 262 Key Concepts 275 Review Exercises 277 Test 282 Cumulative Review Exercises CHAPTER 3 283 Polynomial and Rational Functions 285 Section 3.1 Quadratic Functions 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5 489 Systems of Equations and Inequalities 491 Section 5.1 Systems of Linear Equations in Two Variables and Applications 492 Section 5.2 Systems of Linear Equations in Three Variables and Applications 506 Section 5.3 Partial Fraction Decomposition 517 Section 5.4 Systems of Nonlinear Equations in Two Variables 527 Section 5.5 Inequalities and Systems of Inequalities in Two Variables Problem Recognition Exercises: Equations and Inequalities in Two Variables 547 Section 5.6 Linear Programming 547 536 vi Table of Contents Key Concepts 556 Review Exercises 558 Test 560 Cumulative Review Exercises CHAPTER 6 561 Matrices and Determinants and Applications 563 Section 6.1 Solving Systems of Linear Equations Using Matrices 564 Section 6.2 Inconsistent Systems and Dependent Equations 575 Section 6.3 Operations on Matrices 585 Section 6.4 Inverse Matrices and Matrix Equations 602 Section 6.5 Determinants and Cramer's Rule 612 Problem Recognition Exercises: Using Multiple Methods to Solve Systems of Linear Equations 625 Key Concepts 625 Review Exercises 627 Test 630 Cumulative Review Exercises CHAPTER 7 Analytic Geometry 631 633 Section 7.1 The Ellipse 634 Section 7.2 The Hyperbola 651 Section 7.3 The Parabola 667 Problem Recognition Exercises: Comparing Equations of Conic Sections and the General Equation 680–681 Key Concepts 682 Review Exercises 683 Test 685 Cumulative Review Exercises CHAPTER 8 687 Sequences, Series, Induction, and Probability 689 Section 8.1 Sequences and Series 690 Section 8.2 Arithmetic Sequences and Series 701 Section 8.3 Geometric Sequences and Series 712 Problem Recognition Exercises: Comparing Arithmetic and Geometric Sequences and Series 725 Section 8.4 Mathematical Induction 725 Section 8.5 The Binomial Theorem 732 Section 8.6 Principles of Counting 738 Section 8.7 Introduction to Probability 750 Key Concepts 764 Review Exercises 767 Test 770 Cumulative Review Exercises 772 Appendix A Additional Topics Appendix A-1 (Online only) Student Answer Appendix SA-1 Instructor Answer Appendix IA-1 (AIE only) Credits C-1 Index I-1 Key Features Clear, Precise Writing Because a diverse group of students take this course, Julie Miller has written this manuscript to use simple and accessible language. {(7, 6)} 14. If 4 batteries are drawn at random, what is the probability that all four will be defective? y 5 2 y 39. 212, 6 d. (2`, 2] j. Equation; e 2 f 4 b. If the weight of the kitten continues to increase linearly for 3 months, predit the kitten's weight 12 weeks after birth. a (4i) 5 a u 5 a u i51 k52 j50 k52 Mixed Exercises n n n n 90. {0} d. (23, 2) b. pH ˜ 4.5; acidic 43. $32,000 $166,451.73 87. 1 R.2. 16 R.3. 4 R.4. 5 27 (2`, 215] ´ [25, `) R.6. (2`, 4) ´ (4, `) logarithmic 3. 3 4 R.3. y 5 4 3 2 25 24 23 22 21 21 22 10 10 R.2. y 5 4 3 y 5 23x 2 1 2 24 25 y 5 f(3x) 1 2 3 4 5 x 5 x SA-13 Student Answer Appendix 39. [25, 22] d. 47. y 16. (1, 23) c. Through her friendly and engaging writing style, students are able to understand the material easily. 2 we need to show that the left and right For n 5 1, the sum is 1 which equals (1) . The remaining 4 questions are yes/no questions. a 25. Creating accessible products is a priority for McGraw-Hill. (x 2 2)2 5 8(y 2 3) or (y 2 3)2 5 (x 2 2) 69. Find f (x 1 h) 2 f (x) . From the graph, the minimum or maximum value of the function is readily apparent. The solution set is {2}. 253 • f (a) is a relative maximum of f if there exists an open interval containing a such that f (a) $ f (x) for all x in the interval. i b. 4.5 3 1010; 1.66 3 106 38. 16m2n(5m2n7 2 3m3n2 2 1) 81. 730 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 4 Using the Extended Principle of Mathematical Induction Use mathematical induction to prove that n! . Hyperbola; Center: (24, 1); Vertices: (24, 13), (24, 211); Foci: (24, 14), (24, 212); Asymptotes: y 5 125x 1 535 and y 5 2125x 2 435 ; Eccentricity: 13 12 12. One byte is 8 bits. Evaluate a (21)i11 if n is even. 6 24 y 5 2x 1 2 SECTION 2.1 Practice Exercises Prerequisite Review R.1. R.2. R.3. R.4. Simplify the radical. 3 3 8. 25 12 17. Fernando invested $4500 in the 3-yr CD and $2500 in the 18-month CD. g(x) 5 1x 1 15 2 2 c. Once the first horse finishes, there are 7 horses remaining that can come in second. {104.1 2 17}; p < 12,572.2541 4 2 e3 47. (2`, 0) ´ (0, 3] 65. Explain why a 213 b is undefined. Not possible 22. The exponent on b is one less than the term number. 1, 3, 5, 7, 9, ... Answer 7. The sum Sn of the first n terms of a geometric sequence is given by Sn 5

Sum of an infinite geometric series: Given an infinite geometric series a1 1 a1r 1 a1r2 1 a1r3 1 ... with 0 r 0 , 1, the sum S of all terms in the series is given by S5 Note: If 0 r 0 $ 1, then the sum does not exist. No x-intercept d. Some ancillaries, including electronic and print components, may not be available to customers outside the United States. (6 2 1)! 1! ? n, which terms are positive and which are negative? Identify the slope in terms of the coefficients A and B. 3n for positive integers n $ 7. In this case, the manufacturer should produce 1200 grill A units and 0 grill B units. (1, 22) b. Downward 11 d. Letter from the Authors For many students, college algebra serves as a gateway course to the higher levels of mathematics needed for a variety of careers. Let h, k, and a represent positive real numbers. 22 b. Determine the location and value of any relative maxima. 3, 6, 12, 24, ... 1 1 28. Use the graph to find the solution set to the inequality 6x 2 2(x 1 2) 2 5 $ 0. EXAMPLE 5 Writing the nth Term of a Geometric Sequence Given the terms a2 5 80 and a5 5 40.96 of a geometric sequence, find r, a1, and an. 2x 2 2 67. Then the regions defined by the individual constraints are graphed. 692 For a positive integer n, the quantity n! ("n factorial") is defined as n! 5 (n)(n 2 1)(n 2 2) ... (2)(1) p. log4(2x 1 7) 5 2 1 log4 x 18. 3x 5 5 b. The mathematics involved in finding maximum heart rate and an individual's target heart rate zone use a linear model relating age and resting heart rate. x2 5 60 29. {2} 17. 5y z 22x z 67. [210, 6] 57. As we proceed through the text, we will develop tools to graph equations efficiently. n! (n 1 2)! 1 8 ? f(x2) EXAMPLE 10 F For all x1 and x2 on I, f(x1) 5 f(x2) Determining the Intervals Over Which a Function Is Increasing, Decreasing, and Constant Use interval notation to write the interval(s) over which f is a. x 5 9. 9 73. Events A and K are mutually exclusive. y $ 0 y c. (0, 1) 1 b. None f. (2`, 22] ´ (3, `) d. The range of f. 1 2 3 4 x 26 25 24 23 22 21 22 24 m(x) 5 3x 1 2 1 2 3 4 x b. 233 • Reflection y 5 2f (x) y 5 f (2x) p. Similarly, the graphing calculator exercises are found at the end of the exercise sets and may also be easily skipped. n 6. 114 cups 71. h (f 1 g)(x) 5 0 x 0 1 3; Graph d (f 1 g)(x) 5 x2 2 4; Graph a 11 4 213 11. • f is constant on I if f (x1) 5 f (x2) for all x1 and x2 on I. Evaluate the expressions. 680–681 1. Write a linear model representing the amount of gas G(t) left in the tank t hours into a trip. g(x) 5 • 5x 1 6 for 22 , x , 3 4 for x $ 3 23x 1 7 for x , 21 47. (9, 0, 4) c. Notice that in Example 2(c), the function p n is not defined for x 5 21 or for x 5 3. f (5) 5 (5)2 1 2(5) 5 35. A6 1 i 13B 2 2 12 A6 1 i 13B 1 39 5 0 ✓ 1 2 3 4 5 x y R.3. E24 6 i 13F Remainder: r(x) 7. an 5 31. 2i 43. 49. [ln(x 1 h) 2 ln x] 5 ln a b h h h x x 1 h 1yh b 5 lna x 103. a3 5 45 and a6 5 2243 25 47. Prior to her work at DSC, she worked as a software engineer for General Electric in the area of flight and radar simulation. The customer will wait more than 150 sec. Graph y 5 2f(x 1 1) 2 2. x 5 23 d. Because there is no y variable and because the slope is undefined, an equation of a vertical line cannot be written in slopeintercept form. Given f (x) 5 2x3 2 5x2 2 28x 1 15, a. f (x) 5 (x 2 3)(3x 2 1)2 b. y 5 4 3 y 5 22x 1 1 2 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x Skill Practice 4 Write an equation of the line passing through the point (28, 24) and perpendicular to the line defined by y 5 16 x 1 3. (See Example 2) 25. (See Example 5) d(t 1 h) 2 d(t) a. We begin by investigating the functions defined by y 5 f (x) and y 5 a ? 236 b. (2`, 21) c. 227 Undefined (not a real number) 59. 110 min 29. 2 1 1. 7 27. a b(1) f e. [3, `) b. 1 Section 8.5 EXAMPLE 3 The Binomial Theorem 735 Applying the Binomial Theorem Expand by using the binomial theorem. Refer to the data given in Exercise 29. 9 5 1,404,000 Skill Practice 2 A code for an alarm system is made up of two letters, followed by four digits. an 5 6A 12 B n11 10. The point (21, 25) is the lowest point in a small interval surrounding x 5 21. In how many ways can the word EXACTLY be misspelled? What is the degree of each term in the expansion? 1 and x0 5 1. (3 ? Equation; {27, 25} b. y 5 2x 1 4 5 21 89. y 5 216 2 x2 y 5 2 216 2 x2 x 5 216 2 y2 x 5 2 216 2 y2 66. 1 4 9 16 n2 1 1 1 1p1 2 3 4 5 n11 78. That is, the difference between consecutive terms is not the same. In how many ways can the 64 players be paired to play in the first round? What is the slope of a line parallel to this line? 0.984 33. Predict the number of participants in week 10 if this trend continues. 222–228 3 3 x 1 3; Slope 5 , y-intercept is (0, 3) 5 5 Undefined R.4. 0 R.5. C 5 450 1 850m 1 250n y 2 y1 5 m(x 2 x1) 3. EXAMPLE 10 Applying Function Composition At a popular website, the cost to download individual songs is $1.49 per song. The least-squares regression line is based on all available data points. We have that P(H) 5 0.279. 100 people 30. 2262; The number of new flu cases dropped by 262 per month during this time interval. How many first-, second-, and third-place finishes can occur? The data in Exercise 66 give the average gestation period x (in days) for selected animals and their corresponding average longevity y (in yr). Given a geometric sequence whose nth term is an 5 3(1.4)n, are the terms of this sequence increasing or decreasing? No 1 0 21 c. y 5 11.5 2 x 30. y 5 4x and y 5 24x x 7. 3 e. Isner and Mahut would meet in the first round 2 yr in a row. Parabola b. 28c3d 3 41. 22 41. Coefficients 2. For Exercises 91–94, match the sequence with its graph. g(x) 5 2 a. n 5 53 37. 22 e. (See Example 3) 21. In a "Pick-4" game, a player wins a prize for matching a 4-digit number from 0000 to 9999 with the number randomly selected during the drawing. Year Amount ($) 1 2 3 4 102.60 108.00 113.40 118.80 a. f (x) 5 8x3 2 22x2 2 7x 1 3 31. • • • • The exponent on a decreases from n to 0 on sequential terms from left to right. If h, k, and a represent positive real numbers, then the graphs of the following functions are related to y 5 f (x) as follows. 0.052x 2 0.013y 5 0.39 Technology Connections For Exercises 109–112, solve the equation in part (a) and verify the solution on a graphing calculator. a1 5 102, d 5 4 b. AB2 75. 1 b. This result can also be obtained by using factorial notation: Number of people in the group (5). Social Security numbers assigned in the United States are comprised of 9 digits of the form _ _ _-_ _-_ _ _ _. y 96. 36 4 z2 x2 1 5 1; This represents the graph of an ellipse in the xz-plane. 27 59. At a hospital specializing in treating heart disease, it was found that 222 out of 4624 patients undergoing open heart mitral valve surgery died during surgery or within 30 days after surgery. i51 1 1. Passes through a , b and the slope is undefined. • If a , 0, the parabola opens downward, and the vertex is the maximum point. The slope of a vertical line is ________. Graph Linear Equations In The median incomes for individuals for all levels of education have shown an increasing trend since 1990. If 82 private lessons are held during a given month, how much money will the studio make or lose? Evaluate G(4.5) and interpret the meaning in the context of this problem. S2 5 48,000 1 2000x c. 224: © Caroline Celano; p. Term: 1 2 3 4 5 2 3 4 5 6 2 1 2 1 1 4 9 16 25 5 a (21) i51 i11 ? The expression represents the greatest integer, less than or equal to x. 12`, 2 4 3. 781 c 23. See page SA-46. For an infinite geometric sequence with 21 , r , 1 (equivalently 0 r 0 , 1), the value of rn will become smaller as n gets larger. 1 51 16 25 2 (y (x 1 5) 55. 21 4. {(21, 2, 23)} Infinitely many solutions; The equations are dependent. n58 Alternatively: 8P3 5 8 ? 2 3 n11 n11 1 1 1. In all cases the quotient is the same ratio r. Then the series . a2 , 0b and (1, 27) 2 (x1, y1) and (x2, y2) m5 2 1 Label the points. (f + h + g)(2) 62. c d ; This matrix represents the reflection of the 1 21 0 triangle across the x-axis, followed by a shift to the left 1 unit and a shift upward 2 units. This is slope-intercept form. Evaluate 20P3 and interpret its meaning. f (x) 5 22x4 1 5 0 x 0 TIP In Example 4(a), we suspect that f is an even function because each term is of the form xeven or 0 x 0 . 1 23 23 d. No 71. Write a linear function to model the sales person's weekly salary S(x) for x dollars in sales. { } 35. 0 B 0 5 (10)(213) 5 2130 and, therefore, 0 A 0 ? 3 3 2 1 1 2 3 4 5 27 26 25 24 23 22 21 21 22 x 1 x 23 24 25 26 27 102. t(x) 5 22 0 x 0 1 76. The graph of an even function is symmetric with respect to the y-axis. 5 4 3 2 1 1 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 23 24 25 24 25 24 25 x For Exercises 111–112, a. How can this expression be evaluated 118! by hand? a a b i51 4 ` 3 k21 67. f (x) 5 x 9 , g(x) 5 2 x21 x 2 16 1 , find (f + f)(x) and write the x22 domain in interval notation. Let f be an increasing function. 2, 4, 8, 16, ... 52. b6 5 (6)2 36 36 1 5 5 5 (6 1 1)! 7! 7?6?5?4?3?2?1 140 Skill Practice 4 Given the sequence defined by cn 5 2n , find c4. There were 8 players. (3x 1 1)2y3(8x 1 1) 87. Use the inverse matrix from Exercise 47 to solve the system of equations. C(4) 5 12.99(4) 1 99 5 150.96 The base price $99 is the fixed cost with zero additional family members added. Find the shortest distance from the origin to a point on the circle defined by x2 1 y2 1 4x 2 12y 1 31 5 0. Vertical asymptote: x 5 22; Horizontal asymptote: y 5 3 f. Write a function representing the cost C(x) (in $) for x tubes of paint. Substitute (x 1 h) for x. 62 mph 39. h(x) 5 e 5 4 3 2 25 24 23 22 21 21 22 e. 22376 22. 22: NASA, ESA, and the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration RF; p. Jacob has a job that pays $48,000 the first year. 5 4 3 2 1 2 3 4 5 x 28 27 26 25 24 23 22 21 21 22 23 24 25 24 25 y 5 4 3 2 1 1 2 3 4 5 6 7 8 x 1 2 x 28 27 26 25 24 23 22 21 21 22 25 24 23 22 21 21 22 23 24 25 24 25 101. g. 582–585 y 8 2 R.3. y-axis R.4. x-axis 3 3 True 3. h(0) d. 762 Chapter 8 Sequences, Series, Induction, and Probability 55. 2 3 4 5 1 2 3 4 5 25 24 23 22 21 22 25 4 3 2 y 5 f(x) 1 x 1 2 3 4 5 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 1 2 3 4 y 5 4 3 2 5 4 3 2 1 1 1 2 3 4 5 x 25 24 23 22 21 21 y 5 f(x) 22 23 23 24 25 24 25 1 2 3 4 5 x For Exercises 87–90, write a function based on the given parent function and transformations in the given order. In one county, homeowners pay a flat tax of $172 plus a rate of 19 mil on the taxable value of a home. a0, 2 1 2 x 5 63. Then use the equation to calculate the corresponding y values. a15 5 86, a34 5 200; Find a150. {22, 10} 131. 1 32 Section 8.7 759 Introduction to Probability Solution: Let H represent the event that Albert Pujols gets a hit on a given time at bat. (x 1 0.04)2 1 (y 2 0.02)2 5 0.01 SECTION 2.3 Functions and Relations OBJECTIVES 1. y 5 4 3 2 1 3 2100 2x4 2 5x3 2 17x2 1 41x 2 21 3. P(t) 5 10,000e0.1386t b. (2`, 22) ´ (0, 2) e. This is equivalent to saying that 3 is a factor of 4n 2 1. ( [23, 7) {x 0 23 # x , 7} (2.1, `) {x 0 x . 50, 24, 2 6 2i 136 SA-6 17. 371,800 c. a b 4 5 f. x 5 12 35. x 5 10, y 5 30 b. 2x4 2 5x3 2 5x2 2 4x 1 29 b. a (21)n21(2n) k53 k51 20 8 65. The slopes are 5 and 21. (f + g)(2) 1 23 e. The graph of f is shown in Figure 3-3. 0.02x 1 0.06y 5 0.06 60. Passes through (23, 5) and m 5 22. $10,737,418.23 a. The dimensions of the cargo space are 6 ft by 7 ft by 12 ft. (23, 24) c. Most importantly, we want to give special thanks to all the students and instructors who use College Algebra in their classes. mutually; exclusive 0; P(A) 1 P(B) 9. c d ?A5 c d 0 21 21 23 0 1 21 0 2 23 23 0 e. Given f (x) 5 4x2 23 0 x 0, find f (2x). TIP n The summation Sn 5 a ai 5 a1 1 a2 1 a3 1 p 1 an n a ai is read as the sum of ai i 51 i51 for i equals 1 to n. Write About It 60. All x for which f (x) 5 1. Ten questions have 5 possible responses (strongly agree, agree, neutral, disagree, and strongly disagree). 24 25 24 25 x 69. Horizontal asymptote: y 5 2 f. 1 d. For example, consider the functions defined by g(x) 5 x2 1 2 and h(x) 5 x2 2 4, pictured in Figure 2-25. 5n , 3n For Exercises 29–32, use mathematical induction to prove the given statement. Problem Recognition Exercises, p. 6 k(k 1 1)(2k 1 1) (Inductive hypothesis). P(B) For example, Let A represent the event that a coin lands heads up on the first toss. 5 4 3 2 25 20 15 10 y 5 f(x) 1 5 26 25 24 23 22 21 25 210 215 220 225 4 2 y 5 f(x) 1 2 3 4 25 24 23 22 21 21 22 x f(x) 5 3x4 1 7x3 2 12x2 2 14x 1 12 10. 157 2. y y We have used mathematical induction to prove that a statement is true for all positive integers n. The factors impacting weather are not constant and change over time. {(23, 5)} 19. True a. (q + n)(x) 70. A316, 215B and A 16, 15B For Exercises 37–42, determine the slope of the line. If so, identify the common ratio. 166: © Keith Eng 2007; p. Passes through (20.004, 0.009) and is parallel to the line defined by y 5 6. e , 2 f 2 2 27. The solution set is (2`, 23). If the "money" is respent over and over again each time at a rate of 76%, determine the total amount spent. y x y Ordered pairs 0 0 (0, 0) 1 1, 21 (1, 1), (1, 21) 5 4 3 2 4 2, 22 (4, 2), (4, 22) 1 9 3, 23 (9, 3), (9, 23) 21 21 22 y2 5 x 1 2 3 4 5 6 7 8 9 x 23 24 25 This relation is not a function. g(x) 5 1 x 92. 1 25. Section 8.7 Introduction to Probability 751 Theoretical Probability of Event E Let S represent a sample space with equally likely outcomes, and let E be a subset of S. The maximum profit is $114,000. 0 x 2 70 2 12. f (x) 5 x3 1 2x 2 5 62. log2(x2t) 4 3 m x x11 57. No 3. f (x) 5 x3 2 8x2 1 25x 2 26 3. 5 36 12 36 12 6 1 3 1 35. 2 real solutions 9. 1200 deer 42. The coefficients of the terms in the expansion can be found n triangle or by using a b. x 5 3 and x 5 23 59. 2 ac 2 3ab2 85. y 5 25x 1 26; 5x 1 y 5 26 3 38 y 5 x 1 ; 3x 2 7y 5 238 7 7 y 5 0.5x 1 5.3; 5x 2 10y 5 253 45. The surface area is 4 times as great. 1g + f 21x2 5 1 ; 3x 1 3 Domain: (2`, 21 ) ´ (21, `) 8. f (21) c. an an 6 5 4 3 2 10 8 21 22 24 26 28 210 93. 2.0 3 104 115. 2 c 2 3 3 2 2 c. 3x2 2 2x 2 9 1 1. The x-intercepts are the real solutions to the equation f (x) 5 0. Write an equation of the circle that is tangent to both axes with radius 111 and center in Quadrant III. If x is the population at a certain fixed time, then P(x) 5 0.98x represents the population 1 yr later. A 5 bh 2 5. in the second second, 12 inches in the third second, and so on. 9x3y 2 6.9xy3 97. E3: A brown sock is selected. Given r (x) 5 2 , x 2 5x 2 14 a. e f 15. 9a2 1 6ab 1 b2 2 c2 1 18. Odd x11 21 29. 8y 2 2 1y 2 15 79. The points representing the sequence coincide with points on the graph of the exponential function f (x) 5 2A 32 B x21 for positive integer values of x (Figure 8-6). The person is a nonsmoker. If the second and third terms of a geometric sequence are 4 and 1, what is the first term? To expand (a 1 b)3, we can find the product (a 1 b)(a 1 b)2. c ax c 2 ax or y 5 2 b b b 3. {611i} 45. Parabola; Vertex: (22, 5); Focus: A294, 5B; Directrix: x 5 274 ; Axis of symmetry: y 5 5 4. How many total cups will be required? 2 c7d 2 cd 7 103. Ax 1 i 13 B Ax 2 i 13 B 113. EXAMPLE 4 Applying the Binomial Theorem Expand by using the binomial theorem. Given (a 1 b)17, the 12th term is given by a baubu. 20 yr 63. (g 2 h)(x) 5 g(x) 2 h(x) 5 2x 2 (x2 2 4x) 5 2x2 1 6x The domain is (2`, `). Mixed Exercises 89. (n + p)(x) 66. Real part: 3; Imaginary part: 27 b. 4, 12, 20, 28, 36 23. The sum does not exist. y 5 1 4. f (21). I 5 1 L cA Rt or I5 1LRt cRt 113. Solution: TIP In Example 6, we can also find the value of d by dividing the difference of a27 and a15 by the number of terms between a27 and a15. a1 5 0, a2 5 23 49. See Graphing utilities Cardano, Gerolamo, 344 Cartesian coordinate system. (p4 1 3q)8; term containing p12. Then write the equation using function notation where y 5 f(x). g(x) 5 1x 2 2 b. The graph of y 5 f (x 2 c) is the graph of y 5 f (x) shifted (up/down/left/right) c units. N 5 23.112.2832 t b. An infinite is a function whose domain is the set of positive integers. m(x) 5 24x5 1 2x3 1 x 37. Explain what it means for a function to be increasing on an interval. f (4) b. Graph y 5 f (x). The second hose can fill the pool in 2 hr. Graph r(x) 5 e 2 2x for x . Thus, the graph is shifted upward 2 units. For Exercises 8–9, write the domain in interval notation. (See Example 9) a. x 2. (See Examples 6–8) 10 7 2 k21 51. 10 sec after launch c. To predict the path of a hurricane, meteorologists collect data from satellites, weather stations around the world, and weather buoys in the ocean. h(2x) 5 24x3 1 2x b. As x S 2`, f(x) S 2`, and as x S `, f(x) S `. 315 mg d. (g 1 h)(0) f 15. (2`, 1) ´ (1, `) h. 127 265 758 Chapter 8 Sequences, Series, Induction, and Probability 4. 102: © David Wasserman/Getty RF; p. k(0) d. 172 Chapter 2 Functions and Relations TECHNOLOGY CONNECTIONS Using the Table Feature and Graphing an Equation In Figure 2-9, we first enter the equation into the graphing editor. The point (1, 1) on the graph of f (x) 5 x3 corresponds to (1, 3) on the graph of h(x) 5 x3 1 2. 10w6 1 7w3y2 2 6y4 67. a2`, b 113. order; rows; columns 3. No 57. 123. x2 1 y2 1 12x 2 14y 1 84 5 0 43. • The minimum braking distance of a car depends on the speed of the car. Write a rule for a linear function y 5 k(x), given that k(22) 5 10 and k(5) 5 218. The distance d between the points is labeled in Figure 2-3. • The sequence can be defined recursively as a1, an 5 an21 1 d for n $ 2. 24 23 22 21 21 3 4 1 2 3 4 5 6 x 25 C(1, 26) 26 27 28 29 210 x 23 F 12 10 8 F 21421221028 26 24 22 22 F 24 26 28 4 3 2 C(6, 0) 1 2 4 6 x 24 1 2 F 3 4 5 6 7 8 59. 1x 1 h 1 3 2 1x 1 3 1 a. 30 45. In how many ways can a manager assign 5 employees at a coffee shop to 5 different tasks? Answers 6. 0; 0 7. Graph y 5 2f (x 1 2) 2 4. (21, 7) d(M, P) 5 2[4 2 (22)]2 1 [1 2 (23)]2 5 152 Q8 7 6 d(P, Q) 5 2(21 2 4) 1 (7 2 1) 5 161 2 2 d(M, Q) 5 2[21 2 (22)] 1 [7 2 (23)] 5 1101 2 5 4 3 2 2 Œ101 The line segment MQ is the longest and would potentially be the hypotenuse, c. A(22, 25) 9 7 Ba , b 2 3 C(23.6, 2.1) D(5, 2π) E(3.4, 0) FA0, 13B Objective 2: Use the Distance and Midpoint Formulas For Exercises 11–18, a. 1 x2 2 for x # 22 c. For example, {gold, silver, bronze} represents the set of medals awarded to the top three finishers in an Olympic event. (t 2 9)2 33. Horizontal asymptote: y 5 3 1 2 3 4 5 x 23 24 25 9. (g + f)(x) Solution: a. For Exercises 91–92, use the fact that a median of a triangle is a line segment drawn from a vertex of the triangle to the midpoint of the opposite side of the triangle. No 37. 3 2 41. Use the points (2, 35) and (6, 46) to write a linear model for these data. The money deposited at the end of the first year will have 3 yr in which to earn interest. 2 2 a. The sum of the numbers showing on the dice is not 8. 3 1 p 1 k(k 1 1) 5 k(k 1 1)(k 1 2) 3 (Inductive hypothesis). f (x) 5 2(x 2 2)2 2 3 87. 2 good seeds and 2 defective seeds can be selected. 3 3 3 a. 741 • The number of permutations of n distinct elements is n!. Yes; d 5 4 15. 23. f(x 1 h) 5 3(x 1 h)2 1 2(x 1 h) 5 3(x2 1 2xh 1 h2) 1 2x 1 2h h(23) 5 215 h(21) 5 27 c. Graph G 3. That is, p(a) 5 p(b) 5 3, but a fi b. Other functions that share the characteristics of a parent function are grouped as a "family" of functions. 1) 5! 5! 5 5 5 20 (5 2 2)! 3! (3 ? r 5 1.5; a1 5 36; an 5 36(1.5)n21 1093 6. 8x2 2 40 5 0 R.2. Solve. 5 4 3 2 a. If we solve the equation for x we get equations of the form x 5 h 6 2r 2 2 (y 2 k)2. To find the slope, select any two points on the line such as (2, 1) and (2, 3). (2`, 0] ´ [3, `) 21. f(22) 5 1 b. ln x 1 ln y 2 ln w 2 2 ln z 2 3 3 3 1 2 37. SECTION 2.5 Applications of Linear Equations and Modeling p. 32 12. 22, 1 5. (2`, 5) ´ (5, `) 33. y 5 f (2x) 5 4 3 2 5 4 3 2 y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 y 5 g(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 24 25 25 Objective 5: Summarize Transformations of Graphs For Exercises 55–62, a function g is given. f (x) 5 24x2 2 5x 1 2 58. taken r at a time can be computed by r! Expanding Your Skills 87. If the ship is located at a point (232, 40) on a map, write an equation for the boundary of the area within the range of the ship's radar. ¢ 2a 2a 5 log c b2 2 (b2 2 4ac) 5 log a 4ac 4a2 d b 4a2 c 5 log a b 5 log c 2 log a a 105. 427.9 mph 7w r1 1 r2 a. ElnA4 6 110B F; x < 1.9688, x < 20.1771 5 5 125. a 5 3 c. a k! k51 For Exercises 28–29, find the indicated term of the binomial expansion. f (23.7) 73. a23, b and a1, 2 b 3 3 44. 11, 14, 17, 20, 23, ... , 122 26. (Hint: Consider using the basic functions learned in Section 2.6 and transformations of their graphs.) y 105. • The set of y values in the ordered pairs is called the range of the relation. The person has normal cholesterol or is 61 or older. Therefore, the intersection of their domains is (2`, `). Find a18. 3i Real part: 3; Imaginary part: 27 25. 5x 1 5h 1 9 b. 5 575,757 39C5 3 1 c. 74 8 53. paper) — ISBN 0–07–783634–0 (alk. n Skill Practice 4 Use mathematical induction to prove that a b . f (x) 5 24x2 2 2x 1 6 44. 190 Chapter 2 Functions and Relations EXAMPLE 9 Determining the Domain of a Function Write the domain of each function in interval notation. y 12. 156.9925 a. { } c. • The graph of y 5 f (2x) is the graph of y 5 f (x) reflected across the y-axis. Center: (24, 1); Radius: 3 20. 227 Applications of Linear Equations and Modeling Number of Years Since 1990 (x) Enrollment (millions) (y) 0 10.8 4 11.2 8 11.1 12 12.8 16 13.2 20 14.2 24 14.8 76. a b 3 5 e. The viewing window between x 5 216.1 and 216.1 16.1 x 5 16.1 is divided by the number of pixels 210 displayed horizontally to get the values of x used to graph the equation. 9P3 5 9 ? 4 Chapter R Review of Prerequisites Table R-2 Summary of Inequality Symbols and Their Meanings Inequality a,b Verbal Interpretation a is less than b a.b a is greater than b a#b a is less than or equal to b a$b a is greater than or equal to b a5b afib a is equal to b a is not equal to b a is approximately equal to b a B c. This excludes p. For Exercises 33–46, determine if the function is even, odd, or neither. Solution: The first term is given: a1 5 4. From Example 2(b) and 2(c), notice that event E3 consists of all elements in the sample space not in event E2. y 5 x 2 1 3 88. Functions 2. f 21(x) 5 3 A 2 y 9. log 1,000,000 5 6 25. [x 2 (4 1 i)][x 2 (4 2 i)](3x 2 4) a. 4m3 47. f (g(6)) b. 11 11 c. 760 mmHg b. Find a22. (f + f 21)(x) 5 4a x y 5 f –1(x) (f 21 + f)(x) 5 210 212 11. The graph defines y as a function of x if no vertical line intersects the graph in more than one point. a 2a b 4 k51 j51 5 5 5 5 1 53. 19.8 yr b. The x-intercepts are (24, 0) and (4, 0). All x for which f (x) 5 3. Then, by completing 4A 4C the square, Ax2 1 Cy2 1 Dx 1 Ey 1 F 5 0 becomes D 2 E 2 D2 E2 Aax 1 b 1 C ay 1 b 5 1 2F 2A 2C 4A 4C D 2 E 2 b 1 C ay 1 b 5k Aax 1 2A 2C 2 E 2 D b ay 1 b ax 1 2A 2C 1 51 k k A C a. Solve the equation for y. Notice that for x 5 $20,000, both equations within the piecewise-defined function yield a monthly salary of $3000. x 1 2 for x # 0 c.) 23 7 b. 6, 18, 54, 162, ... 5 15 45 135 , , , ... a2 a4 a6 a8 For Exercises 19–24, write the first five terms of a geometric sequence {an} based on the given information about the sequence. Vertex: (1, 25); p 5 21; Focus: (1, 26); Focal diameter: 4 b. 225u 1 16v 107. Furthermore, the account owner adds $12,000 to the account each year after the first. Ocean: 14.1 m; Tahoe: 8.7 m; Erie: 3.5 m 75. a b 2 5 d. s 5 216t2 1 75t 1 4 b. y 5 x 1 2.99 c. A 1 c 1 3 0 21 23 24 24 24 24 c. Explain how to construct an arithmetic sequence. He did this by intersecting two perpendicular number lines with the point of intersection called the origin. 2 15 y i. 1 2 3 4 5 6 7 8 n Estimate the first four terms of the sequence. (10, 0) b. an 5 102.6 1 (n 2 1)(5.4) c. 0! 6! ? If the Rh antigen is present, the blood is said to be Rh positive (Rh1); otherwise, the blood is Rh negative (Rh2). [24, `) 15. Not possible 63. 6 18. No part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written consent of McGraw-Hill Education, including, but not limited to, in any network or other electronic storage or transmission, or broadcast for distance learning. R.1. y 5 25x 1 8 R.3. 1. Find all x for which f(x) 5 21. 129–132 R.1. 260 ft2 R.2. 56 ft3 R.3. 155 m R.4. 121.5 km2 1 3. The number of columns in the first matrix is not equal to the number of rows in the second matrix. log (m2 1 n) 2 2 3 19. 5 1 10 1 20 1 ... 1 5120 Solution: The common ratio is 2 and a1 5 5. 1 3 7 21 b. 1 2 3 4 5 6 7 8 9 x y 5 log3(x 2 1) 2 3 27 b. Sum, Difference, Product, and Quotient of Functions Given functions f and g, the functions f 1 g, f 2 g, f ? The money is then respent over and over again, each time at a rate of 70%. Write a relationship for a function whose f(x) values are 2 less than three times the square of x. Not a real number f. Identify the center and radius of the circle. 10, e 7. The steps shown in the solutions match the style and methodology of solved examples in the textbook. Using the roster method, the set of the even numbers between 0 and 10 is represented by {2, 4, 6, 8}. 1?2 2 n 1 1 1 11 2 left side of statement right side of statement 728 Chapter 8 Sequences, Series, Induction, and Probability 2. a1 5 215 and a4 5 2 . For Exercises 113–114, evaluate the floor and ceiling functions for the given value of x. 35. y 5 0x0 2y 5 0 x 0 y 5 20 x 0 y 24 23 22 21 21 22 y 5 0x0 y 5 0 2x 0 y 5 0x0 5 5 5 5 0x0 0 2x 0 0x0 20 x 0 Test for symmetry with respect to the y-axis. 2 a b 1 ab 2 2 4 t b 3 4 3 13. a 5 i51 417 12. a 2 2 5 33 f. That is, the height is unique at any given time. 19. x 5 2 1 6 10. 23258 31. (approximately 42.4 in.) from the center along the major axis. 23, 5, 2 b. 23 1 1 0 21 2 1 23 0 0 ¥ 0 1 4 x 27 21 § £ y § 5 £ 1 § 1 z 0 41. Round to the nearest tenth of a percent. That is, the exponent on a is n minus the exponent on b. (That is, the blue line is below the red line for x , 2.) In interval notation the solution set is (2`, 2). $2214.03 c. Therefore, a y-intercept is a point (0, b) where a graph intersects the y-axis (Figure 2-7). 1 real solution 83 10. 2 g 59. A 5 c 1 20. 1140; There are 1140 ways to select 3 distinct items in no specific order from a group of 20 items. R.2. C 5 110 1 70x R.3. e 2 1 12 2 5x x, b ` x is any real number f or 3 3 5(3y, y, 4 2 5y) 0 y is any real number6 or 35. The left side of the equation is graphed as Y1 5 2x 2 3. g(x) 5 21x 2 1 1 3 1 67. a b 1 6 c. Find (g + f)(x). {3, 7} 17. 55% b. (0, 16) y f. 5 8 6 4 2 33. 6 13. Objective 3: Compose and Decompose Functions For Exercises 47–62, refer to functions f, g, and h. (x 2 4)2 1 (y 1 1)2 5 25; Center : (4, 21); Radius: 5 1 x (x2 1 10x 1 25) 1 (y2 2 6y 1 9) 5 225 1 25 1 9 (x 1 5)2 1 (y 2 3)2 5 9 Group the x terms. left 9. A ´ B 5 R b. Graph g(x) 5 1x for x $ 0. Write About It 59. Performing a horizontal shift first means that we replace x by x 1 2. The computer password is a sequence of five characters. 222 Chapter 2 Functions and Relations SECTION 2.5 Practice Exercises Prerequisite Review R.1. R.2. R.3. R.4. R.5. Use slope-intercept form to write an equation of the line that passes through (3, 27) with slope 25. 3 3 By the inductive hypothesis, [1 ? g(f(3)) Week Number, x a. 5, 7, 9, 11 b. 2 1 4 1 6 1 8 1 10 1 12 76. 5y 1 1 5 11 16. 22.013 log2 a b4 ln 53 7 28. {(210, 3)} 19. The value –2 is not in the domain of f. The graph of the sequence an 5 n2 is a set of discrete points corresponding to n 5 1, 2, 3, ... , whereas the function f (x) 5 x2 is a continuous curve over the set of real numbers. ceil(x) is the smallest integer not less than x. y 5 3f (x) 36. c d ?A5 c d 0 1 1 3 0 21 0 23 0 23 0 d 23 Section 6.4 Practice Exercises, pp. The value 4 is a factor of the expression 4(9a 1 2). (The domain is [1, 4) ´ (4, `). m 5 2 1 2 25. E A 13, 21B F 3 87. 4 69. Therefore, the value of a probability is a number between 0 and 1, inclusive. If rain is the only water that enters the pond, explain what the intervals of increasing and decreasing behavior mean in the context of this problem. Never decreasing 3 h. y 5 g(2x) 49. The model cannot continue indefinitely because the population will become too large to be sustained from the available resources. f (x) 5 1 (x 1 1)2 13 b. 0 and r fi 1 is an exponential function whose domain is restricted to the set of positive integers. (u2 1 2v4)15; tenth term 34. 645–650 R.1. Center: (0, 25); Radius: 2 12 R.2. Center: (0, 0); Radius: 5 R.3. Center: (4, 23); Radius: 9 R.4. n 5 16; (a 2 4)2 49 7 2 R.5. n 5 ; ay 1 b R.6. (x 1 5)2 1 (y 2 5)2 5 9 4 2 SA-40 Student Answer Appendix 1. Determine Theoretical The Centers for Disease Control publishes National Vital Statistics Reports every year that provide data for birth rates and mortality rates based on gender, race, age, and other factors. 1 37. 1 17. Therefore, no further restrictions need to be imposed. The nth term of the sequence of terms can be written as an 5 5(2)n21. The number 15 is a real solution to the equation x2 2 5 5 0 and a zero of the polynomial f (x) 5 x2 2 5. Describe the general shape of the graph of y 5 xn where n is an even integer greater than 1. For a given time after the tree is planted, there cannot be two or more different heights. (g + f)(2) 106. x fi , x fi 0, x fi 23 49. 14 m/sec 123. False. 20 15 10 (8, 7) 5 22522021521025 25 210 5 10 15 20 25 x 215 220 225 59. (23, 23, 1) b. f (x) 5 1x 11. The animations are diverse in scope and give students an interactive approach to conceptual learning. Passes through (6, 24) and is perpendicular to the line defined by x 2 5y 5 1. y 5 4x 1 4 c. That is, R(x) , C(x), or equivalently P(x) , 0. 0 10 Y1 5 4 2 2(x 1 1) 1 12 1 x Y1 5 8 2 4(1 2 x) 2 7 2 2x Y2 5 0 22 25 210 20 Y2 5 0 10 210 Write About It 99. KEY CONCEPTS Reference SECTION 2.1 The Rectangular Coordinate System and Graphing Utilities The distance between two points (x1, y1) and (x2, y2) in a rectangular coordinate system is given by p. This is the same as the fee paid to the gym in the absence of fixed costs. The money invested at the end of the second year will earn interest for 2 yr, and the money invested at the end of the third year will earn interest for 1 yr. This means that 15 is irrational. The line in Figure 2-16 Section 2.4 199 Linear Equations in Two Variables and Linear Functions has a slope of $1261. Quadratic Function A function defined by f(x) 5 ax2 1 bx 1 c (a fi 0) is called a quadratic function. a and c x The variable P varies directly as the square of v and inversely as t. Then the number of permutations of the elements of the set is given by u u. y 5 f a xb 2 6 y 5 f(x) 4 3 2 1 28 27 26 25 24 23 22 21 21 22 1 2 3 4 x 23 24 25 24 25 26 Solution: a. S 5 b. To Ryan Blankenship, Marty Lange, and Kurt Strand, we are forever grateful for the amazing opportunities you and McGraw-Hill have given us. 3 3 3 , ,p 33. xk . The leading term within parentheses now has a coefficient of 1. (23, 0) and (1, 0) d. 96 ft3 of sand 15. x 5 0, x 5 2 8. Find the difference between a50 and a32. Vertex: A 72, 21B; Focus: A 72, 252 B; Focal diameter: 6 51. 2 y y i. EXAMPLE 5 Finding the Number of Terms in an Arithmetic Sequence Find the number of terms of the finite arithmetic sequence 7, 3, 21, 25, ... , 2113. Find the y-intercept(s). 24, indicating that P4 is true. $333 a. Based on these results, what is the probability of selecting a student at random taking Freshmen English and getting a student who received a. a1 5 4, d 5 22 18. (x 1 4) 1 (y 1 3) 5 11 y b. f(x) 5 23x 1 8 39. Suppose that the employee begins contributing at age 28. A map of a state park is 5 drawn so that the origin is 4 placed at the visitor center. See also specific types of inequalities absolute value, 148–151 compound, 146–148 graphical solutions to, 204–207 linear, 144–148 nonlinear, 369, 539–540 polynomial, 369–372, 376–377, 393 properties of, 145 quadratic, 369 rational, 372–376, 393 solution sets of, 145–151, 205 symbols for, 4 Infinite sequences, 690, 694 Infinite series explanation of, 694, 695, 764 geometric, 716–718, 765 Infinity symbol, 4, 302 Inner product, 591 Integer exponents, 22, 73 Integers, 2, 73 Interest compound, 418–420 simple, 94–95, 420 Intermediate value theorem, 306–307, 392 Intersection, of sets, 5–6, 73 Interval notation explanation of, 4–5 use of, 145 Inverse functions explanation of, 405–406, 482 finding equation of, 406–409 graphs of, 402, 404, 405, 408, 409 one-to-one, 402–406 Inverse matrices, 607–608, 626 Inverse notation, 405 Inverse property Subject Index of addition, 11 of matrix addition, 588 of multiplication, 11 Inverse variation applications involving, 386 explanation of, 383, 393 Invertible matrices, 605–607, 616–617 Irrational numbers approximation of, 3 explanation of, 2, 73, 418, 483 Irreducible quadratic factors, 344, 518, 519, 522–524 J Joint variation applications involving, 387 explanation of, 384, 393 Jordan, Wilhelm, 568 K Kantorovich, Leonid, 551 L Latus rectum, 666, 669, 670, 683 Law of cooling (Newton), 426 LCD. 107. Check the condition that a2 1 b2 5 c2. When a motorist approaches the intersection, find the probability that the light will be red. x3 1 120 5 x2 1 90 1 0 1 370 d. an 5 4a b 4 25 125 , ... 4 16 A graph of several terms of the geometric sequence from Example 3 is shown in Figure 8-5. 1 25 24 23 22 21 21 22 1 x 6 0x 0 2 3 10 2 33. 727 Extended principle of induction: Mathematical induction can be extended to prove statements that might hold true only for integers greater than or equal to some positive integer j. y 5 f a xb 2 a. x (22 21 0 1 2 3 4 5 6 7 8 Skill Practice 3 Given m(x) 5 x 1 3, n(x) 5 x2 2 9, and p(x) 5 1x 1 1 a. 50. 0 1 2 n The binomial coefficients can also be found by using Pascal's triangle. 6 5 336 3 factors There are 336 possible first-, second-, and third-place arrangements. AB BA AC CA AD DA AE EA BC CB BD DB BE EB CD DC CE EC DE ED Each outcome in the second row involves the same 2 people as the outcome directly above in the first row, but in the reverse order. (See Example 1) 16. 697 698 Chapter 8 Sequences, Series, Induction, and Probability n 5. m 5 21. Given k (x) 5 23x 1 1 and m(x) 5 , x a. x-intercept: A 25, 0B; y-intercept: (0, 1) 25 24 23 22 21 21 22 13. Substitute 258 for m and (4, 26) for (x, y). 8 115 1 22 81. 43 5 7x 2 6 b. a b 5 n provided that y fi 0. 2136 c. x $ 0 2 24 25 5 4 3 2 x 1 23 24 25 1 26 e. 725 million 33. y 5 x3 b. a prime number? (See Example 2) b. 96. 120% g. (multiplicity 1) and 21 (multiplicity 2) 2 5 c. Write terms with a common denominator. c 2 , d 2 2 5 22 13 2 43. If two points in a set of ordered pairs are aligned vertically in a graph, then they have the same x-coordinate but different y-coordinates. 1V + r21d2 5 πd3 is the 2 6 volume of the sphere as a function of its diameter. The expression a b (read as r "n choose r") is called a binomial coefficient and is defined by n n! a b5 r!(n 2 r)! r n Note: The notation nCr is often used in place of a b. 2 51 40 4 16 9 2 2 2 2 y y y2 x x 2 5 1 61. 0 5 4x2 1 y2; This is an equation of a degenerate ellipse. (g + f)(10) Answers 5. 21. 2 x17y8 109. The IRS takes into account exemptions, deductions, and tax credits among Schedule X—If your filling status is Single other things. {(5, 28)} 47. x2 1 y2 2 22x 1 6y 1 129 5 0 44. I remember doing simple calculations with him and using graph paper to plot data points for his experiments. If the player moves at 120 pixels per second, will the player have enough time to pick up both prizes? g(x) 5 61. Therefore, the intersection of A and K is the empty set, A ¨ K 5 {}, and we say that events A and K are mutually exclusive (do not overlap). 23 R.3. There are no restricted values on the variable. R.4. Multiply by using the special case products. The base is 13 yd and the height is 8 yd. Shift the graph upward 3 units. Center: (0, 0); Radius: 3.2 13. 88 people 21 22 24 26 28 b. Thus, the k k denominators are and both are positive. Given the equation of the circle x2 1 y2 1 12x 2 4y 1 31 5 0, a. These alternative notations are often used in computer programming. Distance Formula The distance between points (x1, y1) and (x2, y2) is given by d 5 2(x2 2 x1)2 1 (y2 2 y1)2 d 5 2(x1 2 x2)2 1 (y1 2 y2)2. – Second edition. For example: < 0.0009766 < 0.0000305 1 10 1 15 1 1 1 1 , , , , p,a b , p,a b , p 2 4 8 16 2 2 In fact, for 0 r 0 , 1, as n S `, rn S 0. (9, 0) c. P(x) 5 3.12x 2 790 d. Vertices: (0, 3), (0, 23) Endpoints of minor axis: e. Skill Practice 4 Find the sixth term of a geometric sequence {an} given that a1 5 64 and a2 5 216. y 5 32x 1 2; m 5 32 ; y-intercept: (0, 2) y b. 2A 2 3C 5 c 1 2 x y 5 k(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 24 25 b. 5 y y 5 f(2x) 4 3 2 1 29 28 27 26 25 24 23 22 21 21 22 1 x 24 25 g(x) 5 2x2 y y5f 1 2 5 x 1 23 24 25 1 2 3 4 1 x 5 x (24, 2) g(x) 5 Î2x Reflect across the y-axis (4, 2) 1 25 24 23 22 21 21 22 f(x) 5 Îx 1 2 23 (2, 24) Figure 2-26 4 3 2 29 28 27 26 25 24 23 22 21 21 22 Reflect across the x-axis 23 24 25 5 4 3 2 (2, 4) 1 25 24 23 22 21 21 22 23 b. The base is approximately 17.7 ft and the height is approximately 9.7 ft. ac 0 3 0 95. x 1 3 2(x 1 7) y2 5 12 26. Linear programming is a technique that enables us to maximize or minimize a function under specific constraints. x 5 608, y 5 888 79. 9 d. c 249 1 3 2 9 244 47 28 41 43. 1024 In an arithmetic sequence, the difference between a term and its predecessor is a fixed constant. 5k 2 3 5 5(2a 1 3) 2 3 Replace 5k by 2a 1 3. Use a graphing utility to graph the regression line and the observed data. Figure 2-34 y 6. y3 2 13y2 2 42y 2 24 33. x 5 2 c. Evaluate (f 2 h)(6). 22, 5, 25; each of multiplicity 1 5 25. Therefore, the points do not define y as a function of x. f (x) 5 1 x and 2 g(x) 5 2x 1 1 95. 1.8 1 Greatest integer less than or equal to 1.8 is 1. R 55. Event E is certain to happen. Graph h 75. The graphs of the following functions are related to y 5 f (x) as follows. A third-degree polynomial has 3 zeros (including multiplicities). 5 x c. List all the permutations of two elements from the set. 164 1. x3m14 y2n15 Section R.3 Practice Exercises, pp. Write the answer in slope-intercept form (if possible) and in standard form (Ax 1 By 5 C) with no fractional coefficients. Section 2.1 The Rectangular Coordinate System and Graphing Utilities Applying the Pythagorean theorem, we have y Q(x2, y2) d P(x1, y1) d 2 5 (3)2 1 (4)2 d 5 2(3)2 1 (4)2 5 125 5 5 |y2 2 y1| Since d is a distance, reject the negative square root. a5 5 2a4 1 1 5 2(39) 1 1 5 79 The first five terms are 4, 9, 19, 39, 79. Assume that the money can be respent an infinite number of times. e a1, , 2b f 49. Irrational numbers are real numbers that cannot be expressed as a ratio of integers. The sum Sn of the first n terms of a geometric sequence with first term a1 and common ratio r is given by the formula . Section 8.6 Principles of Counting 745 Solution: a. Shift y 5 x3 to the left 2 units. Determine the slope of the line. Round to 2 decimal places. x0 for x . log6 x 23. Assume that 1 1 3 1 5 1 7 1 p 1 (2k 2 1) 5 k 2. y 5 2x 2 10 y57 65. The probability of selecting a blue marble is 103 . w(t) 5 1t 2 16 c. The person is a smoker or has elevated blood pressure. 25, 6, 27, 8, ... Answers 2 15 5. 38 5 59,280 83. 5 12a 1 3 5 3(4a 1 1) Therefore, 3 is a factor of 4k11 2 1 as desired. 5 d. That is, we can decompose a composite function into two or more simpler functions. { } {0} 51. {12, 10, 6, 16} d. Each year thereafter, she would receive a $5000 raise. 5 (k 1 1)2 (k 1 1)(k 1 2) Factor the numerator. Past history indicates that for a certain route, the probability that an individual passenger will not show up is 0.04. 24 47. Then there are 6 horses that are available for third place. 90 SA-50 Student Answer Appendix 51. A > C e. x11 5. g(x 1 h) For Exercises 57–62, find and simplify f (x 1 h). Even 25. 9 19 c. Write a model of the form P(t) 5 P0e kt to represent the population P(t) for a time t years since 2000. Graph the equation using the slope and y-intercept. 7 23 y2 2 x 2 2 5 0 24 25 210 y 8 7 6 1 43. Each pen can be 25 yd by 10 yd, or it can be 15 yd by 3 Section 1.6 Practice Exercises, pp. Furthermore, the sum of the exponents must equal n. Evaluate the functions at the given values of x y if possible. Graph E 2. Find the center and radius of the circle. (21, 1) g. P1 is true because 1 5 21 2 1. 10 27. [24, 21] c. leading 5. y 5 g a xb 2 1 1 25 24 23 22 21 21 22 y 5 4 3 2 1 2 3 4 x 5 25 24 23 22 21 21 22 1 2 3 4 5 x y 5 g(x) 23 23 24 25 24 25 Objective 4: Apply Reflections Across the x- and y-Axes For Exercises 41–46, graph the function by applying an appropriate reflection. i51 n (a1 1 an) to verify the fifth 2 partial sum of the arithmetic sequence from part (a). 34–37 1. (g + f + h)(x) 85. Section 8.3 Geometric Sequences and Series 719 Suppose that an individual invests P dollars at the end of each year for 4 yr at interest rate r. 22.8 , y and y # 15 37. (See Example 10) a. (g + f)(x) 5 4x2 1 16x 1 16 c. What is the probability that the couple will have at least one girl? (7C3) 5 2940 59. Expanding Your Skills 121. Find the average rate of change in temperature between months 9 and 11 (September and November). f (2) 5 1 d. 0 for all real numbers x. (x 2 4)2 1 (y 2 6)2 5 2.25 57. 4x5/2(3x 2 1) 95. 2x2 1 y2 c. In calculus, we can show that the slope of the line drawn tangent to the curve y 5 x3 1 1 at the point (c, c3 1 1) is given by 3c2. EXAMPLE 1 Writing an Equation of a Circle in Standard Form a. Write a linear profit function representing the monthly profit P(x) for x maintenance calls. (1, 0) and (5, 0) d. The line may be slanted, horizontal, or vertical depending on the coefficients A, B, and C. P(B) 5 EXAMPLE 8 1 1 1 ? q)(x) 5 (x2 1 3x) 11 2 x; (2`, 1] q 11 2 x 23. The y-intercept is (0, 21). Is (k + m)(x) 5 (m + k)(x)? 2 , 1 17. Each term of the geometric sequence a1, a2, a3, ... can be written in the form a1r n21. f (2) 5 1 2(2) 5 8 b. f (24). [210, 10, 1] by [210, 150, 10] d. (See Example 2) 4 9. Determine the value of the annuity if the employee waits to retire at age 65. 4 real zeros; f (x) has 1 positive real zero, no negative real zeros, and the number 0 is a zero of multiplicity 3. 2 111 1 1 1 1 2. g)(x) and state the domain in interval notation. 5 4 3 2 5 4 3 2 y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 5 4 3 2 y 5 f(x) 1 x 25 24 23 22 21 21 22 y 91. . Are they exactly the same? g(1) e. The terms in the given sequence a1, a2, a3, ... columns; rows 7. 23(x 1 2) 1 1 5 2x 1 5 b. 10 5 210 25 10 210 5 7. 5x 0 x $ 92 6 99. (23, 21) ´ (0, `) 81. There is at least one vertical line that intersects the graph in more than one point. EXAMPLE 3 Applying the Vertical Line Test The graphs of three relations are shown in blue. n 5 94 f. Assume that 4k , (k 1 2)! for an integer k $ 2. a.2b. 239–243 25 25 9. • The graph of y 5 2f (x) is the graph of y 5 f (x) reflected across the x-axis. h(c) 5 24 1c 1 20 2 1 109. 2 1x 1 3 a. g(x) 5 e 110. • f is decreasing on I if f (x1) . 10 6. This relation is a function. If a fair coin is flipped H H n times, the number of HT T head/tail arrangements H TH follows a geometric T T sequence. LDL is 144 mg/dL and the total cholesterol is 204 mg/dL. { } 51. £ 4 21 b. 5 5 25 Answers 11. This is approximately 12.65 units. 1?2 2?3 k(k 1 1) k11 Assume that Pk is true. We have: Fibonacci sequence: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, p Point of Interest The Fibonacci sequence is of particular interest because it is often observed in nature. a2`, 4. 1 2 3 4 5 83. [2, 5] c. If someone does not know the code and tries to guess, how many guesses are possible? The x variable can be any real number. The truck was driven 144 mi in the city and 110 mi on the highway. e f 9. Find a Specific Term in a Binomial Expansion (a 1 b)2 5 a2 1 2ab 1 b2 The expression a2 1 2ab 1 b2 is called the binomial expansion of (a 1 b)2. Library of Congress Cataloging-in-Publication Data Miller, Julie, 1962College algebra / Julie Miller, Daytona State College, Donna Gerken, Miami Dade College. China has the largest population of any country with approximately 1.5 billion people. 4 2 R.1. (2`, 21) ´ (21, `) R.4. R.6. 1. 61, 62, 64 9. S1(x) 5 x2 1 4x 8 1 c. Graph I 10. e e4, 4 f ; x < 54.5982, x < 0.0183 e 109. p(x) 5 3(x 2 2)2 2 19 b. Dividend: f(x); Divisor: d(x); Quotient: q(x); 3. 2y2 1 26y 1 31 65. 2: © McGraw-Hill Education/Mark Dierker, photographer; p. Write an expression an for the apparent nth term of the sequence. {(22, 5, 3)} 10. Graphing utilities include graphing calculators, spreadsheets, specialty graphing programs, and apps on phones. negative 151. x t(x) 8 3 4 6 0.05 5 2 5 30 10 1 3 4 230 240 250 25 24 23 22 21 25 210 2 x 24 26 77. 5! 1 ? Interpret the meaning of the slope in context. For what value of x is f(x) 5 4? (28, 1) and (0, 23) 77. 5465 43. a , 0b 3 d. Given a function defined by y 5 f (x), the difference quotient is given by . Power Points present key concepts and definitions with fully editable slides that follow the textbook. Passes through (1.6, 4.8) and (0.8, 6). To the marketing team Michelle Greco, Leigh Jacka, Simon Wong, Megan Farber, Sara Swangard, Ashley Swafford, Jill Gordon, and Alex Gay: Your artistry and creative ideas for our project are 90% inspiration, 90% innovation, and 100% perspiration. The students at Prairiewood Elementary plan to make a pyramid out of plastic cups. many ways can four different people among the 20 be selected to prizes of $50, $25, $10, and $5? m 1 4 . 4 3 2 To graph y 5 f (2x), divide each x value by 2. a , 2 b 2 4 15 2 1165 15 1 1165 , 0b and a , 0b d. x2 1 4 5 0 2 x 2 2x 1 5 5 0 115. (2a 1 5)(4x 1 9) (3x2 2 10)(4x 2 3) 21. Graph K 13. 2 x 2 9 8 21 21 1 1 1 y b. T(a) 5 1.06a 1 10.99 c. Prove a Statement Using Mathematical Induction 1. Not applicable 1 4 47. State whether the graph of the parabola opens upward or downward. 25 24 23 22 21 21 22 57. 21.7370 c. [29, `) 8 e. Determine the amount of time for the population to reach 400,000 if this trend continues. Graph the data in a scatter plot using the number of days for gestation as the independent variable x and the longevity as the dependent variable y. e < 0.56 e. Move to the left 4 units. Complete the squares. 0.6826 c. (0, 1) Factor out the leading coefficient of the x2 term from the two terms containing x. (730, `) a. 425: © Brand X Pictures/ Superstock RF; p. exponential 41. The table gives the average gestation period for selected animals and their corresponding average longevity. y2 2 x 2 2 5 0 41. 290 Chapter 3 Polynomial and Rational Functions Solution: a. None 2 22 1 110 22 2 110 t5 and t 5 25. a i2 5 i51 n(n 1 1) (2n 1 1) 6 23. Use Cramer's rule to solve the system. v21x2 5 103. 46,750 n 93. How many different routes are available for Gaynelle to travel from home to school to work? e 22, 2 f 47. EXAMPLE 5 Graphing an Equation by Plotting Points Graph the equation by plotting points. 2115 1 i 155 35. J 5 M 2 3. No 11. Words cannot begin to express our heartfelt thanks to all of you, but we'll do our best. Even and Odd Functions • A function f is an even function if f (2x) 5 f (x) for all x in the domain of f. 1 for x . (22, `) g. {(0, 0, 0)} 23. 60x5y2z4 2c3(c 2 d) 31. {x 0 23 # x , 5} CHAPTER 1 Section 1.3 Practice Exercises, pp. (2`, 5] 5 b. k(x) 5 int x xb 84. 18, 22, 27, 33, ... 8. y 5 2.48x 1 31.0 b. 5 4 3 2 93. The interval(s) over which g is decreasing. y 5 g(2x) 53. Write the sum 4 2 For Exercises 9–11, find the sum. Slant asymptote: y 5 5x 1 4 4 6 g(x) 5 4 2 c. Simplify the fraction. 1 x2 d. 1.2 d. Cumulative Review Exercises For Exercises 1–4, consider sets A and B and determine if the statement is true or false. (24, 21) b. (3, `) g. A human face is symmetric with respect to a vertical line through the center (Figure 2-29). y 5 3 b. Assume that 8 1 4 1 p 1 (24k 1 12) 5 22k(k 2 5) (Inductive hypothesis). Upward 57. y 48 31. No 1.55 3 1018 N 107. Now suppose that an individual student may not receive both scholarships. Graph B SA-27 5. , 2 , and 4 (each with multiplicity 1) 4 2 1 71. The general shape of y 5 x is similar to the graph of y 5 x2 for even values of n greater than 1. x Section 3.1 Quadratic Functions and Applications 289 3. This is given by 8P3. The value of P(x) is 0 for 80 lemonades produced and sold (Figure 2-23). y2 2 y1 2 2 (26) 8 8 5 52 5 x2 2 x1 21 2 4 25 5 y 2 y1 5 m(x 2 x1) Apply the slope formula. z 5 97 146 (p 2 6)3 (2r 2 1)3 1 R.2. 5 R.3. 18 R.4. R.5. 3 (r 2 2)2 p3 sequence; finite 3. a b 2 6 d. Section 8.2 701 Arithmetic Sequences and Series Expanding Your Skills 109. Write an equation of the circle that is tangent to both axes with radius 17 and center in Quadrant I. Solution: r5 an 5 an an 5 15 12 9 6 3 0 23 26 29 212 215 an 5 15 (2 35 \ (1 2 3 4 n21 a5 5) 5 6 7 8 9 10 n a5 5 a2 29 3 5 52 a1 15 5 n21 a1r 3 n21 15a2 b 5 3 521 15a2 b 5 243 125 Divide a2 by a1 to obtain the common ratio 235 . Evaluate 21C4 and interpret its meaning. g(x) 5 Section 2.6 241 Transformations of Graphs For Exercises 63–78, use transformations to graph the functions. 11 111. Use the binomial theorem to expand (a 1 b 2 2)3. 0.000 000 8 36. a (21)i11 i51 12. w21(x) 5 ; The inverse gives the 21.17 21 barometric pressure w (x) for a given wind speed x. • f (a) is a relative maximum of f if there exists an open interval containing a such that f (a) $ f (x) for all x in the interval. {(2, 21, 0)} 4. 1.783 26. 22, 3, 1, 4, 5, 9 2. 218 Chapter 2 Functions and Relations e. (24, `) 12. No 19. 2c d 57. Suppose that both parent pea plants are hybrids with genotype Yy. Parent 2 a. f 21 21 R.1. Domain (2`, 3), Range (2`, 0] R.2. a. 8; 16; 32 b. g(x) 5 2 1 x26 B3 56. (6, `) a. x 5 14 23. (q + n)(x) 116. differ by d units. He would then tell me what the peaks and features in the graph meant in the context of his experiment. above; horizontal 5. g(x) 5 0 x 0 2 3 b. Cube root function: f (x) 5 1 x 5. If one row (or column) of a matrix is a multiple of another row (or column), then the matrix does not have an inverse. 2 3 4 5 (y 2 1)2 (x 1 3)2 a. Graph a(x) 5 x for x , 1. (See Example 10) 82. 3 h(x) 5 2x 2 7 a. {(0, 23), (7, 4)} 12. 8C5 41. Number of combinations 5 TIP The number of combinations nCr is equal to the number of permutations nPr divided by r!. As a result, there are 10 combinations of 5 people taken 2 at a time. The variables Ymin, Ymax, and Yscl relate to [215, 15, 3]. Concave down b. Explain why the graph of g(x) 5 0 2x 0 can be interpreted as a horizontal shrink of the graph of f (x) 5 0 x 0 or as a vertical stretch of the graph of f (x) 5 0 x 0 . {5} 3 7 c. This gives the slope of the road as the change in elevation per 100 horizontal feet. Graph Linear Equations in Two Variables 1. (x 2 2i)(x 1 2i)[x 2 (4 1 i)][x 2 (4 2 i)] c. Enter the equation Y1 5 0.511x 1 104 into the equation editor and hit the GRAPH key. 22.3 yr 32. Not possible SA-37 Student Answer Appendix 19 57. For example, row 1 represents the cost for plan A for months 1, 2, and 3, respectively. Equation; e 3 6 2 12 f 2 4. Write the expansion of (c 2 d)3. Find the sum of the first 60 terms of the sequence. No 160 320 640 35. 210x 2 5h 2 4 ; Domain: 123, 32 ´ 13, `2 b. y 8 32 y1652 x1 5 5 (21, 2) 3 2 1 23 22 21 21 22 8 32 y52 x1 26 5 5 1 2 23 8 2 y 5 2 x 1 (slope-intercept form) 5 5 5 6 8 7 y525x1 24 25 26 27 8 32 30 y52 x1 2 5 5 5 3 4 x 2 5 (4, 26) To check, we see that the graph of the line passes through (4, 26) and (21, 2) as expected. We are now ready to generalize. 22x 1 4y 5 12 53. 3, 12, 48, 240, ... a3 a2 12 48 5 5 4, 5 5 4, a1 a2 3 12 a4 240 55 5 a3 48 The sequence is geometric because the ratio between each term and its predecessor is the same constant. f (2) 5 22 and f (3) 5 1. Arithmetic b. 31 4 a. 21 79. {27, 22, 2} 5 3 15. (x 1 8)(x 2 8) b. a cai 5 c a ai i51 i51 n n n 3. x 1 4 c. 22 23 24 25 1 2 1 2 26 28 26 28 3 3 2 3 6 4 x 21028 26 24 22 22 24 21028 26 24 22 21 5 4 5 4 5x23 2x27 10 8 2 1 12 2 3 4 5 6 8 10 5 4 3 p(x) 6 4 y 79. Notice that the number of outcomes is easily found by multiplying the number of choices from each group: dg t fu number of toppings Total outcomes: (4)(2)(2) 5 16 bu t te r e Ho dg t fu Butters cotch Nuts Granola Nuts Granola Nuts Granola Nuts Granola Nuts Granola Nuts Granola Figure 8-10 Skill Practice 1 A pizza can be made from either thick or thin crust, and a choice of 6 toppings. y 5 g(x) 1 (25 24 23 3 22 21 211 222 2 3 4 x 5 The range is shown on the y-axis in red tint. (2`, 21) ´ a21, b ´ a , `b 4 4 (2`, `) 13. True 95. Parent 1 59. He borrowed $10,000 from his parents, $8000 from the credit union, and $2000 from the bank. 28, 22, 2 , 2 , ... 2 8 29. 23, 25, 211, 229, 283 27. m 5 125. If the money is respent over and over again in the community an infinite number of times, at a rate of 64%, determine the total amount spent. (23, `) 19. y-axis, x-axis, and origin 5 4 3 2 y 5 f(x) 2 3 4 5 x 25 24 23 22 21 21 22 y 5 f(x) 1 1 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 23 24 25 24 25 24 25 The function is symmetric with respect to the origin. To solve for a1, substitute r 5 0.8 into the equation a1 5 80 . g(21) c. Weight vs. $289,503.57 53. g(x) 5 3 ` 2 x 2 4 ` 2 57. x 5 21 g. floor(23.1) e. a 6 i51 i51 7 j51 i51 3 n53 3 50 64. 256, 268, 280, 292, ... 12. < 0.000062 a. Odd 31. annuity 1 9. (g 2 f)(1) c. y 5 0 y 11. {2}; The value 232 does not check. 2 2 y 5 4 3 2 y 5 f(x) 1 24 25 y 1 1 25 24 23 22 21 21 22 23 83. (4, `) 35. 20 1 30 16 2 20 12 75. 5 4 3 2 1 21 21 22 y 47. 1 or equivalently 0 4 2 x 0 . 14.4 ft 14. ln a 1 ln b 2 ln c 2 5 ln d 2 3 3 4 y 1z 4 55. increases e. 2 b. Consider the geometric sequence 12, 14, 18, 161 , p , A 12 B n, p and the corresponding infinite geometric series 12 1 14 1 18 1 161 1 p 1 A 12 B n 1 p . 10n 2 1 is divisible by 3. The graph of f is shown in Figure 3-2. {32} 43. 0 x 2 0.51 0 # 0.03 or equivalently 0 0.51 2 x 0 # 0.03 b. For Exercises 27–28, determine the x- and y-intercepts for the given function. {0, 12} c. A y-intercept of a graph has an x-coordinate of . 25 24 23 22 21 21 22 x b. 25 24 23 22 21 21 22 24 25 1 2 3 4 5 (23, 2) From the graph, we see that the graph of f (x) 5 24x 1 5 does indeed pass through the point (2, 23) and has slope 24. Objective 2: Evaluate a Finite Arithmetic Series For Exercises 49–50, find the sum. (x 1 y)3 2 (x 2 y)3 For Exercises 49–52, simplify the difference quotient: 49. (2`, `) 5 g(x) 5 2 1 ln x 4 d. 5 36 b. c, d, g, h 11. 28 25. x 1 x ax a(a 1 bx) e 11 e 12 SA-32 Student Answer Appendix Section 5.4 Practice Exercises, pp. EXAMPLE 4 Graphing a Function with a Vertical Stretch or Shrink Graph the functions. Substitute x1 5 2, y1 5 23, and m 5 24. True 5 3 4 5 2 3 4 5 x 9 8 7 m(x) 5 (32 \ 1 25 24 23 22 21 21 1 y y 8 7 6 5 4 3 2 x \ ) 1 2 3 4 23. determinant 4 3§ 24 21. 561–562 1. y y 5 Quadrant II 4 3 2 Quadrant I y units x units Origin 1 25 24 23 22 21 21 22 23 Quadrant III 24 25 1 2 y 7 5) (1, 6 d |9 2 5| 5 4 5 4 3 2 |4 2 1| 5 3 1 24 23 22 21 21 1 2 3 4 5 22 Figure 2-3 6 7 5 x (22, 0) 1 25 24 23 22 21 21 22 (24, 23) 1 2 23 3 4 5 x (4, 22) 24 25 Figure 2-2 2. Use the model in part (a) to approximate the wind speed of a hurricane with a barometric pressure of 900 mb. Skill Practice 3 Write an equation of the line passing through the point (23, 2) and parallel to the line defined by x 1 3y 5 6. Under this system, a person with AB1 blood has all three antigens, and group O2 is absent all three antigens. In how many ways can the letters in the word SHUFFLE be arranged? Center: (0, 0); Radius: 4.2 25. y b. 748: © Royalty-Free/Corbis; p. Yes b. (0, 0) and a2 , 0b f. Therefore, the domain of f 21 must be [0, `). 638 ft a. 5n , 3n for positive integers n $ 3. E 5 kv2 26. Maximum value: 8 9 f(x) 5 22x 1 4x 1 6 8 i. 6 (k 1 1)[(k 1 1) 1 1][2(k 1 1) 1 1] 5 6 2k3 1 9k2 1 13k 1 6 . To Jason Wetherington and Mary Beth Headlee, thank you so much for your work on SmartBook and for the additional pairs of eyes on our manuscript. (2`, 23] ª [21, `) 105. Donnelley All credits appearing on page or at the end of the book are considered to be an extension of the copyright page. 1 26. f (x) f (x 1 h) b. 33 b. y 5 x 32. e 21, 5 1 b. {x 0 x , 23 or x $ 22} f. T(a) 5 1.055a 1 4.99 c. x2 1 y2 2 x 2 3 3 y2 50 2 4 2 5 5 54. (9, 25, 23) and (2, 0, 1) y2 – y1 2 2 P(x, y, z) y x Section 2.2 Circles 177 Objective 5: Graph Equations Using a Graphing Utility (Technology Connections) 87. Objective 1: Apply the Fundamental Principle of Counting For Exercises 9–14, consider the set of integers from 1 to 20, inclusive. 6 5 26 Student Answer Appendix 101. r! ? [23, `) 16. y 5 4 3 (x 2 2)2 1 (y 1 1)2 5 9 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 Skill Practice 4 Determine if the relation defines y as a function of x. m(x) 5 3x 2 7 b. 23 1 61i 7 1 51. 6, 4, 2, 0 b. 758 Probability of a sequence of independent events: Two events are independent if the probability of one event does not affect the probability of the second event. 4845 8. Suppose that the professor picks 3 questions from the review sheet to put on the test. A21 5 £ 3 2 R.2. 21 1. {27, 3} b. Furthermore, no taxes are paid on either the principal or interest until the money is withdrawn. Assume that a number can start with a zero or zeros such as 0001. 6x2y 1 2y3 49. 2 14. Donovan would need to sell more than $250,000 in merchandise. y 5 4 3 2 1 2 3 4 5 x 129. Let Pn be the statement F1 1 F2 1 ... 2 x 12 x 19 29. How much money is initially infused into the local community for admission, food, drinks, and rides? Yes a. (See Examples 6–7) 61. 25a b e. Therefore, we can replace k! by 2k and replace the 5 sign with .. To solve 6x 2 2(x 1 2) 2 5 # 0 determine the values of x for which Y1 # 0 (where the function is on or below the x-axis). y 5 0 y h. k 5 2 t t 9. This image is symmetric with respect to the origin. A 5 5, B 5 3, C 5 21 Section 5.3 Practice Exercises, pp. {21}; The value 12 does not check. g (x) 5 5 30. A recursive formula defines the nth term of a sequence as a function of one or more terms preceding it. A21 5 c 2 3 27. 3 1 p 1 k(k 1 1)] 1 (k 1 1)[(k 1 1) 1 1] k(k 1 1) (k 1 2) 5 1 (k 1 1)(k 1 2) 3 3 2 k 1 3k 1 2k 5 1 k2 1 3k 1 2 3 k3 1 6k2 1 11k 1 6 5 as desired. 1 k 2. This tells us how "high" or "low" the graph is at that point. No 186 Chapter 2 Functions and Relations EXAMPLE 4 Determining if a Relation Is a Function Determine if the relation defines y as a function of x. 29.68t 2 4.84h 1 88 b. The endpoints of a diameter are (22, 4) and (6, 22). Write s as a function of d. Times LT Std. Lakeisha wants to put down new tile in her home. 111 52 p The domain of n excludes any values of x that make n(x) 5 0. x 5 0 y 1 1 40. 212 10. ``50 b. m(x) 5 4 3!ß x 28 210 10 1 24 25 31. If the nth term of a sequence is (21)n11 , which terms are positive and which are negative? Natural numbers, N Whole numbers, W Integers, Z Rational numbers, Q Irrational numbers, H Definition {1, 2, 3, ...} {0, 1, 2, 3, ...} {... , 23, 22, 21, 0, 1, 2, 3, ...} e p ` p, q [Z and q fi 0 f q • Rational numbers can be expressed as a ratio of integers where the denominator is not zero. y y 7 6 5 7 6 5 4 3 2 4 3 2 1 1 26 2524 23 22 21 21 x y 7 6 5 1 2 3 4 x 22 23 69. 2wz 2 z 6 x 75. We learned that if P dollars is invested in an account at interest rate r, compounded annually for t years, then the amount A in the account is given by A 5 P(1 1 r)t Answers 7 9 10. 2 51 25. [6, 8] 275 Key Concepts 125. See Greatest common factor (GCF) General form of equation of circle, 179–180, 275 of equation of conic section, 680 General solution, of systems of linear equations, 498 General term of sequence. The slope of a horizontal line is and the slope of a vertical line is 6. No letter or digit may be used more than once? To find the y-intercept, evaluate f (0). , 617 23. However, a graphing utility can be used to approximate the location and value of relative maxima and minima. (2`, 23] ´ (2, `) 3 3 3 23. Undefined e. 1 is not a function. C(x) 5 2.88x 1 790 b. 4 x 5 y2 2 4 3 2 24 23 22 21 21 22 x 5 y2 2 4 2x 5 y2 2 4 x 5 2y2 1 4 x x 2x 2x x 5 5 5 5 y2 2 4 (2y)2 2 4 y2 2 4 2y2 1 4 Test for symmetry with respect to the origin. a2`, 2 b ´ a2 , `b 3 3 3 y b. 1 2 3 4 5 6 7 8 5 x 1 2 2 21028 26 24 22 22 24 26 2 4 6 8 10 f(x) 5 x 3x 1 6 x22 28 18. This will help you remember that a rational number is a ratio of integers. x2 2 x1 Secant line y 5 f(x) (x2, f(x2)) (x1, f(x1)) m 5 x1 f(x2) 2 f(x1) x2 2 x1 x2 x h is taken to be a positive real number, implying that h ? Informally, this means that we can draw the function without lifting our pencil from the page. Gauss realized that the sum of the integers from 1 to 100 was the same as 50 pairs of numbers each summing to 101. 1000 1000 e. Domain: (23, `); Range: [1, `) 91. positive integers n $ 3. f(x 1 h) 2 f(x) . (3x 1 y2)7; Term containing y6. y 5 0 a. • Instructors will find helpful notes within the margins to consider while teaching. x2 2 x c. Jean runs 8 mph and rides 16 mph. Given a line with slope m and y-intercept (0, b), the slope-intercept form of the line is given by y 5 mx 1 b. 80 60 40 20 25 24 23 22 21 220 240 1 2 3 4 x 5 260 280 f(x) 5 1 1 2 3 4 5 22 23 24 25 3 2 1 23 22 21 21 54 3 2 1 m(x) 5 2 x2 1 3 25 24 23 22 21 21 Chapter 3 Test, pp. 3 7 21 5 (5)2 2 A 15B 2 5 25 2 5 5 20 6 3 4 2x2 2 y2 w2n 2 52 123. Ax 2 72 B 2 5 26(y 1 1) b. x2 1 y 2 b 5 0; Degenerate case (single point): e a0, b f 2 2 3 2 25 1 3 5 1 2 53. Write a linear cost function to produce x cups of lemonade. a (6i 2 7) i51 i51 For Exercises 95–98, determine whether the statement is true or false. No; The element on the main diagonal in the second row is not 1. 0x 0 for x , 0 c. A small business makes cookies and sells them at the farmer's market. t(x) 5 x11 x 2 4x 2 12 105. 2x 2 1 . z 5 0.80x 1 1.10y 7. minor 7. 5, x ? Identify x- and y-Intercepts 5. The slope of a line passing through the distinct points (x1, y1) and (x2, y2) is given by m 5 ¢y y2 2 y 1 5 . Center: (0, 0); Radius: 2.6 24. Solution: To find the value of a9, we need to determine the common difference d. y 5 2x2 2 3x 1 1 c. Column matrix 15. (x 1 2) 1 (y 2 1) 5 5 3. Determine f (3). Y1 , Y2 to the left of x 5 2. {(4, 0, 2)} {(5z 1 3, 22z 1 6, z) 0 z is any real number} 12 2 3y 2 4z ea , y, zb ` y and z are any real numbers f or 2 {(x, y, z) 0 2x 1 3y 1 4z 5 12} {(23z 1 5, z 1 4, z) 0 z is any real number} {(24z 1 7, 2, z) 0 z is any real number} 37. QA154.3.M54 2017 512.9–dc23 2015027054 The Internet addresses listed in the text were accurate at the time of publication. Find the Probability of Sequential Independent Events When a coin is tossed, the probability that it lands heads up is 12 . h(23) b. $17,066 b. x) Horizontal shrink (if a . [24, `) 55. Reference SECTION 8.3 Geometric Sequences and Series A geometric sequence is a sequence in which each term after the first is the product of the preceding term and a fixed nonzero real number, called the common ratio. The function g is defined by a g b(x) 5 . {(2z 1 3, 2z 1 1, z) 0 z is a real number} 39. 2 y(2x 1 y) x(2y 1 x) 9 5. a1 5 2 and r 5 3 223 22. a 1 5 n 18. 3 1 11 1 19 1 27 1 ... 1 363 25. (d + r)(t) 5 576t represents the distance traveled (in ft) in t minutes. 5 1 1 23 24 25 x 24 85. Determine the probability that a. Consider a relation that defines a time y during the course of a year when the temperature T in Fort Collins, Colorado, is 708. x 1 2 55. Range: {92, 58, 98, 72, 86} Skill Practice 1 For the table shown, x a. No, the tree will eventually die. (5 2 2i)4 56. y y5x12 5 4 3 2 (2, 4) (0, 2) 1 25 24 23 22 21 21 22 1 2 3 4 5 x y5x12 25012✓ 22 5 24 1 2 ✓ 45212✓ Solution (0, 2) (24,22) (2, 4) x 23 (24, 22) 24 25 Figure 2-6 The set of all solutions to an equation is called the solution set of the equation. {(26, 24, 3)} 57. (22, 23) c. f (x) 5 • x2 1 3 for 21 # x , 4 5 for x $ 4 a. 170 mph d. The vertex is given by 2b 2b bb. x 5 5 and x 5 2 51. The expression n2 2 n 1 11 is prime for all positive integers n. Solution: By definition (f 1 g)(x) 5 f (x) 1 g(x). One property of summation indicates that a c 5 . Between 6 and 7; 6.0960 c. Reference SECTION 2.8 Algebra of Functions and Function Composition Given functions f and g, the functions f 1 g, f 2 g, f ? f 21(x) 5 21x 1 9 6 y 5 f(x) 5 1 47. , (22, 4) becomes A 22 2 4B 5 (21, 4). (2`, 2) 29. P(B). 0 15 98. The function given by y 5 f (x) shows the value of $5000 invested at 5% interest compounded continuously, x years after the money was originally invested. If the money is respent in the local community over and over again at a rate of 65%, determine the total amount spent. 2 66. TIP The equivalence property of exponential expressions indicates that iff bn 5 bm, then n 5 m. {(21, 21), (0, 0), (1, 1)} 57. The length must be 300 ft or less. y 5 0 x 0 2 1 5 000 2 1 5 21 y y 5 |x| 2 1 4 3 2 (1, 0) 1 24 23 22 21 0 1 21 (21, 0) 22 23 2 (0, 21) 24 Figure 2-8 3 4 x To find the y-intercept(s), substitute 0 for x and solve for y. (See Example 4) 29. A row matrix is a matrix with only one row. Expanding Your Skills For Exercises 95–100, use transformations on the basic functions presented in Table 2-2 to write a rule y 5 f (x) that would produce the given graph. 8! 6! 38. Create Models Using Linear Regression y (x4, y4) (x2, y2) d1 d2 d4 y^ 5 mx 1 b d3 (x3, y3) (x1, y1) x Figure 2-24 In Example 7, we used two given data points to determine a linear model for systolic blood pressure versus age. In future editions, this rubric will be reformatted to increase accessibility and usability. w6 4 9 7 d. Replace y by 2y. g)(x) 5 ; Domain: (2`, 3) ´ (3, `) x23 g 1 ; Domain: (2`, 3) ´ (3, 4) ´ (4, `) 25. An x-intercept of a graph has a y-coordinate of . (Assume that the color of the light is defined as the color when the car is 100 ft from the intersection. 3, 15 9 21 , , ,... 4 2 4 For Exercises 15–18, a. (2`, 1] ´ (2, `) f (21) 5 0, f (1) 5 0, and f (2) 5 4 x53 f. 251cd 22c 59. A0, 2115 B, A0, 115 B f. The rabbit population will approach 2000 as t increases. 22, x ? x . 249 Suppose that I is an interval contained within the domain of a function f. n! 5. 0 t 2 36.5 0 # 1.5 or equivalently 0 36.5 2 t 0 # 1.5 b. Assume that Pk is true; that is, assume that 2 is a factor of 5k 2 3. 10 1000 100,000 34. {(0, 3), (5, 0)} 89. Write the set of ordered pairs that defines the relation given in Table 2-1. 2x2 1 2y2 2 32x 1 12y 1 90 5 0 49. Find the midpoint of the line segment whose endpoints are the given points. I2 5 1 4 d 5. x A point (x, y) on the graph of y 5 f (x) corresponds to the point Q , yR on the graph a of y 5 f (ax). For example: (2, 1, 1), (0, 0, 2), (4, 2, 0) 39. 193 y 5 4 6 5 7 24 8 28. x2 2 2x 2 8 5 0 2 12x 2 11x 1 2 5 0 127. Parent 1 44. m(x) 5 1 x23 c. 27.37 45. y 5 23 a. {23, 3} 97. Skill Practice 2 a. (See Example 6) 52. Write 0.87 as a fraction. How much profit will be made for producing and selling 128 cups? Wind Speed (mph) Wind Speed vs. Partial fraction decomposition is a procedure in which a rational expression is written as a sum of two or more simpler rational expressions. • If b2 2 4ac , 0, the graph of y 5 f (x) has no x-intercept. Given a geometric sequence with a3 5 20 and a8 5 640, find a1 and r. (Hint: There will be a total of five terms. Is the model from part (a) reasonable long term? Factor. Every point in the plane can be uniquely identified by using an ordered pair (x, y) to specify its coordinates with respect to the origin. c 5 249 2 a2 2 b2 32. • There are 26 black cards (spades and clubs) and 26 red cards (hearts and diamonds). a b(x) 5 f (x 2 3)(x 2 4) 1 ; Domain: 35, 142 ´ (14, `) 26. $150,000,000 b. 436: © kickers/Getty RF; p. The purpose of writing an equation of a circle in standard form is to identify the radius and center. {9, 29} 21. (29, 3] Compound inequality b. (4c2 2 t 4)5 b. Expanding Your Skills 42. {64, 6i} 12 does not check. 5 4 3 2 h(x) 5 Î2x 1 23 c. y 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x By inspection, we see that between any two points on the graph, the vertical change is zero, so the slope is zero. (4, 22) and (212, 24) a. Evaluate 21P4 and interpret its meaning. R a. If a person is selected at random from the population, find the probability that the individual has the A antigen. e 3, f 4 5 3 f (x) 5 x3 2 x2 2 14x 1 24 5 3 f (x) 5 x4 2 x3 1 x2 or f (x) 5 2x4 2 5x3 1 3x2 2 2 f (x) 5 x2 2 44 77. Determine the maximum or minimum value of f. Find (T + C)(x) and interpret the meaning in context. [1, 2] b. By finding an equation of the line, we produce a model that relates the two variables. y 5 23 37. The floor is 20 ft by 12 ft. Recall: (a 1 b)2 5 a2 1 2ab 1 b2 5 3x2 1 6xh 1 3h2 1 2x 1 2h Answers 5. e 2 , 6 f 3 4 Compound inequality b. True 67. f (x) 3 x 24. (f 1 h)(5) 1 x23 10. x 5 2, y 5 8 b. 4π 2 11 4(x 2 2y2)(x2 1 2xy2 1 4y4) 10. 4 Answers 5 9. {25, 23, 1, 3} 85. The variable cost is $0.50 per lemonade. If one CD is selected at random from the box, determine the probability that a. 4 y 5 |x| 3 2 y 2y 2y y 1 1 2 3 4 x 23 Same equation: Graph is symmetric with respect to the y-axis. 2, 4, 8, 16, ... 9. 4, 2, 0, 22, 24 b. Evaluate 15C6 12C2 and interpret its meaning. (5a 1 7b)(3c 2 2) 83. Not possible 23. • Graphing calculator screenshots have been updated to reflect the TI-84 Plus C. a150 5 896 43. 1 • If m1 and m2 represent the slopes of two nonvertical perpendicular lines, then m1 5 2 or equivalently m2 m1m2 5 21. n(E) n(S) Number of elements in the event Number of elements in the sample space The probability of an event is the relative frequency of the event compared to the sample space. 27 26 25 24 23 22 21 22 24 9 b. 3.7486 35. Apply the Point-Slope Formula 1. 2 51 b. Top semiellipse b. Answer 1 4. an 5 n 1 b. 1 64. 28 yr 27. 462–466 5 2 5 6 261 R.2. e 2 , 2 f R.3. e f 3 5 2 { }; The value 2 does not check. At x 5 0, the function has a relative minimum of 22. y 5 2f (x 2 3) 1 1 20 408 84. y 5 x2 with a horizontal shift. False; a aibi 5 a1b1 1 a2b2 1 p 1 anbn i51 fi (a1 1 a2 1 p 1 an)(b1 1 b2 1 p 1 bn) 99. That is n(S) 5 38. In this case, the monthly income is a constant $3000. Vertices: (1, 22), (7, 22) Foci: (21, 22), (9, 22) y 5 43x 2 223 and y 5 243x 1 103 y 10 8 6 4 2 26 24 22 22 F 24 2 4 x 6 8 10 12 14 F 26 28 C(4, 2 2) 210 25. • The company experiences a profit if more than 80 cups of lemonade are produced and sold. See also Complex numbers; Integers; Real numbers imaginary, 104–105 irrational, 2, 3, 73, 418, 483 natural, 2, 73 rational, 2, 3, 73, 329 real, 2 sets of, 2, 3 whole, 2, 73 O Objective functions, 547–548, 557 Odd functions, 245–246 One-to-one functions explanation of, 403, 482 identification of, 403–405, 407 Opposite, 11 Ordered pairs, 492–493 Ordered triples, 506–507, 556 Order of matrix, 585–586 Order of operations, 8–9 Origin, 166 P Parabola in applications, 674–675 axis of symmetry of, 286 explanation of, 667, 683 focus and directrix of, 667–669 on graphing utility, 672 graphs of, 286–288, 290, 669–672 (See also Quadratic functions) latus rectum of, 669, 670, 683 standard form of equation of, 667–668, 673–674 vertex of, 289–290, 667–672 Parallel lines, 214–215 Parameter, 498 Parentheses clearing, 12 mistakes involving, 64, 137, 453, 727 Partial fraction decomposition explanation of, 517–519, 557 method to check result of, 522 with rational expression containing irreducible quadratic factor, 522–523 with rational expression containing repeated quadratic factor, 524 with rational expression that has repeated linear factors in denominator, 522 with rational expression where denominator is product of distinct linear factors, 521–522 setting up form for, 519–520 Pascal, Blaise, 733 Pascal's triangle, 733, 766 Perfect square trinomials explanation of, 51 factored form of, 51, 115–116 method to factor, 52 Perihelion, 644 Permutations in applications, 743 combinations vs., 744–745 determining number of, 741–743 explanation of, 741, 766 on graphing utility, 746 Perpendicular distance, 667 Perpendicular lines explanation of, 214 slope of, 214–216 Piecewise-defined functions in applications, 250–251 explanation of, 247 on graphing utility, 248 graphs of, 276–277 interpretation of, 247 Pi (π), 3 Point-plotting method, 169–171 Point-slope formula, 213–214, 276 Polynomial equations, 133, 159, 344 Polynomial functions domain of, 301 end behavior of, 302–303 explanation of, 300–301, 391 fourth-degree, 301 on graphing utility, 310 graphs of, 307–310 intermediate value theorem and, 306–307 third-degree, 301 turning points of, 307 zeros and multiplicities of zeros in, 303–306, 391–392 Polynomial inequalities in applications, 376–377 explanation of, 369, 393 method to solve, 369–372 Polynomials. g(x) 5 12x 2 4 1 73. Solution: To find the eighth term of (a 1 b)10, we require the exponent on b to be 7 (one less than the term number). a2`, 2 b ´ a2 , `b 5 5 (2`, 28) ´ (14, `) 28. Graph three circles whose centers are located at the study areas and whose radii are the given distances to the earthquake. Solution: TIP On many graphing calculators, the greatest integer function is denoted by int( ) and is found under the MATH menu followed by NUM. 2 39. Undefined 2 3 b. h(2) 38. e , 1 f 39. p(x) ? j(x) 5 x16 x2 1 2 c. m 5 2 20 7 3 5 35. f)(0) 105. an an an an 5 5 5 5 a1 1 (n 2 1)d 75,000 1 (n 2 1)(4000) 75,000 1 4000n 2 4000 4000n 1 71,000 b. (6, 24, 21) and (2, 3, 1) 85. k < 0.052 d. 66; If 12 people are present at the meeting, then there will be 66 handshakes. Now we want to find the distance between two points in a coordinate plane. 1) Vertical shrink (if 0 , a , 1) Replace (x, y) by (x, ay). The range is [22, `). Evaluate the expression in part (b) for h 5 0. The first 20 sec is represented by a linear function with a positive slope, y 5 2.25x. {25, 1} 2 b. (0, 2) c. 5 4 3 2 1 25 24 23 22 21 21 22 2 3 4 5 x 25 24 23 22 21 21 22 3 4 5 1 2 3 4 5 x 5 4 3 2 1 1 2 y f. Lines that intersect at a right angle are perpendicular lines. Determine the range of f. {(23z 2 2, 24z 1 1, z) 0 z is any real number} 7 21 2 54 53 18. The amount spent on video games per person in the United States has been increasing since 2006. P(E) 5 0 760 Chapter 8 Sequences, Series, Induction, and Probability For Exercises 17–24, consider an experiment where a single 10-sided die is rolled with the outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. 4a 2b , and then Therefore, it is usually easier to evaluate the x-coordinate first from 2a 2b b. 5 4 3 2 1 M(0.7, 20.5) 25 24 23 22 21 21 22 1 2 3 4 23 24 25 (4.2, 24) 5 x Section 2.1 169 The Rectangular Coordinate System and Graphing Utilities Skill Practice 3 Find the midpoint of the line segment with endpoints (21.5, 29) and (28.7, 4). {(18, 217)} 51. Therefore, the two line segments in the graph meet at (20,000, 3000). g(f (4)) 101. 6 A252, 92 B, A 72, 92 B y 5 32 g. 96,000x2y4 67. or 0.036 49. Costa Rica: 2011; Norway: 2013 c. (g 2 f)(2) c. {1, 3} Rational equation b. Range: {y 0 y # 4} or in interval notation: (2`, 4]. At x 5 22, the function has a relative maximum of 2. a2 , 0b and (1, 27) 2 Solution: a. P 5 $150, n 5 12, r 5 4%, t 5 16 yr 50. 5 A1x 2 2B 2 ? f (x) 5 26x 2 5 2 1 x 5 For Exercises 117–118, find the difference quotient, f (x 1 h) 2 f (x) . P7 is true because 7! 5 5040 and 37 5 2187. (See Example 6) y 79. In how many ways can 2 students from the 5 be selected to receive the scholarships? 9! 5! ? The CD does not have jazz music. y 5 x 5 23 23 37. y 5 y 5 f(2x) 4 3 2 The operations of reflecting a graph of a function about an axis and shifting, stretching, and shrinking a graph are called transformations. h5 4ac 2 b2 2b and k 5 2a 4a 2b 4ac 2 b2 , b. 21 b 2 65. 0.01 b. The amount owed y 5 A(t) (in $) is given by A(t) 5 14,820 2 247t, where t is the number of months after purchase and 0 # t # 60. Graph the functions on the viewing window [24, 4, 1] by [210, 10, 1]. a1 5 4 and a4 5 108. The radius is approximately 25 yd. 95. 24x 1 π 105. Then the velocity vn (in ft/sec) after n seconds is given by vn 5 v0 1 an. Therefore, the equation A C D E is in the standard form of an ellipse with center a2 , 2 b. 7 m2 99. (4P4) ? 0 x2 2 x1 ¢x change in x (run) EXAMPLE 2 Finding the Slope of a Line Through Two Points Find the slope of the line passing through the given points. If P(E) 5 0.842, what is the value of P(E)? When graphing a function requiring multiple transformations on the parent function, it is important to follow the correct sequence of steps. { }; The value 3 does not check. 0.1436 c. 215 8 y 5 0.5x2 2 2 26 Skill Practice 7 Use a graphing utility to graph y 5 2x 1 2 and y 5 0.5x2 2 2 on the viewing window [26, 6, 1] by [24, 8, 1]. then m1 5 2 m2 3 5 Section 2.5 215 Applications of Linear Equations and Modeling In

Examples 3 and 4, we use the point-slope formula to find an equation of a line through a specified point and parallel or perpendicular to another line. These exercises cover concepts in the current chapter as well as all preceding chapters. 0, 8, 23 5 d. e. 25. We have chosen i, (2, 3) b. y 5 c. eb 3 1 40. 4k 2 1) 5 13(4k11 2 1) as desired. The solutions can be verified numerically by using the Table feature on the calculator. (2`, `) R. rational a. 23 1 25 24 23 22 21 21 22 23 1 2 3 4 5 8 7 6 5 4 3 2 1 x f(x) 5 (13) 1 (1 23 22 21 21 22 23 1 2 3 4 5 6 7 x b. Let K be the event that a king is drawn: {K ,K ,K ,K }. C(x) 5 x C(5) 5 41.99; C(30) 5 23.67; C(120) 5 20.92 The average cost would approach $20 per session. 2 d. 0. {(2, 1), (2, 21), (22, 1), (22, 21)} 17. (2`, 4.1]; {x 0 x # 4.1} [26, 0); {x 0 26 # x , 0} ; f(x) 6 37. Write a function representing the nth term of a sequence representing the number of outcomes if a fair coin is flipped n times. y 5 x b. Determine the vertex of the graph of the parabola. m(2x) 5 4x2 2 2x 2 3 b. The line is perpendicular to the y-axis and the y-intercept is (0, 7). Refer to the graph of the sequence {bn}. (2`, 14) The line will be slanted if both A and B are nonzero. Using the fundamental principle of counting, we have 8 ? 58.5 ft 144 1296 2 113 ft 22. In how many ways can she select the 5 players if each player is equally qualified to play each position? (Source: www.cdc.gov) Solution: Let E represent the event that a 20-yr-old lives to age 21. 1 23 220 225 230 63. Undefined p6 1p 3n1/3 4 3 2 47. h(x) 5 x2 2 3 Section 2.6 Transformations of Graphs Vertical Shrinking and Stretching of Graphs Consider a function defined by y 5 f (x). 325–329 y 28 210 27 20 250 26 25 26 103. Apply a vertical shrink (multiply the y values by 12). For Exercises 69–72, determine the number of 4-letter arrangements of the letters in the word MISSISSIPPI ... Use the model from part (b) to predict the longevity for an animal with an 80-day gestation period. k(3) 39. y 5 5 b. Suppose that a function L gives the low H1L b(x) represent? y 5 34.9(2.134) b. If a row of the reduced row-echelon form results in a contradiction (that is, zeros to the left of the vertical bar and a nonzero element to the right), then the system is inconsistent. If an instructor presents all of the material in the text, then each objective of that section of text will be covered. xm28 117. Linear; {24} b. (0, 3) ` (3, `) b. Greatest integer less than or equal to 1 is 1. How many passwords can be made if a. The x-intercepts are (1, 0) and (21, 0). Hyperbola; 8 7 6 5 4 3 2 1 F 27 26 25 24 23 22 21 21 22 23 43. pages cm Includes index. y 92. Thus, the probability of all boys is 81 . Parent function: f (x) 5 63. A scatter plot is a visual representation of a set of points. 2 51. Increasing b. f (x) 5 x 1 1 for 21 # x, 2 y a. 2 By the inductive hypothesis, [5 8 1 p 1 (3k 1 21) 1 [3(k 1 1) 1 2] k 3k2 1 13k 1 10 5 (3k 1 7) 1 3k 1 5 5 2 2 (k 1 1)(3k 1 10) as desired. 47 1. x 5 xk as desired. 2268x12 y9 37. The distance formula can be used to derive an equation of the circle. The diameter d of a sphere is twice the radius r. The graph shows the depth (d in ft) of a retention pond, t days after recording began. ... Use the model to forecast the average weight of 10-yr-old girls. Write a function that models the amount of time, each earn interest at a rate of 75%, determine the total amount spent. P(E2) 5 n(S) 38 19 C. 506: © Digital Vision/Getty RF; p. (3n 1 1)! 2. The equation y 5 0.4x 1 109.6 relates an individual's age to an estimated systolic blood pressure for an individual. Identify Specific and General Terms of an Arithmetic Sequence In this section and Section 8.3, we study two special types of sequences. 5 2 2 2 8 B B G G B G G B BBG BGB G B BGG G B GBG GGB G GBB GGG Skill Practice 8 Suppose that a family plans to have five children. Suppose that a lottery game has the player select 5 distinct numbers from 1 to 30, inclusive. 150,000 b. 6 12 12 4 4 d. a1 2 b5 ? The table gives the number of calories and the amount of cholesterol for selected fast food hamburgers. Edit, print, and view assignments in just one click. bn 5 19. For a recent year, the Centers for Disease Control reported that the probability that a 50-yr-old will live to age 51 is 0.9959. 107. 24 25 b. Vertical Translations of Graphs Consider a function defined by y 5 f (x). The indexed root of the plan with 4 additional family members beyond the primary account holder is $150.96. ... If (b) # f (x) for all x in the interval. x 1 y 61. a2`, 2 b , `b 5 59. vertically 13. If P(E) 5 0, then E is called an P(E) 5 1, then E is called a 4. A linear revenue function models revenue R(x) for selling x items. • Values of x that make a radicand negative within an even-indexed root. {25} 11. A Democrat? $17,091 c. 3 1 1 5 3 n12 1 1 1p1 2 27 32 n3 79. • (x, y 2 k) is on the graph of y 5 f(x) 2 k. not the same Replace x by 2x to determine if h(2x) 5 h(x). Then plot points r units to the left, right, above, and below the center. (x 2 4)2 R.2. (5x 2 3y)(x 1 4y) 3 2 15 R.4. (4x 1 5)2 R.5. 4p (p 2 6q)2 2 2b 6 2b2 2 4ac 5. 23x 2 2y 5 60 19. The distance is 24 mi. , 3k 1 3k , 2k 1 2k by the inductive hypothesis (Figure 8-3). f (x) 5 x2 and g(x) 5 x 2. 220 SECTION 2.6 Transformations of Graphs Skill Practice 6 Graph the function defined by y 5 f (x). What is the total arc length that the pendulum travels? Note that 0 2 x 0 5 0 x 0. a. 24. Find the 35th term of an arithmetic sequence with a1 5 50 and a22 5 2265. The survey has 6 yes/no questions and 4 multiple-choice questions each with 3 possible responses. 1410 a. In how many ways can the letters in the word MISSISSIPPI be arranged? c. What is the amount that is repayable if the cost price is $138,000. ... Use the graph to write an equation representing Equation 2. 212 30. Avoiding Mistakes The only functions that are symmetric with respect to the x-axis are functions whose points lie solely on the x-axis. Event E cannot happen. Determine the slope of a line perpendicular to the given line. In the 2010 Wimbledon Championships, John Isner from the United States and Nicolas Mahut from France played a first-round tennis match that became the longest match in tennis history. x 5 24 d. k(x 1 h) 50. (Highlighted in orange tint.) c. Passes through (261.5, 47.6) and is parallel to the line defined by x 5 212. 2500 Section 8.2 Arithmetic Sequences and Series 707 Point of Interest An old story suggests that at the age of 7, Carl Friedrich Gauss (see page 333) amazed his teachers by quickly computing the sum of the first 100 positive integers. 2,562,560u12v36 39. 2x2 1 1 115. Geometric b. equation in the variables x and y can be written in the form Ax 1 By 5 C, where A and B are not C. The number of combinations of n elements taken r at a time is denoted by nCr and is computed by . 0 14. Find the sum if possible. 2y 5 25x 1 2 12. Jean has a list of 8 books that she knows she will read for a class in the upcoming fall semester of school. f 21(x) 5 211 2 x Domain: (2`, 1]; Range: (2`, 0] Domain: (0, `), Range: (2`,) b. Vertical asymptotes: x 5 2, x 5 22, and x 5 21. Horizontal asymptote: y 5 0 47. 2 71. cn 5 (3n) ! find cn 5 n 48. x2 1 y2 1 6x 2 4y 1 15 5 0 y 29. y 1 (3, 21) L 88. x 2 24 75. Mixed Exercises 59. The slope is 25 and means that conservation services rose $25 per year during this time period. k(x) and write the domain of g ? 4, 10. Second, it is generally preferable to write a model that is based on all the data points, rather than just two points. The determinants are opposite in sign. {26.2} 19. z2n 1 2wmzn 1 w2m 69. {21} b. {(23, 1, 4)} 1 9 a. (S1 2 S2)(x) 5 x2 1 4x 2 mx2 and represents the area of the 8 region outside the semicircle, but inside the rectangle. The graphs have the shape of y 5 x2 with a vertical shift. {(1, 3, 1), (21, 23, 21)} a. {(7, 22, 1)} 53. 5 120 15 120 30 87 29 83 5 47. Determine the x- and y-intercepts of f. 21 a. P(d) 5 2 12 1 h. Answer 6. a 10 i51 i51 i50 100 5 34 u k52 16. Denote the sample space as S 5 {R1, R2, B1, B2, B3, G1, G2, G3, G4, G5}. 0, b ? There are 10 choices for the first digit, but only 9 remaining for the second. P(Y or O) 5 P(Y) 1 P(O) 28 128 7 1 5 265 265 17 TIP As an alternative to computing P(N) 1 P(F) 2 P(N ` F ), count the number of elements in the event (N ` F), being careful not to count the elements common to N and F twice: {boy, 3 girls} If 7 males who answered "No" for a total of 169 elements in event (N ` F). Ellipse Center: (0, 0); Vertices: (5, 2), (25, 2); Endpoints of minor axis: (0, 5), (0, 25); Foci: (4, 2), (24, 2); Eccentricity: 45 3. log(8y 2 7) 69. For example, a 25-year-old with a maximum heart rate of 195 beats per minute should strive for a target heart rate zone of between 98 and 166 beats per minute. 8 y 2 (26) 5 (2 x 2 4) 5 Substitute y1 5 26, x1 5 4, and m 5 285 . a1 5 7 and r 5 2 21. (f + g)(3) 5 {x 0 x , 23} e. Given an equation in the variables x and y, what does the graph of the equation represent? 6000 cases 1 1 205e20.67t 49. 2.366 79. 40 30 20 10 24 23 22 21 210 220 1 2 3 4 5 6 x 26. Assuming negligible air resistance, the vertical acceleration is 32 ft/sec2. These observations are consistent with the following rules. In such a case, the goal is to look for a pattern that can be expressed mathematically as a function of the term number. 16 1 16 d. By the inductive hypothesis i51 i51 1 5 1 i51 i51 a 5 1 a 1 b 1 1 as desired. 1023 19. However, if (, `) x 5 23 The solutions to this equation must have an x-coordinate of 23. Section 2.5 Applications of Linear Equations and Modeling 217 Linear functions can sometimes be used to model the cost, revenue, and profit of producing and selling x items. Consider a relation that defines the height y of a tree for a given time t: after it is planted. 1 1 8 15 2 ... Radius: 2 4 1 ... 0.2020020002..., 0.444 [R Skill Practice 1 Given set B, determine which elements belong to the following sets. 11 c. ax 2 b 1 ay 2 b 5 ; Center: a , b; Radius: 24 8 y 24 1 ... and the width is approximately 1.94 in. (2100, 216) and (84, 30) 3 5 33. Therefore, f(g(1)) is undefined. Evaluate T(80,000) and interpret the meaning in the context of this problem. Domain: (2`, `); Range: (21, `) c. Determine the probability that a 40-yr-old will live to age 41. The length is approximately 2.91 in. 772 Chapter 8 Sequences, Series, Induction, and Probability 40. In geometry, it is known that the tangent line to a circle at a given point A on the circle is perpendicular to the radius drawn to point A. Apply the square root property. P(E) 5 n(S) 36 10 5 6 b. Notice that if we were to switch the first and third letters (both "N's") we would get the same arrangement. Undefined 23. 25 24 23 22 21 21 22 23 4 3 2 1 22 22 21 21 22 y x 5 4 y 5 f(2x) 3 2 25 24 23 22 21 21 22 23 1 2 3 4 5 y x 5 4 y 5 2f(x) 2 ... The vertex (x, f) 22. Expand (ex 1 e2x)3. (23, 4) (16) b. The fixed cost does not change relative to the number of items produced. The function f (x) is defined by f (x) 5 g(x) ... (r 1 1)! 1 (2 1) ... The second step does not follow because the multiplication property of radicals can be applied only if the individual radicals are real numbers. Recall that i 5 121. Therefore, we have the option of using the formula P(E) 1 P(E) 5 1. The domain. (See Example 8) 18 55. {x 0 3 , x # 4} 1 19 25. Notice that the number of ancestors for n generations for a male honey bee follows the Fibonacci sequence (Figure 8-3). The Pythagorean theorem tells us that if a right triangle has legs of length a and b and hypotenuse of length c, then a2 1 b2 5 c2. (23, `)3` (13, `) e. x 23 c. 4y8x 6 5 y5 1 y2 x9. Use the model A(t) 5 P a1 1 n b nt P dollars in principal invested at an interest rate of r compounded n times per year for t years for the following compounding options. Inductive hypothesis We must show that 4 is a factor of 9k11 2 1. 4! 41. 0.27 ... The book is gorgeous. For example, a person with B1 blood cannot receive AB1 blood because of the presence of the A antigen from the donor. 20.1320 744 Chapter 8 Sequences, Series, Induction, and Probability TECHNOLOGY CONNECTIONS Evaluating a Number of Permutations, nPr Most graphing utilities can evaluate the number of permutations of n elements taken r at a time. Find the average rate of change in the number of new flu cases between months 0 and 2, and interpret the result. Substitute a for x. (f + g)(x) 5 f (g(x)) 5 2(g(x)) 2 6 1 5 2a b26 x14 2 5 26 x14 Function g has the restriction that x ? (m 2 n)(22) p c. inverse 2b d a 0 d 1 1 0 9. The average rate of change of f on the interval [1, 3]. f (x) 5 x3 2 x 19. For Exercises 63–64, e a. To determine whether the graph is shifted to the left or right, we can locate the x-intercept of the graph of g(x) 5 (x 1 3)2 2 4 may be evaluated at different values of x by using substitution. An 5 12A212 B n 1 B n 1 ... Yes 65. Therefore, to graph an equation of a circle such as (x 1 5)2 1 (y 2 3)2 5 9, Example 2, we first solve for y. {(2, 1, 230)} 30. f (x) 5 (22x 2 1)2 b. e. x2 ; f 8 f 40 46 23 4y 1 8 ea , yb` y is any real number 7 1 3. 52–556 R.1. a. 0.139, 0.00139, 0.0000139, ... Test 10. Increasing on (22,500, 0.667); Decreasing on (2`, 22.500) ` (0.667, `) SA-15 Student Answer Appendix Section 2.8 Practice Exercises, pp. 216 11 4 11 31. The fixed monthly cost for use of a Health Department-approved kitchen and rental space at the farmer's market is $790. In Examples 1 and 2, we use mathematical induction to prove a statement involving a summation. Answer 4. 3 10 1. For example, any polynomial of the form f (x) 5 a(x 2 2)3 2 5 has the required zeros. Student Answer Appendix Center: (0, 4) e. y 5 2 y 10. 5 1 p (2k 2 1)(2k 1) 2k 1 1 1 (2k desired. 4 For example, y 5 2x 1 c where c is any real number. 3. If we have a formula for the expansion of the binomial (a 1 b)n. 536 deer c. Domain: (2`, `); Range: [22, `) 4 22 23 17. 3.5 L should be replaced. Suppose that one parent pea plant has genotype YY and the other has genotype Yy. Parent 2 a. f. A f 12xB is in the form f (ax) with a 5 12 . k 5 5 2 1 a. (2`, 25] 15. A lawn service company charges $60 for each lawn maintenance call. (f 2 h)(2) 106. E5 1 5 F or E54y3 F 32 5 83. (22, 0) and a , 0b 3 f. growth; decay 22 b. 1 21 f 0.655 5 A0e24k c. This uses a description of the elements of the set. That is, P(x) 5 C(x), or equivalently P(x) 5 0. The ball will be at a height of 52 ft at times 1.25 sec and 2.5 sec after being kicked. Minimum point: (8, 29) d. x12 3 17 x. (3i 2 4) 58. (t3 2 v5)6 25. To write a rule defining this function we use a piecewise-defined function in which we define each "piece" on a restricted domain. 6C4 40. Z d. 23, 3 d. If the disc is located at point C, determine the distance to the fire from each observation platform. No y-intercept e. (}; The value 295 does not check. It will be shown in the text as an open dot for interior points. When a function is defined by an equation, we often use function notation. f (x) 5 1 x 2 (2 2 5 1 2) (2) Line 3 Lines that give the same graph. Therefore, the lines do not intersect, they are parallel. 2 y 5 2x ... 2 {(1, 2, 3)} 7 0 21 63. Refer to the graph of the sequence {an}. 11, y ? Therefore, the graph of f is stretched vertically by a factor of 2. 1.5, 1.4167, 1.4142 113. s(t): 5 216t2 1 216t b. (22, 4), (5, 0), and (25, 1) 22. w3 1 12w2 1 48w 1 64 49. e 615, f 2 1 67. EXAMPLE 2 Writing an Equation of a Line Given Two Points Use the point-slope formula to write an equation of the line passing through the points (4, 26) and (21, 2). Principal invested: ($150)(12)(34) 5 $61,200 The amount of interest is $199,548.50 2 $61,200 5 $138,348.50. 23x 1 4y 5 212 51. 2b 15ab 2 16. For Exercises 35–42, find the indicated term of a geometric sequence from the given information. n! . 62.5 lb of 7 cement and 225 lb of gravel 25. y 5 4 3 2 (25.1, 22.5) 2 1 y5x 51 3 25 24 23 22 21 21 22 23 1 2 3 4 5 x Arbitrarily select negative and positive values for x such as 23, 22, 21, 0, 1, 2, and 3. Using the Vertical Line Test Consider a relation defined by a set of points (x, y) graphed on a rectangular coordinate system. The value f(1) 5 2 3, but f(23) is undefined. y 5 21 y 31. A female honey bee hatches from a fertilized egg, so she has two parents: one male and one female. r(x) 5 2x 1 1; (0 # x , 7 110. The graph of f is the same as the graph of y 5 0 x 0 with a horizontal shift to the right 2 units and a vertical shift downward 3 units. 230x 6 20y 1 600 2x 1 5y 1. The difference quotient represents the average rate of change of f over the following intervals for t. f 7 41. If a couple has 3 children, how many boy/girl sequences are possible for the births? 3 1. 1520 at (8, 6) b. 3 3 1 43. Domain: {8, 3, 11, 5} c. P 5 21 1 2w 7. The center is (22, 21) and another point on the circle is (6, 5). Reference SECTION 2.4 Linear Equations in Two Variables and Linear Functions Let A, B, and C represent real numbers where A and B are not both zero. The y-intercept is (0, 3). Assuming that the student has met the prerequisites of each course and that there are no scheduling conflicts, determine the number of ways in which the student can select these courses. x 5 y2 1 3 14. 3 4Q R.3. b 5 62a2 2 1c 2 92 2 B 3 c. Determine the slope of a line parallel to the given line. This is called the mortality rate. 1 x 2 4 x2 1 x 1 4 x 15 (x 1 5) 2 A D Ex 1 F (x 1 B C 19. (x 1 6) 5 24(y 1 1) 67. 14 3x 2r1r2 2 17 2 85. x2 5 5 1 y2 16. Write a linear cost function representing the monthly cost C(x) for x maintenance calls. What is the slope of a line perpendicular to the x-axis? SECTION 2.7 (4, 26) b. 10 (14, 13.0) (4, 11.2) a. The events from parts (a) and (b) are not complementary events. Graph of the regression line passes near but not necessarily through the data points that represent the general trend of the data. (See Example 10.) 9 a. 4 3 2 26 25 24 2322 21 21 22 y 5 4 3 2 1 24 23 22 21 21 22 23 1 2 3 4 5 x y x The common difference is 4. • A linear model can be made from two data points that are chosen to represent the general trend of the data. (210, 0) and (21, 0) d. 23 (multiplicity 2) and (multiplicity 2) 2 7 5. 132. There are 5 candidates for the $1000 scholarship, which leaves 4 students left over for the $500 scholarship. 0 2x 2 3.8 0 2 4.6 # 7.2 110. Principle of Mathematical Induction Let Pn be a statement involving the positive integer n, and let k be an arbitrary positive integer. f (23) c. The range is the set of y values. x. Section 2.4 203 Linear Equations in Two Variables and Linear Functions Skill Practice 5 Write an equation of the line that passes through the point (21, 24) and has slope 3. f 21(x) 5 y 5 4 3 2 y 5 f(x) 4x 1 3 x21 1. f (x) 5 x b. (23, 28) and (4, 67) 27. Graph y 5 f(2x) 1 3. Write f(x) 5 ax2 1 bx 1 c (a fi 0) in Vertex Form 4 3 2 1 27 26 25 24 23 22 21 Vertex 22 h. EXAMPLE 2 Finding the Probability of an Event An American roulette wheel has 38 slots, numbered 1 through 36, 0, and 00. y 5 3. Determine the probability that both students chosen are freshmen. 701 an 5 a1 1 (n 2 1)d where a1 is the first term of the sequence and d is the common difference. • Write About It exercises are designed to emphasize mathematical language by asking students to explain important concepts. The final exam grades for a sample of students in a Freshman English class at a large university result in the following grade distribution. 1 e. Use the graph to find the solution set to the inequality 3x 2 (x 1 4) 2 1 $ 0. 64 73. a22 5 217 21. In how many ways can a platoon leader select 4 soldiers from among 15 soldiers to secure a building? How far will the ball roll in the 10th second? e f 3 135 5 89. n Sn 5 (a1 1 an) 2 60 S60 5 (8 1 185) 2 S60 5 5790 Substitute n 5 60, a1 5 8, and a60 5 185. $14,600 and $0 d. (2`, 0) ` (0, `) c. 63. 769 Review Exercises 79. 227 (multiplicity 1), 0 (multiplicity 1) 39. a (5k 1 3) k51 i51 56. Let n represent the row number in Pascal's triangle. The pressure is 9 times as great. 6! n 5 6 and r 5 2 c. 80. Reports are also available to both students and instructors that track progress and scores on all assignments. 2 1 2 1 5 125 625 Several important properties of summation are given in Table 8-2. (2, 0) and (22, 0) d. Printed in the United States of America. In this expression n 5 3 and r 5 5. r! 39. 3(669 c. Cubes. x 1 2y 5 1 b. (a 1 b)2 5 Vertical asymptote: x 5 7; Slant asymptote: y 5 2x 1 1 1 13. 7, 14, 42, 88, ... 15. e ax, ea 12 2 3z 4 z z , zb ` z is any real number ` f 5 15. A car can comfortably hold a family of five. Determine the vertical asymptote(s). If students still prefer holding a text as they study, they can order a loose-leaf copy of their textbook for just $15. From the table, the probability that a 20-yr-old will live to age 21 is 0.9991. P(E) 5 0 003 15. The solution set is {(x, y) 0 x 5 2y 5 2(2x 2 6x 1 (2y 1 4)) 3 2 2 19 17 y2 5 0 ... b3 c63 x3 b2 15. The vertex is (21, 2), (22, 2), d. 0 5 10 15 20 Year 1 1 2 (2, 8) 23 C 9 2 3 ... In how many ways can such a committee be formed? e 11. [2, 18] 115. For Exercises 45–48, find a1 and r for a geometric sequence {an} from the given information. f (x) 5 1x 2 2 f (6) 5 2 5 6 is on the interval x $ 2. Section 2.5 225 Applications of Linear Equations and Modeling c. (2`, 3) ` (3, `) c. A dance studio has fixed monthly costs of $1500 that include rent, utilities, insurance, and advertising. The lengths of the legs of the triangle are 0 x 2 x1 0 and 0 y 2 y1 0. The distance from the center of a circle to any point on the circle is called the . f (x) 5 46. From this observation, we might make the following hypothesis, which is proven in Example 2. Notice that the graph of the relation is not a function. b. Round the slope to 2 decimal places and the y-intercept to the nearest whole unit. Three biology books, 4 math books, and 2 physics books are to be placed on a book shelf where the books in each discipline are grouped together. Domain: (2`, `); Range: (2`, 0] Suppose the number of miles traveled is 1 + ... Which of the variables is the independent variable? A set of points in which the distance to the ... 21 k51 x2 ... 9 12 11 19 g(x) 5 0 x 0 2 1 ... [2`, 0) (3, 2) Write a function that defines the distance d(t) (in mi) traveled per week that represents the number of miles of driving and miles of highway driving. 119 79. y 5 x2 33. For what value of x will R(x) 5 C(x) or P(x) 5 0? 4CD D 2C C ay2 1 12 9 6 3 28 26 24 22 23 26 29 212 1. See page 755. x-intercept: (4, 0); y-intercepts: (0, 24), (0, 210) 1. 10 210 2 3 4 5 6 7 8 9 x 10 y 5 x3 Section 2.2 Practice Exercises, pp. {22, 1} e f 3 1 3 77. 1 2 3 4 5 6 7 8 9 0 DOW/DOW 1 0 9 8 7 6 ISBN 978–0–07–783634–4 MHID 0–07–783634–0 ISBN 978–1–259–57046–9 (Annotated Instructor's Edition) MHID 1–259–57046–0 Senior Vice President, Products & Markets: Kurt L. 2 ; c Section R.4 Practice Exercises, pp. Yes; d 5 Section 8.3 Practice Exercises, pp. 294 21251 13. Between 23 and 22; 22.2924 a. 1 2 50. (1, 5), (1, 27) d. Objective 1: Graph Equations in Two Variables For Exercises 9–20, graph the equation and identify the x- and y-intercepts. 78. 5050 c. x2 2 x 1 1c Given a line with slope m and y-intercept (0, b), the slope-intercept form of the line is given by y 5 mx 1 b. The window settings shown here are [0, 80, 10] by [0, 200, 20]. For example, consider the line representing the median income for individuals with a bachelor's degree, x years since the year 1990. 250% f. 31 90 However, rather than making a one-time lump sum payment of P dollars, many individuals will invest smaller amounts at regular and more frequent intervals. The value of A 0 A equals 0 b. The cards are all hearts. Determine the slope of the line containing the points (3, 22) and (25, 12). g(x) 5 2 x 1 4 1 3 y a. 24ab d. The equations that represent the two lines are called linear equations in two variables. The vertex is the center. The center is in quadrant IV, the radius is 4, and the circle is tangent to both the x- and y-axes. 9 16 13 5 Focal length: 3; Focal diameter: 12 29. Suppose that two cards are drawn from a standard deck with replacement. g(x) 5 2 (x 1 2)2 1 3 3 77. Shift upward 3 units. 7530 Write an. d 5 12 8 3. form) Skill Practice 1 Use the point-slope formula to find an equation of the line passing through the point (25, 2) and having slope 23. So instead of graphing a single smooth curve, it graphs a series of short line segments. Definition of a Function Given a relation in x and y, we say that y is a function of x if for each value of x in the domain, there is exactly one value of y in the range. (0, 2] 2 42. Evaluate a (21 1 3). {611(y4) } 1 22. h(x) 5 0 x 0 2 8 76. 22.87 Therefore, the sequence is arithmetic. Determine the y-intercept. 2850 59. Prove that F1 F3 1 F5 1 ... 1 F2n21 5 F2n for all n $1. • The cards are divided into four suits (or categories) called spades ( ), clubs ( ), hearts ( ), and diamonds ( ). To eliminate this distortion, use a ZSquare option, located in the Zoom menu. y 5 4 3 2 y2 1 y 1 y2 5 1 22 21 22 23 24 25 1 2 3 4 5 x 27 Apply Graphing Calculator Exercises Quadratic Function and Piecewise-Defined Functions Test for y-axis symmetry. y 5 f(x) 1 25 24 23 22 21 21 22 23 3 x 26 y 5 2f(x) 24 1 2 3 4 27 2 5 x 27 Section 2.5 Linear Equations in Two Variables and Linear Functions ... y 5 x 2 12 ... Write a linear function that represents the monthly revenue ... x is the number ... y. 3 4 C(x) 5 12 8 210 x 16 27 24 29. Express your answer in simplified radical form. (2`, 0] b. 3391 45 990 a. 2x2 1 4 For Exercises 41–46, refer to the matrices given and perform the indicated operations, if possible. Center: (2, 4) e. f. (32) 5 5 c. 1 0x 0 2x for x , 2 for x $ 2 In computer programming, the greatest integer function is sometimes called the "floor" function. Write the standard form of an equation of the circle with center (24, 6) and radius 3. Graph Equations by Plotting Points The relationship between two variables can often be expressed as a graph or expressed algebraically as an equation. 0.3, 0.33, 20.9, 212, 114 , 6 e. Let Pn be the statement 1 1 5 1 p 1 5n21 5 14(5n 2 1). Horizontal asymptote: y 5 0 f. h(21) c. b 5 5 b. (24, 1) 22 23 1 71 13. The value of the series is equal to the 60th partial sum of the sequence of terms. Direction: h 5 1 2r 2 1 2r 2 1 2 (y 2 k)2 represents a parabola with vertex (h, k) and . ... Unchanged ... Show that the set of points are the vertices of a right triangle. ... An individual with a $400 monthly car payment ... (x, 2y) ... a number n of trials ... 1 ... Figure 2-14 ... The domain of f is the set of real numbers ... Chapter 4 Review Exercises, pp. 6 1 1. (g + f)(0) 2 24 25 f 5 {(2, 4), (6, 21), (4, 22), (0, 3), (21, 6)} and g 5 {(4, 3), (0, 6), (5, 7), (6, 0)} 1 23 For Exercises 103–110, refer to the functions f and g and evaluate the functions for the given values of x. a 1 ar 1 ar2 1 p 1 arn12 81. s(x) 5 e 2x 2 1 for x # 21 1x 1 1 for x ... 5 4 3 2 1 21221028 26 24 22 22 24 26 1 2 3 4 5 ... The real zeros are approximately 27.6, 21.5, and 1.6. d. Domain: (2`, `); Range: 2 23 24 25 26 27 28 29 3 3. Graph f(x) 5 2x 2 x 1 2 4 5 x 4 2 3 y 5 f(x) ... 5 3 4 3 22 21 ... (Ε61 (4, 1) P1 1 25 24 23 22 21 21 (22, 23) 22 23 25 24 ... Œ52 23 A 161B 0 A 1101B 52 1 61 ? x22 3x 1 1 c. paper) — ISBN 1–259–57046–0 (alk. M 2 D 5 c $3600 $2400 d; $3400 $2000 This represents the profit that the dealer makes on each model. The number of ways that n distinguishable items can be arranged in various orders is . Minimum: 0. h. an an 5 4 5 4 5 4 5 4 3 2 1 3 2 1 3 2 1 3 2 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 6 7 8 25 24 23 22 21 ... 5 4 3 2 1 ... Objective 2: Write Terms of a Sequence Defined Recursively For Exercises 25–30, write the first five terms of the sequence defined recursively. 7 1 5 5 3 ... For the x-intercepts, set y 5 0 and solve for x ... The student's average would be approximately 78.5. 3 7 1 1 21 2 2 14 (4, 0) Ordered pairs x Figure 2-7 TIP In some applications, we may refer to an x-intercept as the x-coordinate of a point of intersection that a graph makes with the x-axis. Any point on the x-axis has a y-coordinate of zero. Change assignment dates right from the home page. The student's average will be 85. Major axis: in. $2450 c. (2x3 2 y)5 22. 2 5 1 5. 9. x 2 5 7 3y d. 5 10 15 ... An individual with questionable integrity prints and spends $12,000 in counterfeit money. Apply Vertical and Horizontal Translations (Shifts) For Exercises 15–26, use translations to graph the given functions. There are two scenarios for the salesperson's income. (2`, 213] ` [21, `) 5 1 b. y. 30. 5 4 3 2 4 3 2 1 25 24 23 22 21 22 23 22 1 2 3 4 5 x 3 4 5 x 25 24 23 22 21 ... Hyperbola; Center: (2, 22); Vertices: (6, 22), (22, 22); Foci: (7, 22), (23, 22); Asymptotes: y 5 34x 2 72 and y 5 234x 2 12 ; Eccentricity: 54 2. No (4, 2, 24) and (22,8) (3) (x1, y1) and (x2, y2) 4 2 1 (22,8) 14 3 M5x , 2y 2 2y 2 1 21 ... The sequence is arithmetic. b. Find the sum of the first five terms... Recursively defined sequences ... 2x ... Determine the time at which the stone will hit the ground. Relations. Determine the x-intercepts... 2k11 2 1 as desired. {(4, 21), (6, 21)} 19. Test for Symmetry 2. 6.1% b. 5 4 3 2 5 4 3 2 1 ... For Exercises 97–110, write the domain in interval notation. 1 b. 17 7 4 5 ... The value 24 does not check. a (2i 17 59). Write a linear revenue function representing the monthly revenue R(x) for x maintenance calls. P) is true because 8 5 22(1(1 2 5), 25y2 2 4x2 2 16x 2 9 2 55. provided x ? a b(3) py 5 5 h(x) 1 25 24 23 22 21 21 22 23 1 2 3 4 5 x d. For n 5 1, the sum equals Answer 1. The sequence is not arithmetic because the difference between a2 and a1 is different than the difference between a3 and a2. 16.94 cm 16 y2 x2 1 51 a. m 27. (10, 20) 15 10 10 (0, 0) 0 (20, 0) x 563: © Image Source/Getty Images RF; p. For Exercises 87–88, ... The exponent ... is equivalent to ... The 2-ft increase ... Suppose that we wanted to arrange the letters in the word NINE. How many different arrangements can be made? The sequence... Explain what the difference quotient represents. Find the slope of the line ... 0 24 The open dot at (23, 1) indicates that 23 is not in the domain of f. In the New York state lottery game "Lotto" a player wins the grand prize by choosing the same group of 6 numbers from 1 through 59 as is chosen by the computer. Because the principal is invested pretax, the individual potentially has more money available to invest. Apply the Point-Slope Form of an Equation of a Line ... She takes 2 pairs of slacks, 6 blouses, and 4 scarves, all of different colors. 89,000 700 0 3 4 y 12 108 4 8 6 4 CHAPTER 5 ... 2 (2 2 1 2 1 3 4 2 1 5 2 6 1 2 1 5) ... n 5 6 a. Write the first 10 terms of the Fibonacci sequence. g. 0 1 5 P(E) 5 1 2 5 The probability of rolling a sum other than 7 is 56. (2`, 22) ` (3, `) b. 5. Round to the nearest hundredth of a mile per hour. How much interest will have been earned? The statement is false for n 5 11. Each equation represents an ellipse with a vertical major axis of length 20 units. Then determine the probability that the coin will land heads up on both tosses is P(A and B) 5 P(A) ? 80 Figure 2-23 From Figures 2-22 and 2-23, we can draw the following conclusions. e 6f 6 6 16. (2`, `) 29. (25, 23) a (21, 2) b. Height: 3 12 ft; Width: (2 12 ft; $29,836.49 c. 2 x 1 3 f Skill Practice 3 Determine if the given relation defines y as a function of x. The amount of fuel used by this hybrid vehicle is given by y 1 A5 1362 1 1912 48 52 5 2.5 gal 2. See Complex fractions Compound inequalities, 146–148, 159 Compound interest, exponential functions to compute, 418–420 Computer, 307 Conditional equations, 85–86, 158 Conditional statement, 167 Conic sections, 691, 5 y 29,200(0.8)t 0 c. y 5 12 18 17. In how many ways can the letters in the word FLORIDA be arranged? The commutative property of addition indicates that the order in which numbers are added does not affect the sum. For the first time, SmartBook is now available on mobile devices. The cost of producing ... Table 2-1 shows two different test scores for 8 hr of study. 3 27 5 3 1 5 1 23. Determine the probability that Iglesia will not get a hit on a given time at bat. This is because the two N's are indistinguishable. Write P as a function of A. Variable costs include labor, material, and shipping. f (g(0)) Practice Exercises Prerequisite Review For Exercises R.1–R.4, write the domain in interval notation. For Exercises 55256, the fixed and variable costs to produce an item are given along with the price at which an item is sold. x 5 23 59. R(6). {29, 4} exponential 3. 67.18 1,670,000,000,000,000,000 molecules 81. Write a relationship that represents the amount of wire remaining w(x) as a function of the number of feet of wire x already used. 210 210 (1, 21) 21 x 25 24 23 22 21 21 (0, 21) 22 23 ... The range is the set of y values ... Answers 5. The company would make 8 trips with the small truck and 6 trips with the large truck. Use interval notation to write the domain ... Vertex: A23, 32 B; p 5 12 ; Focus: (23, 2); Focal diameter: 2. T(80,000) 5 1692 means that the property tax is $1692 for a home with a taxable value of $80,000. y 5 f(x) 1 25 24 23 22 21 21 22 23 1 2 3 4 5 x y x completing the square on f (x) 5 ax2 1 bx 1 c. (x2 1 3y)(x2 1 3y2 2 3a2 93. Skill Practice 4 Graph the functions. Passes through (3, 21) and is parallel to the line defined by 23x 1 y 5 4. No d. Even 29. f (x) 5 x4 2 6x2 2 4 For Exercises 53–56, use the binomial theorem to find the value of the complex number raised to the given power. Not a polynomial function. Then the value A (in $) of the annuity after t years is given by A 5 EXAMPLE 11 PC A1 1 nr B nt 2 1D r n Finding the Value of an Annuity Suppose that an employee working for a state college puts aside $150 at the end of each month in a tax-sheltered annuity. 30 30 25 20 20 17. (3 2 24) 0 or 0 24 2 3 0 ; 7 3 2 5 3 3 3 3 3 2 1 2 1 2 3 4 5 x-intercepts: A2 13, 0B, A22 13, 0B; y-intercept: (0, 12) 81. 5 4 3 2 1 1 2 3 4 5 6 7 x 25 23 22 21 21 22 23 24 25 26 27 ... The hypothesis is true for n 5 k ... Find the probability of the Union of Two Events We now study the probability of the union of two events. y 5 2 45. m 5 2 y3 1 33 11 a. Round to 3 decimal places. 2x 1 h 4 41. Horizontal translation (shift) y 5 f(x 2 h) y 5 f(x 1 h) Shift to the right h units Shift to the left h units Replace (x, y) by (x 1 h, y). Slant asymptote: y 5 2x 2 5 17. 731–732 R.1. x2(x2 1 1) R.4. 1. 726: © Image Source/Getty Images RF; p. Use Stirling's formula to approximate the given expression. f (x) 5 x3 1 14. n 5 169; (p 2 13)2 e 6 2 2 35. 2 1 2 17. 11.2 yr y 5 76.8 11. 1 2 3 4 5 ... For example, ... Write the standard form of the equation of the circle ... Just as an athlete must first learn the basics of a sport and build endurance and speed, a student studying mathematics must focus on necessary basic skills to prepare for the challenge ahead. x2 2 36 a. 12 unit to the right of the vertex y 27. 5 4 3 2 7 5 (2, 5) 1 1 (2, 23), (23, 22) 22 23 24 25 1 2 3 4 5 x 200 Chapter 2 Functions and Relations y 5 b. k(210) 55. Vertices: (0, 0), (10, 0), (0, 40), (8, 30), (36, 12), (36, 0) 19. 22 (multiplicity 2) b. g, and f g are defined for x ... Systems of linear equations in two variables applications, 197, 275 graphs of, 197–198 solution of, 198 ... Linear factorization theorem, 333, 344 Linear functions applications of, 217–216 explanation of, 202, 209 graphs of, 229 Linear inequalities in applications, 151 explanation of, 144–145, 202 graphs of, 536–539 method to solve, 144–148 in two variables, 315–316, 536–540, 557 Linear models, 216, 276 Linear profit functions, 217–218 Linear programming applications of, 548–552 constraints and, 548–549 explanation of, 547, 557 objective functions in, 548–549, 551, 557 Linear regression, creating models using, 220–221 Linear revenue functions, 217, 218 Linear speed, 510, 512, 516 ... Logarithmic equations applications of, 472–473 ... explanation of, 457 ... Logarithmic functions ... Long division ... Lower bound ... Major axis ... Mathematical induction ... Matrices ... Maximum value ... Midpoint formula, 168 Minor, of element of matrix, 612–615, 627 Minor axis, of ellipse, 635 Mixture applications, 96, 498–499 Modeling with exponential and logarithmic functions ... Multiplicity of zeros ... Natural logarithmic functions ... n factorial ... Nonlinear systems of equations ... Oblique asymptotes ... One-to-one functions ... Ordered pairs ... Parabolas ... Parallel lines ... Partial fraction decomposition ... Pascal's triangle ... Permutations ... Perpendicular lines ... Piecewise-defined functions ... Point-slope formula ... Polynomial functions ... Probability ... Pythagorean theorem ... Quadratic formula ... Quadratic functions ... Radius of a circle ... Range ... Rational functions ... Real numbers ... Reciprocal functions ... Rectangular coordinate system ... Recursive formula ... Reflections ... Regression ... Relations ... Remainder theorem ... Row-echelon form ... Sample space ... Scatter plots ... Sequences ... Series ... Shrinking and stretching ... Slope ... Square root property ... Standard form ... Summation notation ... Symmetry ... Synthetic division ... Systems of equations ... Test points ... Transformations of graphs ... Translations ... Upper bound ... Variation ... Vertex ... Vertical asymptotes ... Vertical line test ... Zero of a function ... The hiring firm ... Suppose that a student ... Choose the number ... 1 1 2 (2, 8) 23 C ... Application In the game "Florida Lotto," a player must select a group of 6 numbers (without regard to order) from the numbers 1 to 53. {(1, 2)} y 5 4 3 2 y 5 23x 1 5 1 y Hours Studying History 5 210 23 24 25 e. 22x 1 y 5 4 11. 5 250 250 52 14 3 12 13 32 8 39 3 6 5 3 7. By the inductive hypothesis, 1 1 2 k(k 1 1) ... Determine the number of ways ... A set of points ... equal distance ... The motor vehicle death rate ... 13P5 5 154,440 and 13C5 5 1287 A permutation of n items taken r at a time is always greater than or equal to the corresponding combination ... The motorist will be driving ... The call letters of a radio station must begin with either K or W. 94. n(S) 10 It is intuitively obvious that a white marble cannot be selected. R1 1R2 SR2 5 a 2R2 R1 SR1 5 c 1 0 c a a 1 1 0 c ... The initial swing (one way) of a pendulum makes an arc of 24 in. (Source: NOAA: www.noaa.gov) 150 (950, 110) (See Example 7) a. By the inductive hypothesis ... gives a total of 16 elements in event (A ` B). Use the slope formula ... EXAMPLE 6 Reflecting the Graph of a Function Across the x- and y-Axes The graph of y 5 f (x) is given. 2i 3x ( ); The values 3 and 210 do not check. Assume that 11 1 4 1 p 1 4k21 5 13 (4k 2 1). The inequality 0 x 2 3 0 ... or R.5. Suppose that an investor deposits $14,000 in an account that pays interest ... at 2% interest. x2y5 2 3x1y5 1 15 Find ... 1 1 1 ... Answers 1. Functions 3. How much interest will be earned? r (x) 5 0 x 2 8 0 82. ... Skill Practice 14 Use the data points (480, 60) and (720, 90) to write a linear function that defines the amount of cholesterol c(x) as a linear function of the number of calories x. 2 (3x)2(3x2 1 1)4/3 Chapter R Review Exercises, pp. This means that if the polynomial has no real zeros, there will be an even number of them. (2`, {24} 59. (2`, 0]. We say that a is less than b (written symbolically as a , b) if a lies to the left of b on the number line. ... The height of a girl at age 11 is 90% of her full-grown adult height, use the result of part (c) to estimate the average height of adult women. The minimum cost is $1860. 5 b 1x 12 11 x Skill Practice ... in a 30-sec ad, ... 29 Avoiding Mistakes ... The vendor will lose $45. 40P3 or 40 ? 397–398 y 16. Write a function that represents the number of gallons of gasoline n(d) used for d miles traveled. 3 1 3! ... 25. 24x 2 2h 1 7 d. Let Pn be the statement 4n , (n 1 2)! for n $ 2. (2a 1 5) 2 5 Replace 7k by 2a 1 5. One such model is called the least-squares regression line. 0 30 a 1 26 1175. EXAMPLE 6 Counting Permutations in an Application If 8 horses enter a race, in how many ways can the horses finish first, second, and third? m 5 29 n 5 25 93. Graph a Quadratic Function In Chapter 2, we defined a function of the form f(x) 5 mx 1 b (m fi 0) as a linear function. 6 5 336. The fixed distance from any point on the circle to the center is called the radius. For Exercises R.3–R.4, solve the equation. f (x) 5 x 3 , g(x) 5 2x x. number of distinguishable permutations of the elements of the set is: p. an 5 2n 1 1 3 4 3 1 2. The original population is 40,000. g 5 2 P2V2 T1 9 2 3 15 1 3 15 119. Consider a sequence representing the salary for Job A for year n. Assume that P1 5 k (inductive hypothesis). However, it is acceptable for a function to have more than one x-intercept. The ratio of the ... In how many ways ... 2 ... 1. 0.95 0.95 ... The graphs of ... 0 x 2 5 0 ... (22, 1) 5 y 2 x |x| 5 21 4 3 (3, 2) 21 (0, 2) ... Skill Practice 4 Graph the equation by plotting points. 12 740 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 2 Applying the Fundamental Principle of Counting A computer password must have three letters, followed by two digits. In how many ways ... large trees and small trees. • The value of r is the quotient of any term after the first and its predecessor. 741 n! r 1! ? Likewise, the number of letters left for the third letter will be decreased by 1 ... The expression 80 ... an ... Apply the inductive hypothesis ... a1, and an. f(2) 5 5 b. Write the equation of the circle in standard form. 40,000 ... Simplify the expression from part (a) for t. c. 5. R.5. {7}; The value 22 does not check. No Problem Recognition Exercises, p. (24, 5) Chapter 3 Cumulative Review Exercises, p. Suppose that 9 horses run a race. 60. 6 h. 210 3. That is, 5x4 1 4x3 5 x3(5x 1 4) and 5x24 1 4x23 5 x24(5 1 4x) Ax 1 15B Ax 2 15B 103. 3x 5 2y 2 4 54. (2`, 24] ` [1) c. parabola; directrix; focus 3. 5 4 12 3 q(x) 5 2x 1 6 2 10 8 6 4 2 22 24 26 28 ... Sum of a finite arithmetic ... Find the sum of the first ... 220 Chapter 2 Functions and Relations ... Since y 5 0 ... The total earnings ... if the graph ... An investor ... 8 6 4 2 ... 3n ... EXAMPLE 1 Determining Whether a Sequence is Arithmetic ... function that represents the cost C(x) (in $) for x tickets ... by the ... The distance between ... the point ... f 5 12 ... In the student ... parameters. Graph f (x) 5 e 2x for x , 0 x for x $ 0 ... Vertex (1, 8) ... Skill Practice 3 Figure 3-2 Skill Practice 1 Repeat Example 1 ... is a point close to the relative maximum. ... 23 4 3 2 1 0 1 2 3 4 5 ... The graph of the function ... P1 is true because ... Therefore the statement is true for all positive integers n. Cost to produce ... 2 (k 1 3)(k 1 2)! 5 (k 1 3)! as desired. ... By the inductive hypothesis ... This implies that k2 2 k 5 2a for some positive integer a, and thus k2 2 k ... • At x-intercepts: (0, 23), (0, 3) 47. 8.6 3 1021 b. In this case, 24 scoops of whey protein should be mixed with 36 scoops of soy protein. 623. Suppose ... a person at the ... Use the ... Five people enter a ... 8 3 5 ... 2 ... The probability of rolling a sum of 7 ... (See Example 10) 10 ... 60, 70, and 80 ... a person caught speeding 15 mph over the speed limit ... A21 5 E 21 2 35. 62. 413: © Malcolm Schuyl/Alamy RF; p. F 2 1 F b. TL 5 E $2688 § $1657 $46 77. A probability is a value assigned to an event that quantifies the likelihood of the event to occur. and day 30? Domain: [0, 4); Range: [0, `) 1 23 22 21 22 67 x is not; is 3. To find the probability of the event (A or B), denoted P(A or B), find the probability of the union of A and B. ... The table gives ... 3 ... The variable ... This is a 3 3 3 ... What is the probability that all four will be good? (See Example 10) 159, π [H f. y 5 4 3 2 ... The data set ... f 5 19 ... We use the 5500 cal ... An individual ... in the first 30 days ... by a 120-lb individual who hiked for 6 hr, ran 3 hr, and walked for 5 hr in a given week. 3x2 2 3 3xh 1 h2 c. The person is 61 or older or has elevated cholesterol. 50 items a. 4c4d 2 20c2d2 1c 1 25c4 77. In a rectangular coordinate system, the center has coordinates (0, 0) and ... The x-intercepts ... For example, the element 5500 in the first row tells us that ... we expect ... explanation and ... Examples ... 62 ... 1; 3 Focal length ... 23/2 ... (3, 0) ... 2 25 ... Find the 600th term of the arithmetic sequence ... 1, 3, 5, ... FINDING THE PROBABILITY OF COMPLEMENTARY EVENTS Suppose that 2 dice are rolled. 2 3 4 5 a. • The axis of symmetry is x 5 h. (See Example 8) a. 20 e. A car traveling 60 mph (88 ft/sec) undergoes a constant deceleration until it comes to rest approximately 9.09 sec later. ... Finding the Probability ... a single die ... navigate their learning, track their progress and ... set the pace ... the value of the ... The sum of ... 10 ... Sum of an Infinite Geometric Series ... approaches a limiting value. Consider a right circular cone with given height h. A chocolate chip cookie is selected. For example, y 5 x10 1 ... 5 has no x-intercepts. If a1, a2, a3, a4, ... is a geometric sequence with common ratio r, show that a11, a13, a14 ps is also a geometric sequence and determine the ... Perhaps the most famous sequence is the Fibonacci sequence, named after the twelfth-century Italian mathematician Leonardo of Pisa (known as Fibonacci). The fourth roots of 1 are 1, 21, i, and 2i. 173–177 R.1. 4 13 B. 24 km B F 1 25 24 23 22 21 21 22 17 7. 8 ? It is important to realize that for nonterminating decimals, a calculator or spreadsheet will only give approximate values, not exact values. [21, 0] ` {3} 21 5 5 3 15. Find the average rate of change in the number of new flu cases between months 4 and 6, and between months 10 and 12. Up to the left, up to the right. Suppose that ... 5,4 ... Up to the left ... 23 ... For Exercises 15–28, expand the binomial by using the binomial theorem. (2, 3) 73. 9, 8.4, 7.8, 7.2, ... 239 39. x 5 0 a. In how many ways ... The instructor may ... the slides in class ... in a group of ... 4 ... 57. Let n represent the number of subsets ... To represent the ... 5 ... In a group of ... Dispute ... The frequency ... 98 ... Suppose that 4 ... the number of people ... Halina Adamska, Broward College–Central; Mary Beth Angeline, West Virginia University; Colleen Beaudoin, University of Tampa Rachel Black, Central New Mexico Community College; Tony Bower, Saint Phillips College; Brown Baranowski, Tarleton State University; Denise Brown, Collin College; Wyatt Bryant, Tarleton State University; Palm Beach State College–Michelle Carmel, Broward College–North; Lydia Casas, Saint Phillips College; Carlos Cotona, Collin College; Deric Davenport, Pikes Peak Community College; Tonya DeGeorge, Georgia Gwinnett College; Jason Geary, Harper College; Steve Gonzales, Northwest Vista College; Jeffrey Gould, Broward College–Campus; Craig Hardesty, Hillsborough Community College; Tony Hedges, University of New Orleans; Carolyn Horseman, Polk State College; Ahmed Kahnayi, Tarleton State University; ... Houston Community College; ... Georgia Gwinnett College; ... Broward College; ... Ozarks Technical Community College; ... Collin College; ... North Harris Community College; ... Tallahassee Community College; ... Daytona State College; ... Central New Mexico Community College; ... Saint Phillips College; ... Houston Community College; ... University of North Georgia; ... Valdosta State University; ... Florida State College at Jacksonville; ... Clayton State University; ... Northwest Vista College; ... El Paso Community College; ... Lone Star College; ... Miami Dade College; ... Austin Community College; ... Hillsborough Community College; ... Tarrant County College; ... Blinn College; ... Collin College; ... Mississippi State University; ... Santa Fe College; ... Northern Virginia Community College; ... Southern Illinois University; ... Broward College–North; ... Montgomery College; ... Central Texas College; ... Houston Community College; ... Miami Dade College; ... Collin College–Plano; ... South Plains College; ... Saint Phillips College; ... Salisbury University; ... Windward Community College; ... Tyler Junior College; ... Georgia Gwinnett College; ... California State University–Long Beach; ... Houston Community College; ... Collin College–Rio Grande; Edmund MacPherson, Tyler Junior College; Anna Madrid-Larranaga, Central New Mexico Community College; ... SE Louisiana University; Roderick McBane, Houston Community College; ... 152–156 R.1. {x 0 x . 21}; (21, `) R.2. {x 0 x # 5}; (2`, 5] R.3. {x 0 23 , x # 2}; (23, 4] R.4. {12} R.5. e 2 f 2 f 13 R.6. {27} 1. an 5 2n 2 1; find a10 18. Greatest integer less than or equal to 0.4 is 0. 24. 22x2 2 x 2 14 1 4 5 x 10. 4 5 6 {(Tom Hanks, 5), (Jack Nicholson, 12), (Sean Penn, 5), (Dustin Hoffman, 7)} b. As written, g(x) 5 0 2x 0 is in the form g(x) 5 f (ax), in which a . 1. That is, R(x) 5 C(x) and the company breaks even. q(x) 5 12x 1 2 x 2 For Exercises 33–40, use the graphs of f and g to evaluate the functions. 4x 2 2 , 23x 1 5 c. See also Counting principles Fundamental theorem of algebra application of, 332–335 explanation of, 333 Future value, 719–720, 765 I-4 Subject Index G Galois, Evariste, 344 Gauss, Carl Friedrich, 333, 568, 707 Gaussian elimination, 567–570, 625 Gauss-Jordan elimination, 568–570, 625 GCF. • Following each example is a similar Skill Practice exercise to engage students by practicing what they have just learned. 3 2. c. f(x) 5 x2 1 6 5 x 2 5 91. (2`, 23] ` [23, `). Therefore, the eighth term of ... 1 ... Sn 5 n (a1 1 an) where a1 is the first term of the sequence, and an is the nth term of the sequence. (2`, 4) b. 5 6 1 b. e , 2 e 65. See also Circles; Ellipses; Hyperbolas; Parabola Conjugate axis, 653 Conjugate of complex numbers, 106, 107 Conjugate zeros theorem, 333, 334 Constant functions, 200, 203 Constant of variation, 383, 384, 393 Constraint equations, 292–293 Constraints, 548–549 Continuous functions, 249 Contradictions, 85, 158 Converse, 167 Coordinate plane. Find the 500th term of an arithmetic sequence with a1 5 6.9 and d 5 0.3. 774 Chapter 8 Sequences, Series, Induction, and Probability 58. g(x) 5 x 1 0 1 2 c. y x x Barometric Pressure (mb) (x) Wind Speed (mph) (y) 1007 35 1003 45 1000 50 994 65 983 96 980 100 950 110 930 145 905 160 a. Determine ... 5 b. Suppose ... 4 ... n 57 27. (1, 8) d. Answer 1 3. By inspection, we can see that the graph is symmetric with respect to both axes and the origin. Vertex: (0, 0); p 5 52 ; Focus: A0, 52 B; Focal diameter: 10 b. The person has elevated blood pressure or is a nonsmoker. i11 i2 Look for a relationship between the number and the values in the numerator and denominator. ex1h b. EXAMPLE 7 Graphing a Piecewise-Defined Function f (x) 5 e Graph the function. 90 # d # 110 yd 73. Recall that for k . These lines form a rectangular coordinate system (also known in his honor as the Cartesian coordinate system) or simply a coordinate plane. [3, 5) 57. No; For example, the points (1, 23) and (21, 23) have the same y values but different x values. c. Domain: (2`, `); Range: [28, `) 8 4 23 22 21 24 28 ... The graph ... 49. (See Example 5) 22 0 x 2 3 0 # 22 # 48. Knowing the units that the grid are marked in. ... Decreasing 125. (0, 22), (1, 22), (2, 21) ... The graph in Exercise 63 shows the average weight of girls based on their age. (6v 2 7)90 1 216 35. 2.3 visits per year 18. y is also tripled. y 5 1 (J 25 24 23 22 21 21 22 0 c. { } b. Graph does not cross y 5 0. symbol can be accessed by selecting • If the calculator is in "Classic" mode, the sum can be evaluated by entering S (nth term, variable, lower limit, upper limit) • If the calculator is in "Mathprint" mode, then the user is prompted to enter the nth term, the variable, and limits of summation in text fields. If so, find the common difference. y 5 x 5. For example, consider the equation 2x 2 1 5 x 5. by 33 in. Find the exact distance between the points. 697 i51 n 1, x 2 5 b. 4x 1 8y 5 8y 5 4 3 2 For

Exercises 57–63, write an equation of the line having the given conditions. The boundaries of the window are often denoted by [Xmin, Xmax, Xscl] by [Ymin, Ymax, Yscl]. Assume that the “money” is respent an infinite number of times without being detected. 534 cm3 The divisor must be of the form (x 2 c), where c is a constant. Find a20. n(x) 5 3x 2 7; x , 0 c. y 5 f (2x) 4 3 2 y 5 f(x) 1 29 28 27 26 25 24 23 22 21 21 22 1 x 23 24 25 4. matrix 3. Using function notation, this is equivalent to finding f(0). {x 0 x # 6 or x . An odd function is symmetric with respect to the . Evaluate r(50) and interpret the meaning. 5 For Exercises 85–88, determine if the graph of the equation is symmetric to the y-axis, x-axis, origin, or none of these. 73 2 5 15 4 3 6 1 i 41. The break-even point is defined as the point where revenue equals cost. 21 4 73. T(t) 5 78 1 272e20.046t b. 2 1 2 5 1; This is an equation of an ellipse in the xy-plane. {x 0 x , 21} e. a2n 2 25 71. shift right shift up 1 n(x) 5 2 (x 2 2)2 1 3 2 reflect over x-axis y 5 x2 vertical shrink y y (0, 4) 5 4 3 (4, 4) 2 1 24 23 22 21 21 22 y 5 (x 2 2)2 1 2 23 3 4 5 x 6 Vertical shrink: y-coordinates half of original value y5 Avoiding Mistakes As a means to check the graph of y 5 n(x), substitute the x-coordinates of the strategic points (0, 1), (2, 3), and (4, 1) into the function. a 17 b 15 13. To find the total income over 20 yr, we need to know a1 and a20. Each swing (one way) thereafter makes an arc of 85% of the length of the previous swing. x 5 4 g. x-intercepts: (0, 0) and (3, 0); y-intercept: (0, 0) y y 8. Event E is very unlikely to happen. 10! 6! ? y 33. Each stage provides personalized guidance and just-in-time remediation to ensure students stay focused and learn as efficiently as possible. Passes through (2, 5) and is parallel to the line defined by 2x 1 y 5 6. {(3z 1 5, 24z 1 3, z) 0 z is any real number} 19. a 8 81. Two students are selected at random from the group of 12 to receive the scholarships. 23 9. Show that (k 1 1)! . The sequence defined by an 5 n 2n 1 is not defined for n 5 1 because the denominator would be zero. Thank you for overseeing the enormous job of managing digital content and ensuring consistency of the author voice. Using the graph and the results from parts (a) and (b), what does the difference in the rates of change mean? Equation; { }; The value 2 does not check. Vertices: (23, 22), (23, 12) Foci: A23, 5 1 174 B, A23, 5 2 174 B y 5 75x 1 465 and y 5 275x 1 45 y 21 18 F 15 12 9 6 C(23, 5) 3 21521229 26 23 23 F 26 3 6 x 9 12 29 27. 192 53. Write a linear cost function representing the cost to the studio C(x) to hold x private lessons for a given month. ¢C represents the change in cost per change in time. a2 5 215 and r 5 . t(1.99) d. 220 2 48i 37. Graph d 95. y 109. 1024 ft a. Suppose that a1, a2, a3, ... is an arithmetic sequence with common difference d. No Yes; If f (a) 5 f (b), then 4a 2 7 5 4b 2 7, which implies that a 5 b. For Exercises 20–23, determine if the relation defines y as a function of x. 71. The system of equations reduces to a contradiction. 1 4 93. (See Example 1) a. h(x) 5 x2 2 3x 2 28 x12 104. Section 2.8 EXAMPLE 4 265 Algebra of Functions and Function Composition Finding a Difference Quotient Given f (x) 5 3x 2 5, a. h(x) 5 0 x 0 2 4 11. 6(3x 1 1)3(x2 1 2)2(5x2 1 x 1 4) 16. floor(2.8) d. down 5. 2 24 25 25. (That is, the blue line is above the red line for x . (x 1 5) 1 (y 2 1) 5 9 b. y 5 0.118x 1 4.97 b. C 5 110 1 60x b. 2, 4, 6, 8, 10, ... Solution: The sequence is arithmetic because each term is 2 more than its predecessor. e , 2 f 4 2 6 25. (f + g)(3) 5 f (g(3)) 5 f (21) 53 f. Evaluate f (x) 5 Œx 2 1œ for the given values of x. 2 The midpoint between the points is given by M 5 a 2 p. $200,000 b. The ball lands on a number that is a multiple of 6 (do not include 0 and 00). f (x) 5 2 0 x 1 3 0 f. (p + p)(x) For Exercises 77–80, find (f + g)(x) and write the domain in interval notation. (0, 27) Using the Discriminant to Determine the Number of x-Intercepts Given a quadratic function defined by f (x) 5 ax2 1 bx 1 c (a ? a1 5 4 and an 5 an21 2 2 for n $ 2 a. 8, y ? A 15, 2 12B and A415, 2712B 18. Wiles’s proof is extremely complex and was revised to correct a slight but critical flaw shortly after publication. Explain how the average rate of change of a function f on the interval [x1, x2] is related to slope. (3, 0) d. Therefore, we have the restriction f (x) ? {20} 57. (2`, 25) ´ (22, `) e. 5 e. (0.88)(0.88) 5 0.7744 200 50 6 2 12 1 1 1 < 0.007874 b. The set of __________ values is called the range of the relation. In Figure 2-18, the average rate of change in BAC between two points on the graph is the slope of the secant line through the points. 2x 2 3 c. [21, `) [0, `) f 21(x) 5 x2 2 1; x $ 0 The range of f is [0, `). f (3) For Exercises 96–98, graph the function. In how many ways can the professor choose 3 questions from 10 questions? 21 d. {(22z 1 16, 3z 2 5, z) 0 z is any real number} 65. x 5 23 g. 4 32 128 8 1 1 1 p is a geometric series with a1 5 2 and r 5 43 . Graph b1x2 5 1x 2 1 for x $ 1. 24 The domain is (2`, 24) ´ (24, `). Evaluate the functions for the given values of x. Odd 47. If an 5 256, what is n? Constant x x2 x1 b. The business will make a profit if it produces and sells 254 dozen or more cookies. x 5 0 y 1 7 0 2 3 6. 66 11. Neither 3 4 b. a1 5 , d 5 2 3 b. 123–125 SA-5 7. (a 2 c)(a 1 2c 1 1) (y 2 4)(y 1 3) x2 2 7x 1 2 79. Likewise, the y-coordinate of the midpoint is the average of the y-coordinates from the endpoints. The intensity at 20 m should be 14 the intensity at 10 m. Height of Girls vs. d 5 0.16 c. EXAMPLE 7 Computing Average Rate of Change Given the function defined by f (x) 5 x2 2 1, determine the average rate of change from x1 5 22 to x2 5 0. Since r2 5 0, the solution set is {(0, 7)}. 4 defective seeds can be selected. 4n 2 1 is divisible by 3. Then apply the power property of logarithms to write the product of x and the logb 4. Using calculus, we can show that the series a k! k50 approaches e as n approaches infinity. The distance Joe rides d(t) (in mi) is given by d(t) 5 18t, where t is the time in hours that he rides. 5 ? The numbers on the dice form a sum that is a multiple of 5. 5 d. Passes through (211, 13) and is parallel to the y-axis. SmartBook is the first adaptive reading experience designed to change the way students learn. 33. Value of $8000 with Continuous Compounding at 6% 60. y 5. A 1 B 5 c 91. 2 51 4 3 16 20 2 2 (y 1 3) (x 2 2) 12 134 2 51 26. Notice that R and C intersect at (80, 160). 63. R.1. Simplify. a 8a b 2 3 n21 18. 4 3 2 1 37. To compute this numerically, select any two points on the line such as (2, 3) and (4, 3). On a graph, these two points are aligned vertically. 1 5 24 and 24 5 16. x 5 29 19. Approximately 5012 times more intense a. exponential 37. See Figure 2-4. Graph a. {0, 4, 6, 7, 8, 12} 51. Fermat made this claim, now famously called Fermat’s last theorem, while annotating a copy of Diophantus’ Arithmetika. A vertical line drawn through one point also intersects the other point (Figure 2-14). Suppose that the Barry home has 3200 ft2 of living area with tile floor. f (x) 5 21x 1 3 2 1 66. 3 28 6 12 227 37. 23 c. 0.72 81. Explain how you might remember the midpoint formula to find the midpoint of the line segment between (x1, y1) and (x2, y2). Shift 4.5 units to the left. 90C15 < 4.58 3 1016 81. a1 5 16 and a2 5 212. b4 5 x2 1 y2 23. What is the slope of a line perpendicular to this line? 3.4 3 1028 W/m2 corresponds to 45.3 dB which indicates a moderate hearing impairment. y 5 2x 2 3 30. 2 2 1 r(x) 5 ! x 2 3 1 1 1 1 y 75. The pitch of a roof is defined as Rafter C 7 ft A B Span 24 ft 2.5% Grade For Exercises 25–36, determine the slope of the line passing through the given points. Summarize Transformations of Graphs Table 2-2 Basic Functions and Their Graphs 1. 1 64 B Apply the formula for the nth partial sum with n 5 6. P(0) 5 78 means that on January 1, 1900, the U.S. population was approximately 78 million. Vertical asymptote: x 5 1; Horizontal asymptote: y 5 0 f. 620 y 20 18 (0, 18) 16 14 12 (4, 10) 10 8 6 4 2 (12, 0) 0 2 4 6 8 10 12 14 16 18 20 x x SA-35 Student Answer Appendix 1. f (x 1 h) 2 f (x) (3x 1 3h 2 5) 2 (3x 2 5) 5 h h 3x 1 3h 2 5 2 3x 1 5 5 h 3h 5 h 53 Clear parentheses. In Section 2.2, we learned how to complete the square to write an equation of a circle x2 1 y2 1 Ax 1 By 1 C 5 0 in standard form (x 2 h)2 1 (y 2 k)2 5 r2. E E2 E2 y1 b 5 2Dx 2 F 1 2 C 4C 4C E 2 F E2 C ay 1 b 5 2D ax 1 2 b 2C D 4CD 2 2 E D E F ay 1 b 5 2 cx 2 a 2 bd 2C C 4CD D Assuming that C fi 0 and D fi 0, this is the standard form of an equation of a parabola opening to the left or right with vertex E2 F E a 2 , 2 b. 2(8x2 1 9) 2 23x (x 1 1) 2x 1 1 24x2 1 9 If x 5 y, then the denominator x 2 y will equal zero. 3315 61. The numerator of each term on the left side of the equation is nonnegative. x3 2 2x2 2 25x 2 4 b. 5! (2n 2 3)! 13. So we say that the function f is increasing on the interval (0, 40). {(1, 2, 3)} 19. {(1, 3, 0)} No solution; The system is inconsistent. In Example 9 we encounter a situation in which more than one technique of counting must be used. 6840; There are 6840 ways to select 3 distinct items in a specific order from a group of 20 items. 1 2 ln 5 17. Passes through (21, 0) and m 5 . f 21(x) 5 log2 (x 1 7) 89. 26. a2`, 2 4 4 35. if this trend continues. e 6 , 2 f 11. 300 km $336 33. Write a linear revenue function representing the revenue R(x) for selling x dozen cookies. [23, 3] 95. (2`, 21.5) c. 2.25x for 0 # x # 20 f (x) 5 • 45 for 20 , x , 80 21.5x 1 165 for 80 # x # 110 EXAMPLE 5 Interpreting a Piecewise-Defined Function y Evaluate the function for the given values of x. 3 4 5 d 2 1 b. 64 b. 4 5 85. (2`, 21) ´ (2`, 24) ´ 35. 2 1 24. minimum x value TIP The calculator plots a large number of points and then connects the points. f(x) Relative maximum f(a) ≥ f(x) for all x “near” a y 5 f(x) (a, f(a)) Relative minimum f(b) ≤ f(x) for all x “near” b (b, f(b)) ( ) a ( ) x b Figure 2-37 • The function has a relative maximum of f (a). No 9. decreasing 5. So the constant b is 99. [0, `) i. A ´ B 5 B 17. The x-increment is entered as ¢Tbl (read “delta table”). • The set of x values in the ordered pairs is called the domain of the relation. (Hint: The population of China is approximately 1.5 billion.) 81. y 5 x5 b. Undefined 55. Solution: We begin by labeling the students as A, B, C, D, and E. The numbers are 7 and 4. (2t4 2 3v)3 3. (3, 21) b. y 1 2 3 4 5 x 23 24 25 1 2 3 4 x b. 160C4 5 26,294,360 83. Endpoints of minor axis: A3, 14 B, A3, 154 B d. N b. computed from the fomula P(A ´ B) 5 8. The vibration of sound is measured in cycles per second, also called hertz (Hz). f (x) 5 x13 3 99. Horizontal Shrinking and Stretching of Graphs Consider a function defined by y 5 f (x). A musician plans to perform 9 selections. See also Complex numbers explanation of, 104 method to simplify, 104–105 powers of, 107 Imaginary part, of complex numbers, 106 Improper rational expressions, 522–523 Inconsistent systems of linear equations explanation of, 493, 575, 625 on graphing utility, 575 identification of, 575 in three variables, 509, 575 in two variables, 493, 556, 575 use of dependent equations to solve, 576–581 Independent events, 758–759, 767 Indeterminate, 10 Index, 28 Index of summation, 695, 707 Inductive hypothesis, 727, 765 Inequalities. 1s 1 t21x2 5 2 x3 2 4x2 2 5x 1 23 1x 1 321x 2 321x 2 22 1x 2 22 1x 1 3 1x 2 321x 1 32 33. 120, 80, , , 37. 2 1A + A21x2 5 11.0452 x represents the amount of money in the account after 2 yr compounded annually. The distance is 90 12 ft or approximately 127.3 ft. That is, 0 # P(E) # 1. 4 5, 47. The arithmetic mean (average) of two numbers c and d is given by x 5 81. (22, 2) At x 5 1, the function has a relative minimum of 23. A number between 4 and 10, inclusive, is rolled. The person is a nonsmoker or has normal blood pressure. Compute the sum of the first 50 positive integers that are exactly divisible by 5. 5 2 2 4 Finding the Probability of Independent Events Suppose that a family plans to have three children. 2A 2 C 5 £ 33. EXAMPLE 1 Adding Two Functions Given f (x) 5 225 2 x2 and g(x) 5 5, find (f 1 g)(x). The light is green for 80 sec, yellow for 5 sec, and red for 35 sec. (3, 0), (23, 0) e. Section 2.2 y 6 5 4 3 2 179 The radius of the circle is the distance between either endpoint of the diameter and the center. 16 1 16 b. (g + f)(0) g. Find (A1 2 A2)(x) and interpret its meaning. X 5 c 1 5 238 d 273 8 5 13 d 210 51. f (x) 5 (x 2 2)2 2 3 97. 12x2 1 12xh 1 4h2 2 3 b. Therefore, the graph of f (x) 5 x3 2 27 has only one x-intercept. n 5 49; (x 1 7)2 33. Applying an Arithmetic Sequence A park ranger in Everglades National Park measures the water level in one region of the park for a 5-day period during a drought. (See Example 6) 6 5 5 57. EXAMPLE 2 Evaluating Functions for Given Values of x 1 , determine the function Given m(x) 5 4x, n(x) 5 0 x 2 3 0 , and p(x) 5 x 1 1 values if possible. Find the absolute value of the slope of the storm drainage pipe. Sum of exponents must be 10. 10 yr, 2 months 71. Then for every value a and b in the domain of f such that a , b we have f (a) , f (b). $34,665.06 a. We must show that 1 1 1 k11 k11 1 1 1p1 1 5 5 . 3 c. Undefined d. Explain the difference between the graphs of f (x) 5 0 x 2 2 0 2 3 and g(x) 5 0 x 2 3 0 2 2. Introduction to Probability OBJECTIVES 1. By how much do the results of part (c) differ from the result of Exercise 64(d)? Therefore, the graph of f(x) 5 2x2 1 4x 2 5 has no x-intercept (Figure 3-4). y 5 x6 1 b. Domain: (2`, `); Range: (2`, 1] x R.1. {26, 3} 3 4 5 6 7 8 9 210 f(x) 5 2(x 2 4)2 1 1 218 9. 1) Number of people to be selected (2). R.2. 215r3(r 1 4) R.3. (w 1 2)2 2 t 2 15 3 R.6. (v 2 3)(v 2 6) R.5. t14 a23 induction; P1; Pk11 Let Pn be the statement 2 1 6 1 p 1 (4n 2 2) 5 2n2. However, the letter I appears twice, the letter O appears twice, and the letter C appears 3 times. Write a formula for the total cost to rent an apartment for m months with n cats/dogs. A junior is selected. R; (2`, `) 55. {36} Radical equation b. 255–261 5 y 5 4 3 2 x 8) R.2. Interval notation: (2`, 8) 69. m 5 21.2 mph/mb means that for an increase of 1 mb in pressure, the wind speed decreases by 1.2 mph. t(0.04) 5 17.3; t(0.06) 5 11.6; t(0.08) 5 8.7 a. Use the Distance and Midpoint Formulas (4, 9) 8 3 4 Quadrant IV Figure 2-1 10 9 (23, 5) (x, y) 5 (2.5, 3.5) 4 3 (0, 3) 2 8 x Recall that the distance between two points A and B on a number line can be represented by @ A 2 B @ or @ B 2 A @. 0 n 737 738 Chapter 8 Sequences, Series, Induction, and Probability 59. 3 4 5 4 3 2 1 1 2 y 20. 3.1 2 2.2(t 1 1) . {c, f, h} b. h(x) 5 4 3 2 The graph extends infinitely far downward and infinitely far to the left and right. (2`, 25) ´ (1, `) 2 25 2 8. The set of all ordered pairs that are solutions to a linear equation in three variables forms a plane in space. x(x 1 1) x 2t 1 1 5y4 a12 4 2 2 13 1 99. Because there are infinitely many positive integers, there are actually infinitely many statements to prove and we cannot approach them on a case-by-case basis. Determine the speed of the car 6 sec, 12 sec, 45 sec, and 80 sec after the car begins motion. C 5 2 and D 5 3 83. The numbers are 8 and 6 or 28 4 and 26. pentagon (5 sides) 71. The sum of the exponents on each term (that is, the degree of each term) is n. Determine Relative Minima and Maxima of a Function (x, y) (x, y) (2x, 2y) (x, 2y) Figure 2-28 Figure 2-29 Figure 2-30 The photo of the kingfisher (Figure 2-28) shows an image of the bird reflected in the water. {a, b, c, d, e, f, g, h, i, o, u} a. y 8 7 6 5 4 3 2 7 6 5 4 3 2 1 2 3 4 5 x 3 4 5 x 23 24 25 24 25 26 27 b. {(4, 2)} 6 5 39. For Exercises 27–28, consider an American roulette wheel. And the last 30 sec is represented by a linear function with a negative slope, y 5 21.5x 1 165. Section 2.8 Algebra of Functions and Function Composition c. Do the average monthly electric bills follow an arithmetic progression? y-axis symmetry 21. E A 12, 13, 216 B F Infinitely many solutions; The equations are dependent. 5 9. (a 1 y 2 5)(a 2 y 1 5) 5xy(3x 1 8)(2x 1 3) 55. Determine x- and y-Intercepts of a Function Defined by y 5 f(x) Recall that to find an x-intercept(s) of the graph of an equation, we substitute 0 for y in the equation and solve for x. a 5 6 115. 5 a. Recognize Basic Functions 1. 555 ft The pole is 7.2 ft long, and the snow is 4.8 ft deep. Problem Recognition Exercises Problem Recognition Exercises appear in strategic locations in each chapter of the text. Given (y 1 2)2 5 28(x 2 1), a. Upward b. 3x 5 4y 56. (See Examples 3–4) y 15. FIVE IFVE VFIE EFIV FIEV IFEV VFEI EFVI FVIE IVEF VEIF EIFV FVEI IVFE VEFI EIVF FEIV IEVF VIEF EVIF FEVI IEFV VIFE EVFI 24 arrangements There are 24 such arrangements. There are 36 slots that are not green. P(128) 5 1.50(128) 2 120 5 72 Substitute 128 for x. Input x Apply function g to x. Not possible 46. (2`, 0] d. How many different types of pizza can be made? 127 127 127 45. Is the point (2, 27) on the circle defined by (x 1 6)2 1 (y 1 1)2 5 100? Apply Vertical and Horizontal Translations (Shifts) We will call the eight basic functions pictured in Table 2-2 “parent” functions. {x 0 21 # x , 9} c. (3300)2 2 y2 (2189)2 23. f (x) 5 x4 2 5x2 1 1 52. (25, 0) d. 23x 1 1 . For Exercises 4–5, determine if the relation defines y as a function of x. (0, 1) 12. 2 28. How many 4-letter arrangements are possible assuming that letters may be repeated? It travels 45 27 y 5 2.25x mph for 1 min (60 sec), and then decelerates 18 for 30 sec to stop at another red light. In how many ways can the word WRONG be misspelled? Lemon juice is more acidic. a.–b. C 5 J 1 1 119. 5 b. g(x) 5 3x 2 12 78. 0.78 77. Skill Practice 4 Given f (x) 5 4x 2 2, a. {25, 21, 2, 10} E22 6 16F 5 1 3 3 95. 3 is an element of the set of natural numbers. 409–414 1 d 4 2 (n + p)(x) 5 x2 2 3x 1 1 R.5. (p + n)(x) 5 x 2 x 2 2 (p + p)(x) 5 x4 2 6x3 1 6x2 1 9x {(2, 1), (3, 2), (4, 3)} 3. 26 Skill Practice 5 The graph of y 5 f (x) is shown. Q(t) 5 2e20.0079t b. g(x) 5 4x3 2 x Replace x by 2x to determine if f (2x) 5 f (x). (1.2, 2.8); m 5 2.4 For Exercises 75–78, a. , n2 Terms in the denominator are powers of 5: 51, 52, 53, 54, . 9 12. logistic 5. Shrink horizontally by a factor of . Evaluate a Finite Arithmetic Series 3. π 2 3 b. No; For example, the points (2, 3) and (24, 3) have the same y values but different x values. Write an Equation of a Circle In addition to graphing equations by plotting points, we will learn to recognize specific categories of equations and the characteristics of their graphs. A 12, 0B and (3, 0) e. Section 8.6 749 Principles of Counting 61. 81.25 mg 67. Solve the inequality 2x3 2 5x2 2 28x 1 15 , 0. 5 c. Linear; {22} 73. The slope of both lines is 214 . Show that 1 1 5 1 p 1 5k21 1 5(k11)21 5 14(5k11 2 1). r 80 4 r r 80r3 r3 0.8 80 5 100 0.8 Divide by 80. u 5. Students today thrive on efficiency, mobility, and motivation. What will the resale value be 4 yr after purchase? (r + n)(x) 75. A sequence of payments made at equal intervals over a fixed period of time is called an . p)(3) (m + p)(0) (p + m)(0) p(m(24)) y 5 4 3 2 1 25 24 23 22 21 21 22 3 4 5 x y 5 g(x) y 5 4 3 2 y 5 p(x) y 5 m(x) 1 25 24 23 22 21 21 22 23 24 25 103. (4) 2,598,960 52C5 95. See Figure 8-9 on page 732. (See Example 9) 109. 2x(5x 1 8y)2 (2c2 2 5d3)2 37. It may have three or fewer turning points. Given an arithmetic sequence with first term a1 and nth term an, the nth partial sum is given by the formula . The kth term of (a 1 b)n is a EXAMPLE 5 n ban2(k21)bk21 k21 Finding a Specific Term of a Binomial Expansion Find the eighth term of (2x 1 y4)10. Easily move from one to another. Not possible 24 d 236 b. f (x) 23. (23, `) g. z(x) 5 • 1 for 21 , x # 1 3 for 1 , x # 3 3 for 24 , x , 21 69. Therefore, A is singular (does not have an inverse). b2 b Therefore, y 5 2b2 or y 5 . We have put in place processes to make accessibility and meeting the WCAG AA guidelines part of our day-to-day development efforts and product roadmaps. Determine whether the sequence is arithmetic or geometric and find the value of the common difference or the common ratio. {x 0 x $ 5} 24. solution 5. Center: (1, 0); Vertices: A 12, 0B, A 32, 0B; Endpoints of minor axis: A1, 13 B, A1, 213 B; Foci: A1 2 2 2 25 6 , 0B, A1 1 25 6 , 0B y x 1 51 17 98 2 2 3) (y 2 1)2 (x 2 4)2 51 49. 108. 3 Show that 34 1 163 1 p 1 4k 1 4k31 1 5 1 2 A 14 B k11. For Exercises 14–18, evaluate the sum if possible. Sum does not exist 32,760 71. (n 1 1)! Solution: bn 5 n2 Substitute (n 1 1)! 6 for n. P3 is true because F1 1 F2 1 F3 5 1 1 1 1 2 5 4 and F312 2 1 5 F5 2 1 5 5 2 1 5 4. The data in the table give the average height y (in inches) for girls of age x (in yr). The radius should be no more than 1.9 in. 766 Chapter 8 Sequences, Series, Induction, and Probability SECTION 8.5 The Binomial Theorem Reference Binomial theorem: Let n be a positive integer. c1d . 1 2 3 4 5 6 7 8 9 x B 12 x2 18 144 51 Chapter 7 Cumulative Review Exercises, p. The value r! in the denominator “divides out” the redundant cases involving different arrangements of r elements within the same group. For what value of x is f(x) 5 6? c. f (x) f (x 1 h) 2 f (x) (22x2 2 4xh 2 2h2 1 4x 1 4h 2 1) 2 (22x2 1 4x 2 1) 5 h h 22x2 2 4xh 2 2h2 1 4x 1 4h 2 1 1 2x2 2 4x 1 1 Clear parentheses. 1 f (x) 5 2x2 1 3x g(x) 5 h(x) 5 1x 1 2 x 3. Not applicable c. A tax rebate returns $100 million to individuals in the community. Even d. y is also doubled. 215a 1a 5y 4 3 3 83. The textbook is filled with robust applications and numerous opportunities for mathematical modeling for those instructors looking to incorporate these features into their course. A function is constant on an interval in its domain if its graph is horizontal over the interval. (2x 2 5)(3x 1 12) 1 65 5 6x2 1 9x 1 5 ✓ 6 3x2 1 x 1 4 1 11. Skill Practice 7 Find the x- and y-intercepts of the function defined by f (x) 5 0 x 0 2 5. Polynomial equation SA-7 14. For a recent year, the rate for first class postage was as follows. The resulting equation is equivalent to the original equation. 37. South Florida humorist Dave Barry often wrote about his dog, Zippy. Objective 1: Determine Binomial Coefficients 8. a (4)i21 i51 3 46. 3! ? e 2 87. 0 x 2 2 0 # 5 105. Determine if the graph of the equation is symmetric to the y-axis, x-axis, origin, or none of these. Given the series 1 1 1 1 1 1 1 1 p , 111. (multiplicity 2), 1 6 i (each multiplicity 1) 2 79. 25 23. 21 51. 26 Center: (0, 0) 19. 0.69 5 A0e23k b. (21, 8) and (4, 22) 25 24 23 22 21 21 22 2. a a b j52 2 4 1 n 62. y $ 0 3 4 y 5 4 3 2 25 24 23 22 21 21 22 d. In Example 8, we graph the greatest integer function. (g + f)(5) 54. (1) The left side of statement Pk11 can be written as Sum of first k terms (k 1 1)th term [1 1 3 1 5 1 7 1 p 1 (2k 2 1)] 1 [2(k 1 1) 2 1] k2 1 [2(k 1 1) 2 1] By the inductive hypothesis, 5 we can replace the sum of the first k terms by k2. In this chapter, we study polynomial and rational functions. Perimeter: 10 12 ft; Area: 12 ft2 Center: (1, 2); Radius: 110 73. Graph Piecewise-Defined Functions Speed (mph) 0 # x # 20 20 , x , 80 80 # x # 110 Suppose that a car is stopped for a red light. A function is continuous if its graph can be drawn without lifting the pencil from the paper. • Julie Miller constructed over 50 dynamic math animations to accompany the college algebra text. The graph shows the number of views y (in thousands) for a new online video, t days after it was posted. 49a 2p7 3k3 2 b2 27z15 x9y6 1 x16 63. 1 1 15 n 1 2 15 n b 1a b gives b. y2 5 x y c. f (4) 248 Chapter 2 Functions and Relations TECHNOLOGY CONNECTIONS Graphing a Piecewise-Defined Function A graphing calculator can be used to graph a piecewise-defined function. n The nth partial sum of a sequence {an} is a finite series and is given by Sn 5 a ai 5 a1 1 a2 1 a3 1 p 1 an p. Graph. Suppose that a line has a slope m and passes through a known point (x1, y1). 164: © Tetra Images/Getty RF; p. (g + f)(5) Section 2.8 271 Algebra of Functions and Function Composition Concept Connections 1. 2 107. E 5 n 1n kmn 5 c5 3 21. e2x c. c1 5 5; cn 5 22cn21 1 1 3 4 5 6 7 1 1 1 1 2 4 8 16 32 14. (2, 28); m 5 25 71. 2 51 144 25 144 81 (y 1 3)2 (y 2 4)2 (x 1 3)2 (x 2 2)2 2 51 47. Write a linear profit function that represents the profit P(x) for producing and selling x items. 1 26 25 24 23 22 21 21 22 23 24 25 1 2 3 4 x TIP Consider a positive real number h. 8x 2 5y 5 3 32. e 6 Student Answer Appendix 2 13 , 6i 15 f 3 19. nonzero real number, called the common 2. 24(3p 2 2)(p 1 3) 91. The t-intercept is (60, 0) and means that after 60 months, the amount owed is $0. (22, `) 79. 1 5 24 5! 5 5 ? a1 5 27, an 5 13an21 for n $ 2 For Exercises 25–30, write a formula for the nth term of the geometric sequence. The slope of a horizontal line is ________. If the sequence is geometric, find r. The numbers are 12 and 12. 5 Chapter 2 Test, pp. 2 51 16 25 9 16 E A4, 3 13 B, A4, 23 13 B, A24, 3 13 B, A24, 23 13 B F The transverse axis is horizontal if the coefficient of the x2 term is positive. By the inductive hypothesis, [1 1 2 1 22 1 p 1 2k21] 1 2(k11)21 5 (2k 2 1) 1 2k 5 2 ? an 5 1n a. 1 22 21 21 22 3. By the inductive hypothesis, [1 1 4 1 p 1 4k21] 1 4(k11)21 5 13 (4k 2 1) 1 4k 5 134k 2 13 1 4k 5 43 ? Minimum value: 37,000 SA-34 Student Answer Appendix 13. Answers 4 Let Pn be the statement that A 32 B n . 0.025 11 1331 y b. x 1 y 5 6.76 y b. 16x2 2 25 1 4 39. P(boy on 2nd) ? 212x 2 49 y12 7 2 7 a8 1 1 2 9. 92. What is the probability that all three will be good? 1 y 5 2 x (slope-intercept form) 4 1 4(y) 5 4a2 xb 4 4y 5 2x x 1 4y 5 0 (standard form) y 5 (24, 1) 4 3 2 1 25 24 23 22 21 21 22 23 24 25 x 1 4y 5 3 1 y 3 4 5 1 52 4 x x From the graph, we see that the line y 5 214 x passes through the point (24, 1) and is parallel to the graph of x 1 4y 5 3. arithmetic 25. Ex 0 x # 176 F; A2`, 19. r n2r 55. 6 c. The expression an 5 20.8n 1 54.8 resembles the slope-intercept form of a linear function f (x) 5 mx 1 b. x 5 y 2 4 2 2 60. EXAMPLE 5 Using a Linear Function in an Application A family plan for a cell phone has a monthly base price of $99 plus $12.99 for each additional family member added beyond the primary account holder. 90–94 R.1. R.4. 1. y 2 1 28 27 26 25 24 23 22 21 21 22 23 24 25 5 x b. 20.25x b. Solution: an 5 a1 1 (n 2 1)d The first term of the sequence is 7. Reference p. £ $69,754 $28,400 § ; The first column gives the total revenue $66,438 $26,960 for Friday, Saturday, and Sunday, respectively. Therefore, an x-intercept is a point (a, 0) where a graph intersects the x-axis (Figure 2-7). The set of x values is the domain of the relation, and the set of y values is the range of the relation. 120 65. Substitute n 5 20, a1 5 75,000, and a20 5 151,000. † 22 1 0†50 b. {(0, 2, 3)} 9. a A4 2 14kB k51 k51 61. (a 1 b)7 Determining the coefficients of a binomial expansion using Pascal’s triangle would be cumbersome for expansions of higher degree. 2 1 2 5 1 1 251 y5b 12 2 2 B a b a b a a2 2 c2 b y5b y 5 2a2 2 c2 a B a2 Recall that c2 5 a2 2 b2, or equivalently b2 5 a2 2 c2 and b . Round to the nearest day. g(a) 5 5 8 2 Za 2 2Z c. AD 1 47. Expand the binomial. They are the same. f(4) is not defined. The greatest profit is realized 20 (0, 0) (120, 0) when 80 kitchen tables and x 0 20 40 60 80 100 120 140 90 dining room tables are Kitchen Tables produced. Section 3.1 291 Quadratic Functions and Applications 4. The integers are 10 and 12 or 210 and 212. A(t) 5 8000e0.062t b. {(1, 22, 3)} 25. For consistency, the guided solutions match the style and voice of the original text as though the author is guiding the students through the problems. x2 5 2 ft y b. f (0.1) b. 6 15 m 99. x 3 4 5 x y 5 4 3 2 23 21 24 f (x) 5 2!x 1 3 1. Show that 4k11 , [(k 1 1) 1 2]!, or equivalently, that 4k11 , (k 1 3)!. $150 is invested 12 times per year for 34 yr. Expanded Chapter Summary available at www.mhhe.com/millercollegealgebra. 4 h(24x 2 2h 1 4) Factor numerator and denominator, and simplify the fraction. 24795 29. If Albert Pujols had a batting average of 0.279 for a recent season, determine the probability that he would get a hit on four consecutive times at bat. This type of plan is meant as a long-term investment, and withdrawals are typically taken after age 59½ without penalty. Objective 2: Prove a Statement Using the Extended Principle of Mathematical Induction For Exercises 25–28, use trial-and-error to determine the smallest positive integer n for which the given statement is true. Test for x-axis symmetry. c2 2 d 6 43. If the sequence is geometric, determine r. g(0) 5 0 2 4 5 24. Geometric; r 5 12 13 11. 3 6 15; each of multiplicity 1 1 1 35. $600,000; $1,800,000; $5,400,000 772.4 99. y 5 22x 1 1 (slope-intercept form) Write the equation in slope-intercept form by solving for y. For each revolution of the wheels, the bicycle travels 7.2 ft. In how receive many ways can four different people among the 20 be selected to prizes of $50 each? Graph iv Problem Recognition Exercises, p. Domain: (2`, `); Range: (2`, 2) c. R.2. y 5 0 75. Written in Vertex Form Write f(x) 5 ax2 1 bx 1 c (a fi 0) in Vertex Form Find the Vertex of a Parabola by Using the Vertex Formula Solve Applications Involving Quadratic Functions Create Quadratic Models Using Regression TIP A quadratic function is often used as a model for projectile motion. Then, • A function defined by f (x) 5 mx 1 b is a linear function. What does ¢P ¢t represent? The result should be a system of two linear equations in two variables. 1 25 24 23 22 21 21 22 y 5 f 21(x) 24 25 x 24 25 3 2 23 23 ⎛ ⎞ 1 b. 25k2 2 30k 1 9 71. P(K) 5 524 . 5 4 3 2 1 2 3 4 1 2 5 6 7 8 y 3 2 1 25 24 23 22 21 21 22 1 25 24 23 22 21 21 22 49. An equation is in quadratic form if, after a suitable substitution, the equation can be written in the form au2 1 bu 1 c 5 0, where u is a variable expression. 59.75 in. Sketch the function. Since a , 0, the parabola opens downward. In many applications in the sciences, the change in a variable is denoted by the Greek letter D (delta). (See Examples 1–2) 3. If q is r minus seven, and s is the square root of q, write s as a function of r. [215, `) c. 5! Solution: b. P1 reads: 4 is a factor of 91 2 1 5 8. E211 6 5 15F 45. Section 8.6 747 Principles of Counting 5. The solution set is a single point (the origin). 712 Chapter 8 Sequences, Series, Induction, and Probability Expanding Your Skills 86. 2 45. Undefined a. Write a relationship for a function whose f (x) values are 3 more than the principal square root of x. The axis of symmetry is x 5 2. No 29. The ball will be at an 80-ft height 1.5 sec and 3.2 sec after being kicked. If two DVDs are selected from the box with replacement, determine the probability that both are comedies. Therefore, P(A ¨ S) 5 521 . b is the fixed cost. (x 2 h)2 1 (y 2 k)2 5 r2 (y 2 k)2 (y 2 k)2 (x 2 h)2 (x 2 h)2 3. 1.0 3 1025 cm 73. 1 25 24 23 22 21 21 22 5 4 3 2 y 5 f(x) x 107. If five cards are dealt from a standard deck of 52 cards, find the probability that a. • The test score that a student earns is related to the number of hours of study. 1 6 n 5 6 and r 5 6. a (3i 1 7) 5 3 a i 1 7n i51 i51 n n 96. 233.1787 c. a b ? EXAMPLE 8 Determining Domain and Range Determine the domain and range for the functions shown. Therefore, it is important to learn how to create and interpret meaningful graphs. 1 p p(x) x11 a n b(x) 5 5 n(x) 0x 2 3 0 EXAMPLE 3 Denominator is zero for x 5 21. 22 101. Therefore, this image is symmetric with respect to the x-axis. one, to, one 5. a , 0b and (23, 0) 5 c. (0, 23) f. 0 23. 20 square units SA-31 41. (0, `) h. (29, `) 101. Admission to the event is $10 per person. 1 5 120 6! 5 6 ? • Create learning goals with due dates that align with your textbook/syllabi and to pace student learning • Implementation services and training help make setup simple and timely • 100% mobile-ready allows you to manage your classes from anywhere • LMS integration offers single sign-on and gradebook sync capabilities ALEKS Reporting provides detailed data on student progress, allowing you to quickly identify intervention needs and to better understand student learning behaviors. For example, a home with a $60,000 taxable value in a municipality with a 19 mil tax rate would require (0.019)($60,000) 5 $1140 in property taxes. Therefore, the expression cannot be negative for any real number. c 55. 2 1 2x 1 13. 4 27. C(x) 5 µ 0.78 for 2 0.95 for 3 3 4 0.1x f (x) 5 • 0.15x 2 446.25 0.25x 2 4071.25 4 3 2 26 25 24 23 22 21 21 22 x 2 (2`, `) c. { } 19 29 , f 3 3 3 53. (p + n)(x) 67. x-axis, y-axis, and origin 17. McGraw-Hill has no control over and is not responsible for the content or accessibility of any linked website. A 5 x a b 45. 2 4 781 40 18. a n 10 10 ban2(k21)bk21 5 a b(2x)102(821)(y4)821 5 a b(2x)3(y4)7 5 960x3y28 k21 821 7 The eighth term of the expansion is 960x3y28. The right side of the equation is graphed as Y2 5 x 2 1. An investment earns 4.5% interest paid at the end of 1 yr. Find an equation of the median of a triangle drawn from vertex A(5, 22) to the side formed by B(22, 9) and C(4, 7). {x 0 x , 2} d. What is the difference in total salary between the two jobs over 20 yr? 66 7 [4, 10] 12. Show that x(k11) . Find the probability that all five children will be girls. The width is 26.5 in. E A1, 13 B, A21, 13 B, A1, 213 B, A21, 213 B F The numbers are 5 and 7. f (0) 5 22(0 2 1)2 1 8 56 The y-intercept is (0, 6). The maximum profit is $13,400. , b. A0 < 0.81 µg/dL e. Consider the standard form of a linear equation Ax 1 By 5 C in the case where B ? a A3 2 12kB 60. 1600 tickets 71. y 5 x 2 7 y y 21. Also note that the graph is symmetric with respect y Axis of symmetry to the vertical line through the vertex called the axis 8 of symmetry. [29, `) b. T (170) 5 27 means that a mammal that inhales 170 mL of air per breath during normal respiration is approximately 27 kg (this is approximately 60 lb—the size of a Labrador retriever). If the employee invests $200 instead of $100 at 6%, find the value of the annuity after 20 yr. 119. 5 4 3 2 5 4 3 2 For Exercises 31–34, write the domain in interval notation. • Core Exercises are presented next and are grouped by objective. (n + m)(x) 69. (3, 26), (21, 26) d. Graph the circle. y 5 2 x23 26. {0, 2} 73. Simplify without using a calculator. 5 10a 1 12 5 2(5a 1 6) Therefore, 2 is a factor of 5k11 2 3 as desired. y 51. Perform Operations on In Section 2.5, we learned that a profit function can be constructed from the difference of a revenue function and a cost function according to the following rule. log5 a 3 b x ln 51 f ; x < 2.0206 61. e f ; t < 25.3618 49. {7, 27} b. 0, c. If the coin is flipped 2 times, then there are four possible outcomes: HH, HT, TH, and TT. 3.1 2 2.2(t 1 1) 5 6.3 1 1.4t b. If the third and fourth terms of an arithmetic sequence are 12 and 16, what are the first and second terms? [210, 10, 1] by [210, 10, 1] c. Easy to Use. 6 d. e. (27, 7) 27. Suppose that y 5 P(t) represents the population of a city at time t. There are four letters available for the first choice in the arrangement. (2, 4), (2, 24) d. (6.0 3 1013)(9.0 3 108) 2.0 3 1026 For Exercises 7–10, simplify the expression. (25, 2) 3. f (x) 5 0 x 0 2 2 70. We would first have y 5 12x, and then replacing x by x 1 2 would give y 5 12(x 1 2) 5 12x 2 2 rather than y 5 12x 1 2. (n + p)(x) 5 x2 2 9x 2 5; (2`, `) (m + n)(x) 5 1x 1 3; [23, `) 1 (q + n)(x) 5 ; (2`, 15) ´ (15, `) x 2 15 1 13 13 7 7 (q + r)(x) 5 ; a2`, 2 b ´ a2 , b ´ a , `b 0 2x 1 3 0 2 10 2 2 2 2 (n + r)(x) 5 0 2x 1 3 0 2 5; (2`, `) 101 101 x 2 10 ; 12`, 102 ´ a10, b´a , `b 1q + q21x2 5 2 10x 2 101 10 10 3 ; 12`, 2142 ´ 1214, 2 4 1 f + g21x2 5 2 x 1 14 125. If three people are selected at random, find the probability that they all have the Rh factor. 109. Skill Practice 12 Refer to the functions f and g pictured in Example 12. 6 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 23 24 1 2 3 4 5 x 1 25 24 23 22 21 21 22 23 24 1 2 3 4 5 x S 1618 3 64 d 32 3 4 5 6 x 214 1 8 29. 228xy 22xy 91. Table 8-2 Properties of Summation If {an} and {bn} are sequences, and c is a real number, then: n 1. Circle c. 7, 16, 25, 34, ... , 574 37. P1 is true because a 1 5 1. i is the index of summation. Odd 95. 2! 31. g(x) 5 e 23.1x 2 4 for x , 22 2x3 1 4x 2 1 for x $ 22 2.5x 1 8 for x , 22 131. The flower shown in Figure 2-30 is symmetric with respect to the point at its center. State one application of using the point-slope formula. A department store marks up the price of a power drill by 32% of the price from the manufacturer. For example, the points (1, 22) and (0, 25) are on the left branch of the parabola. 2$65 e. a b(23) g y 5 4 3 2 y 5 4 3 2 102. 53. y a. Round to the nearest meter. 2 1 23 22 21 21 22 23 24 25 26 27 28 Vertex: (2,21) 1 2 3 4 5 6 7 x f(x) 5 2x2 1 4x 2 5 x52 Figure 3-4 Skill Practice 3 Repeat Example 3 with f (x) 5 2x2 2 4x 2 7. 8 2 4(1 2 x) 2 7 2 2x . 9 2 6 122 5 d ´ c , `b 6. Solution: To find the x-intercept(s), solve the equation f (x) 5 0. 2 3 3 b. f 21(x) 5 8 y 71. The x-intercept(s). 12, 5, 22, 29, 216, ... EXAMPLE 2 b. There are no real numbers x and 4 9 y that would make the sum of two squares equal to 21. [0, 2) ´ (4, 6] 117. 2 x 113. For Exercises 43–44, use the Fibonacci sequence {Fn} 5 {1, 1, 2, 3, 5, 8, 13, ...}. 23 24 y 2. However, the money invested at the end of the fourth year will not earn any interest. If f (a) 5 f (b), then 2a 2 3 5 2b 2 3, which implies that a 5 b. 12r Sn 5 a1 rSn 5 a1r 1 a1r2 1 a1r3 1 a1r 1 a1r2 nth Partial Sum of a Geometric Sequence The sum Sn of the first n terms of a geometric sequence is given by a1(1 2 rn) 12r where a1 is the first term of the sequence and r is the common ratio, r fi 1. y 5 Objective 2: Identify Even and Odd Functions 19. x1 5 76 vehicles per hour; x2 5 97 vehicles per hour b. c 6 2 2 x 25. For a recent year, 31.9% of Americans living below the poverty level were not covered by health insurance. an 5 2n b. { } 91. Interest compounded quarterly c. Determine f(9). Older models of garage door remote controls have a sequence of 10 switches that are individually placed in an up or down position. xy 81. x 1 y # 18 65. The legs are 6 ft and 8 ft, and the hypotenuse is 10 ft. Maximum: 1 2 h. {25, 22} b. 56 1 2 1 126 41. (2z 1 7)(3z 1 2) yz(7y 1 2z)(y 2 6z) 31. Not a real number 17. The Fibonacci sequence is defined recursively as a1 5 1, a2 5 1, an 5 an22 1 an21 Section 8.1 Sequences and Series 693 The first two terms of the Fibonacci sequence are 1, and each term thereafter is the sum of its two predecessors. a i51 8 i51 1 (21)i11 i 7 3 n i2 75. e 3 1 5 2 6 i 12 16. 4 2 21221028 26 24 22 22 23 4 5 23 24 y 6 25 25 24 23 22 21 22 23 24 25 23 2x17 2 1 28 27 26 25 24 23 22 21 21 n(x) 5 1 4 3 2 2 1 y 4 3 2 1 2 4 x c. 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 y d. By completing the square we can write an equation of a circle given in general form as an equation in standard form. a (23) i51 716 13. x $ 3 c. 725 The principle of mathematical induction: Let Pn be a statement involving the positive integer n, and let k be an arbitrary positive integer. If a student forgets to study and must guess on each question, in how many ways can the student answer the questions on the test? [215, `) b. 2 243 3 4 Sum does not exist 65. If the y term is linear, then the parabola opens vertically. (x 1 4)2 1 (y 2 1)2 5 9 y y b. To do so, we use the Minimum and Maximum features. 2.3 b. Let E represent the event that the numbers showing on the dice have a sum of 7. 9 16 3 b. Suppose that n represents the number of distinct elements in a group from which r elements will be chosen in a particular order. x ? y(x) 5 x Zx 1 1Z 1 4 c. (xy)n 5 xnyn 34. 0.1520 13. Downward c. Infinitely many solutions; {(2z, 3z, z) 0 z is any real number} 57. Let k 5 1 2 F and assume that k fi 0. a , 0b, (23, 0), (1, 0) 2 y g. The road sign shown in the figure indicates the percent grade of a hill. The lines are not exactly the same. EXAMPLE 2 Determining if a Relation Is a Function Determine if the relation defines y as a function of x. Show that Pk11 is true; that is, show that 3 is a factor of 4k11 2 1. Event E is very likely to happen. 5 42. 5 21 g(21) 5 21 TIP The name of a function can be represented by any letter or symbol. q(x) 5 x2 2 8 79. Graph is shrunk/stretched horizontally by a factor of 1a . m(x) 5 2x 2 4x 1 1 34. SECTION 2.4 For Exercises 37–40, graph the equation and determine the x- and y-intercepts. True b. • New applications appear in Chapter 7 to provide students more real-world context for conic sections. The water level on day 30 will be 30.8 in. Given the sequence defined by an 5 n 2 2n, find the fifth partial sum. Determine the number of private lessons that must be held for the studio to make a profit. Objective 1: Test for Symmetry For Exercises 7–18, determine whether the graph of the equation is symmetric with respect to the x-axis, y-axis, origin, or none of these. 25 2 2y2 87. Each wheel has 11 stops, denoted by 0 through 9, and bar. Invoke the linear regression feature on a calculator, graphing utility, or spreadsheet. 2.31% d. f (c) 5 14 2 c 10. (See Examples 1–2) 9. Likewise, as x approaches ` and 2`, the graph approaches the x-axis without touching the x-axis. 627–630 1. • The perimeter of a rectangle is a function of its length and width. Is n(2x) 5 n(x)? Given 3x 5 24y 1 8, b. 5 4 3 2 1 1 2 3 4 5 x 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 6 x x 176 Chapter 2 Functions and Relations For Exercises 71–72, the endpoints of a diameter of a circle are shown. 3k11 as desired. The proofs of properties 1 and 3 are examined in Exercises 89 and 90. 2268c3 d30 SECTION 8.5 Practice Exercises Prerequisite Review For Exercises R.1–R.5, multiply and simplify. The sequence is defined by a1 5 25 and an 5 an21 1 4 for n $ 2. (a 2 b) 9. Show that 6 1 10 1 p 1 (4k 1 2) 1 [4(k 1 1) 1 2] 5 (k 1 1)[2(k 1 1) 1 4] 5 (k 1 1)(2k 1 6). How far apart are the players? x 2 x1 y 2 y1 5 m(x 2 x1) This is called the point slope formula for a line. f)(2) f d. f (1) 5 21 can be interpreted as (1, 21). 5 2 1; find b20 n 17. k(x) 5 • 2x3 1 2x 1 5 for 21 , x , 2 1 for x $ 2 129. x-intercepts: (4, 0), (2, 0); y-intercept: (0, 2) 29. The ball will hit the ground at the point A128 13, 2128B or approximately (221.7, 2128). A 1x 1 512 B A31x 2 12 B 22 9. a4 2 2a2b2 1 b4 b2a b. x 5 < 3.56 2 3 97. 0 41. (See Example 11) b. d. Then either f (u) , f (v) or f (v) , f (u). E2, 21 6 i 12F 23. (2, 1.5), (4, 2), and (8, 3) 77. In Example 5, we determine the number of permutations from a group of n items in which fewer than n items are selected at one time. x1 1 x2 5 180 1 220 c. A0, 13B e. 1 a. x 5 23 c. 13 ? R.1. 9! R.2. 0! R.3. 7! 5! R.4. 10! 4! 6! Concept Connections 1. One method is to determine if the sum of the lengths of the line segments AB and BC equals the length of AC. At x 5 0, the function has a relative maximum of 2. 2 3 4 5 x y 5 g(x) 24 25 1 8 3 21 6 30 9 40 12 46 15 56 18 68 c. Week number Weight (lb) 1 2 3 4 5 0.6 0.88 1.16 1.44 1.72 a. c21(x) 5 B 4 x 2x 1 4 3 21 21 51. 4 months 85. Explain how you can use slope to determine if two nonvertical lines are parallel or perpendicular. $772.20/yr c. Therefore, the graph of y 5 (f 1 g)(x) is the graph of f with a vertical shift (shown in blue). Find the probability that a student answers each question incorrectly. • The graph of y 5 f (x 1 h) is the graph of y 5 f (x) shifted h units to the left. Strand Vice President, General Manager, Products & Markets: Marty Lange Vice President, Content Design & Delivery: Kimberly Meriwether David Managing Director: Ryan Blankenship Senior Brand Manager: Caroline Celano Director, Product Development: Rose Koos Senior Product Developer: Emily Windelborn Marketing Communications Manager: Audrey Otto Marketing Specialist: Cherie Harshman Director of Digital Content Development: Robert Brieler Digital Product Analyst: Michael Lemke Associate Digital Product Analyst: Adam Fischer Director, Content Design & Delivery: Linda Avenarius Program Manager: Lora Neyens Content Project Manager: Peggy J. f (x) 5 x2 b. If Iglesias is at bat three times in a game, what is the probability that he will not get a hit on any of the three times at bat? y 1 1 2 23 24 Figure 2-31 3 4 Test for symmetry with respect to the y-axis. Thus, 16 P(A ´ S) 5 52 5 134 Answers 6. p 5 254 b. (1, 22) 23 26 6 121 3 x < 20.47 x < 23.53 e. These prep products can be used during the first 3 weeks of a course to prepare students for future success in the course and to increase retention and pass rates. 331 cases 35. An nth-degree polynomial has at most n 2 1 turning points. (23, 3) 24. Custard Flavors Syrups Toppings Vanilla (V) Hot fudge (H) Nuts (N) Chocolate (C) Butterscotch (B) Granola (G) Mint chip (M) Peanut butter (P) Solution: e Ho Butters Va nil la We can depict the 4 flavors of custard by the left-most branches in Figure 8-10. 10 y y i. Skill Practice 4 Find the tenth term of the arithmetic sequence in which a1 5 12 and a30 5 128. y 5 x 1 3 b. nonzero 1 1 (2`, 5) ´ (5, `) 9. In particular, notice that together the elements of the set of rational numbers and the set of irrational numbers make up the set of real numbers. 3.1 2 2.2(t 1 1) , 6.3 1 1.4t 111. To prepare for the discussion in Section 2.6, use a graphing utility or plot points to graph the basic functions in Exercises 128. {2, 10, 18, 26, ...} 54. (See Example 5) 46. This is to determine the most time-efficient route. Notice that the midpoint of the diameter is the center of the circle. 178 An equation of a circle written in the form x2 1 y2 1 Ax 1 By 1 C 5 0 is called the general form of an equation of a circle. 553: © Julie Miller; p. Given the sequence a1, a2, a3, ... , each term after the first is obtained by multiplying the preceding term by r. 36.6 m 129. Explain how you can determine from a linear equation Ax 1 By 5 C (A and B not both zero) whether the line is slanted, horizontal, or vertical. When referring to individual elements of a set, the symbol [means “is an element of,” and the symbol ” means “is not an element of.” For example, 5 [{1, 3, 5, 7} is read as “5 is an element of the set of elements 1, 3, 5, and 7.” 6 ” {1, 3, 5, 7} is read as “6 is not an element of the set of elements 1, 3, 5, and 7.” A set can be defined in several ways. (22, 3) c. Write About It 83. The expression 3i 1 5 is linear in the variable i. See Example 5 in Section 2.4. Solution: Label (2, 23) as (x1, y1) and m 5 24. 32x5 2 240x4 1 720x3 2 1080x2 1 810x 2 243 63. For what value of x is f (x) 5 7? y 5 2 73. This is the interval where the blue line is below the red line. Suppose that a1, a2, a3 , ... is a geometric sequence with r . (2`, 24) ´ (24, `) e. Find the probability that a. The result from Example 1 suggests that the number of outcomes for the sequence of events is the product of the number of outcomes for each individual event. Use the model to estimate the systolic blood pressure for a 55-year-old. EXAMPLE 4 Writing an Equation of a Line Perpendicular to Another Line Write an equation of the line passing through the point (2, 23) and perpendicular to the line defined by y 5 12x 2 4. (0, 3) 1 11 g. 24, 216, 323 , 2649 , 128 27 t n21 1 23. Vertices: (0, 10), (0, 210) e. A third point can be used to verify that the line is graphed correctly. The data in Table 8-4 give the 1-yr survival rates for people in the United States for selected ages. (4, `) g. The x variable 15 represents the number of years since 1990 and the y variable represents the number of students (in millions). Write two functions f and g such that h(x) 5 ( f + g)(x). R; (2`, `) 69. Domain: (2`, `); Range: (2`, 0] 1 2 x 26 27 28 1 11 b. Approximate the population in the year 2015 assuming that this trend continued. Undefined (not a real number) x24 24. 11 1 11 1 11 1 11 1 11 700 Chapter 8 Sequences, Series, Induction, and Probability 1 1 1 1 2 1 2 3 9 27 81 83. 5 x2 1 0 y 0 5 8 x For Exercises 18–19, determine if the function is even, odd, or neither. Find (S1 2 S2)(x) and interpret its meaning. See also Conic sections Annuities, 718–720, 765 Annuity due, 719 Aphelion, 644 Applications. 5 4 3 2 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 24 25 24 25 y 23. (6x) 2 41. a 5 10 c. If four seeds are selected at random, determine the number of ways in which a. $0.40 per mile b. Determine f (22). cn 5 ln e 15. The time at which the stone will be at its maximum height is the t-coordinate of the vertex. (h, k) 5 (24, 6) and r 5 2 [x 2 (24)]2 1 (y 2 6)2 5 (2)2 (x 1 4)2 1 (y 2 6)2 5 4 y b. 25 24 23 22 21 22 24 26 28 210 28 210 y 10 8 6 4 2 2 24 d. Joe rides his bicycle an average of 18 mph. (2`, 2) ´ (2, `) c. (See Example 9) 58. Interest compounded monthly Concept Connections 1. 24 23 22 21 21 22 21028 26 24 22 22 24 F 26 28 210 x 17. Point of Interest Swiss mathematician and physicist Leonhard Euler (1707–1783) is credited with the use of the modern symbol S to represent a sum, i to represent the imaginary unit, and e to represent the base of the natural logarithmic function. (x 2 2)2 1 (y 1 1)2 5 9 This equation represents the graph of a circle with center (2, 21) and radius 3. Identify Even and Odd The photos in Figures 2-28 through 2-30 each show a type of symmetry. • f is increasing on I if f (x1) , f (x2) for all x1 , x2 on I. e 2 f 5. The second notation is the length of the line segment with endpoints P and Q. 10 c. A card numbered between 5 and 10, inclusive. Note that the x2 term is already a perfect square: (x 2 0)2. Horizontal stretch/shrink y 5 f (a ? • If b2 2 4ac . SECTION 8.7 84. Singular matrix 24 x 21 dc d 5 c d 1 y 14 20.27 0.27 ¥ 0.25 20.01 41. Vertices: (3, 1), (3, 21) c. 1 51 b. {77} 1 1 3. Jim has 8 unread emails in his inbox before going on vacation. P(x) , 0 (the company experiences a loss) c. p 5 24 b. 105. f (3) 5 2; f (4) 5 6 b. 5ex11 2 100 5 0 5. 21 2 i Stephan borrowed $6000 at 5% and $2000 at 4%. ex2h d. y 5 g(x) 25 24 23 22 21 21 22 23 y 5 f(x) 2 1 25 24 23 22 21 21 22 23 24 25 y 26 21 22 69. In this scenario, we want to select a set of 2 people from a set of 5 people without regard to order. Sketch the graph. Determine the probability that a patient will not survive the surgery or 30 days after the surgery. A geometric sequence a1, a2, a3, ... has a common ratio r. Vertical asymptote: x 5 22 f. Given a geometric sequence whose nth term is an 5 6(0.4)n, are the terms of this sequence increasing or decreasing? Therefore, a minimum of two points is needed to graph the line. C 5 5x b. h Use the difference quotient to determine the average rate of speed on the following intervals for t. a b(0) f h 18. (2`, 22) ´ (22, `) 105. 6x2 1 6xh 1 2h2 4x3 1 6x2h 1 4xh2 1 h3 2 10x 2 5h 53. (Source: U.S. Census Bureau, www.census.gov) If three people were selected at random from this population, what is the probability that all three would not have coverage? (9, 28) 29. SECTION 2.3 19. a b 5 6! ? (2`, 26) ´ a , `b 2 Sign of (x 2 a) (b 2 x)(x 2 c) : y2 2 24 c. {5, 12, 7} d. above the center of the dish. CHAPTER 2 Cumulative Review Exercises y 1. 2.5310 e. index; summation; lower; limit 5, 11, 21, 35 9. 2 6 5i, 617 b. Arithmetic; d 5 3. 3 3 1 b. (This means that the probability that Iglesias will get a hit on a given time at bat is 0.306.) a. An ace, 2, or 3. 9 c. If x . symbol. h(3) 5 9 f(t) 5 2t2 1 4t f(a 1 h) 5 2a2 2 2ah 2 h2 1 4a 1 4h Substitute x 1 h for x. {c 0 c , 2}; (2`, 2); 17. a g b(24) For Exercises 19–26, refer to the functions r, p, and q. 16 81. Write a linear function to model the monthly cost C(x) (in $) of a family plan for x additional family members added. The domain is (25, `). The viewing window with these parameters is denoted [210, 10, 1] by [210, 10, 1]. (2`, 25] a. {9} 121. (23, 1) 12. 3.1536 3 10 sec b. 64. Vertical asymptotes: x 5 3, x 5 23; Horizontal asymptote: y 5 0 30. If he receives an average of 22 emails each day, write the nth term of a sequence defining the number of unread emails in his box at the end of day n of his vacation. h(x) 5 (x 1 7)2 92. What is the probability that four unrelated people will all catch winter “colds”? True 65. (x 1 3)2 1 (y 1 4)2 5 1 2 30. a2 1 b2 a. 34. “Do you think that the college has adequate lighting on campus at night?” The table gives the results of the survey based on gender and response. a b y2 z2 b. a (2i2 2 i) i51 i51 50 50 93. x2 1 y2 2 8x 1 2y 2 8 5 0 Not all equations of the form x2 1 y2 1 Ax 1 By 1 C 5 0 represent the graph of a circle. 2}; (2, `); 221 iv 3 1 2 2xy3 7 f 3 83. Write 1.975 as a fraction. y 5 4 3 2 1 F 25 24 23 22 21 21 1 2 3 4 5 4 6 8 10 x 22 23 24 25 39. In addition to linear functions, we will learn to identify other categories of functions and the shapes of their graphs (Table 2-2). f (5) c. Write a linear revenue function representing the revenue R(x) for holding x private lessons for the month. (15.99, 16.01) 87. {1} 13. P1 is true because 1 5 13 (41 2 1). 0 143. Determine whether the sequence ln 1, ln 2, ln 4, ln 8, ... is arithmetic or geometric. 2 (x 1 2)(x 2 2) 1 2 3x 17 2 13 3 6. TIP Sometimes when solving for an x- or y-intercept, we encounter an equation with an imaginary solution. (1, 25) and m 5 2 3 4 63. Domain: {24, 22, 0, 3, 4}; Range: {23, 0, 1, 5} b. h h Solution: a. 23 6 2i, 2 , 1, 24 c. x, x Yes 9. |x| # 3 y 5 4 3 2 1 25 24 23 22 21 21 22 23 24 5 x 25 24 23 22 21 21 22 23 24 25 24 25 y $!x 5 4 3 2 1 1 3 4 5 6 7 3 4 5 x 2 2|y| . linear 3. SA-22 Student Answer Appendix 101. T21(2988) 5 120 means that if a homeowner is charged $2998 in property taxes, then the taxable value of the home is $120,000. k(x) 5 13x3 1 12x 36. x 5 21 13. Identify Subsets of the Set of A hybrid vehicle gets 48 mpg in city driving and 52 mpg on the highway. 47C5 5 1,533,939 57. Given h(t) 5 24.9t2 1 10t 1 100, the coefficients are a 5 24.9, b 5 10, and c 5 100. 2076 e. a1 5 4 and a2 5 12. 5 4 3 2 1 25 24 23 22 21 21 22 TIP y 5 4 3 2 1 2 3 4 5 x 1 25 24 23 22 21 21 22 1 2 3 4 x 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 This is a function. ax 1 b 1 ay 2 b 5 7 5 9 For Exercises 17–32, information about a circle is given. Use transformations on one of the parent functions from Table 2-2 on page 229 to model these data. Domain: (0, `); Range: (2`, `) c. x13 x22 (x 2 2)2 67. (0, 0) g. (h + k)(22) g. For Exercises 86–88, a. c14 5 7.5, c101 5 29.25; Find c400. f (x) 5 3x6 1 2x2 1 0 x 0 34. 708 Chapter 8 Sequences, Series, Induction, and Probability Solution: a. Given f (x) 5 x3 2 x2 2 7x 1 15, a. U63, 626 V 7 b. R.2. r1x2 5 1x 1 3 R.4. p1x2 5 2x2 2 3x 1 1 c. For example: • AB means that Alberto gets $1000 and Beth gets $500, whereas • BA means that Beth gets $1000 and Alberto gets $500. P(E) 5 0.75 14. g, and g are all real numbers f in the intersection of the domains of the individual functions f and g. If events A and B are independent events, then the probability that both A and B will occur is P(A and B) 5 P(A) ? The numbers are 5 and 25. 1 22. The student is male or had no opinion. f 21(x) 5 l0x Domain: (2`, `); Range: (0, `) Domain: (2`, `); Range: (1, `) b. 6.1 g. Plot Points on a Rectangular Coordinate System 2. Section 2.1 The Rectangular Coordinate System and Graphing Utilities Select the GRAPH feature. Symmetric to the y-axis, x-axis, and origin. y 5 11.9x 1 169 c. Our goal is to offer every student an opportunity for success in college algebra by bringing together a seamless integration of print and digital content delivery. 0.54 81. Identify the x-intercept(s). The coefficients for the expansion of (a 1 b)n follow a triangular array of numbers called Pascal’s triangle (Figure 8-9), named after the French mathematician Blaise Pascal (1623–1662). m 5 210 27. 122. The sum of the numbers on the dice is less than or equal to 5. y¿ 5 6. 77. 23 y 5 k(x)24 25 (m ? floor(5.5) d. The remote control can “talk to” the overhead door unit if the 10 corresponding switches in the unit are in the same up/down sequence. True Problem Recognition Exercises, p. t 5 ln(1 1 r) ln (1 1 r) 15. 10c2 1 21 45. y 5 1x 2 10 29. 24 5 156,250,000 23. 16 1y2 45. 1 23 e ax, 2 x, 2 xb ` x is any real number f or 5 5 E(25y, y, 23y) @ y is any real numberF or 5 1 e a2 z, z, zb ` z is any real number f 23 23 She put $2000 in savings, and invested $12,000 in the bond fund and $6000 in the stock fund. (2`, 22) ´ (1, 4) 2 7 7 (25, 21] 25. Determine the interval(s) over which f is constant. Write d as a function of r. a12 5 52, a51 5 208; Find a172. y 5 0 x 0 2 9 SECTION 2.2 Circles OBJECTIVES 1. 1: © Tetra Images/SuperStock RF; p. For g , we further restrict the domain to exclude values of x for which g(x) 5 0. q(x) 5 22 0 x 2 1 0 1 4 Mixed Exercises For Exercises 79–86, the graph of y 5 f (x) is given. Determine the number of seats in row 32. 1 Show that 1 1? 5 1 5 p 1 (2n 2 1 1 ? The integers are 7 and 8 or 27 and 28. The multiple-choice questions each have 5 possible responses (a, b, c, d, e) of which only one is correct. e 5 1 11. 202 Chapter 2 Functions and Relations y c. Not possible 33. Yes 2 24 y 23 22 21 21 22 1 23 5 4 3 2 35. y 5 26 17. Find the equation of the least-squares regression line. 1 2 3 4 5 6 7 x 23 q(x) 5 √¯¯¯¯¯¯¯¯ x1225 26 4. SA-17 c. A ¨ S: Overlap of A and S A 5 {A ,A S 5 {A ,2 ,A ,3 ,A ,4 } ,5 ,6 ,7 ,8 ,9 , 10 ,J ,Q ,K } Figure 8-13 Notice that events A and S share the comment element of the ace of spades, A . k(x) 5 5 1x 1 15 2 2 108. (See Example 1) b. What value does the difference quotient seem to be approaching as h gets close to 0? x1 5 36.58F, x2 5 37.58F, x3 5 40.58F, x4 5 41.58F 0 0§ 1 1(1) 1 23(0) 1 4(0) 1(0) 1 23(1) 1 4(0) 1(0) 2 3(0) 1 4(1) 5 £ 9(1) 1 5(0) 1 3(0) 9(0) 1 5(1) 1 3(0) 9(0) 1 5(0) 1 3(1) § 11(1) 2 6(0) 2 4(0) 11(0) 2 6(1) 2 4(0) 11(0) 2 6(0) 2 4(1) 1 5 £ 9 11 23 5 26 1 b. Apply Reflections Across the x- and y-Axes 5. Such solutions are called Pythagorean triples, such as a 5 5, b 5 12, and c 5 13. • Mixed Exercises do not refer to specific examples so that students can dip into their mathematical toolkit and decide on the best technique to use. [22, 0] ´ [3, `) 11. The remainder theorem states that if f (c) is equal to the remainder obtained after dividing f (x) by (x 2 c). (22, 4) 7 6 5 4 1 c. g(f (23)) c. 215, 219, 223, 227, ... , 2679 11. There is a sales tax of 5.5% and a processing fee of $8.00 for a group of tickets. C(x) 5 21.95x b. x 5 0 g. 5 4 3 2 5 4 3 2 1 1 1 23 24 25 1 2 3 4 y 5 f(x) 5 x 25 24 23 22 21 21 22 1 2 3 4 23 y 5 f(x) 24 25 x 5 1 2 3 4 5 x y 94. y 5 2 x 1 4 c5P2a2b 71. At the time of the purchase, the exchange rate was $1 5 €0.80. 125. 41. {3} 107. g(x) 5 5 11 x24 59. f 21(x) 5 log3(x 2 1) Domain: (1, `); Range: (2`, `) Domain: [25, `); Range [0, `) b. Assume that k! . Solution: Let A be the event that an ace is drawn: {A ,A ,A ,A }. a1 5 3 and an 5 an21 1 10 for n $ 2 a. (12, 68) ´ (184, 200) c. The person is 61 or older. AB, AC, BC (Note: The order within the individual combinations does not matter. g(0) b. y 97. 0 Section 2.4 Linear Equations in Two Variables and Linear Functions 201 Linear Equations and Slopes of Lines Ax 1 By 5 C (A ? This makes the slope undefined because the ratio representing the slope has a divisor of zero. Yes; 4 3 1 21 17 53. Minimum: 60 17. Given f (x) 5 1x 2 4, a. Identity; R 43. 47! There are 22,957,480 different groups of 6 numbers taken from 53 numbers. g(f (3)) 51. The cost is $21.95 per box. 1?2 2?3 3?4 n(n 1 1) n11 Solution: Let Pn denote the statement 1 1 1 1 n 1 1 1p1 5 . an 5 a1 1 (n 2 1)d 164 5 24 1 (22 2 1)d 164 5 24 1 21d d58 Therefore, an 5 24 1 (n 2 1)(8). 2 a. Three points are collinear if they all fall on the same line. (0, 3) e. Round to the nearest $1000. Use the model from part (a) to estimate the average consumer spending on television services for the year 2007. Endpoints of minor axis: (211, 2), (3, 2) d. If 0 , x , 1, then xn , xn21. 0 4π 2 11 0 or 0 11 2 4π 0 b. a , 0b and a , 0b d. Does this relation define y as a function of t? (24, 1) and (2, 22) EXAMPLE 3 Finding the Slope of Horizontal and Vertical Lines Find the slope of each line. 2 48. 21 TIP TIP The function in Example 6 has no “gaps,” and therefore we say that the function is continuous. Finally divide both sides by logb 4. Suppose that y 5 C(x) represents the cost to produce x items, and that y 5 R(x) represents the revenue for selling x items. {22, 0, 3, 4, 6, 8, 9, 12} f. x 1 (x 1 1); 2x 1 1 c. h(x) 5 2 3 4x d. Yes; r 5 3 11. (2`, 27.6) ´ (21.5, 1.6) SA-23 Student Answer Appendix 123. EXAMPLE 4 Using a Quadratic Function for Projectile Motion A stone is thrown from a 100-m cliff at an initial speed of 20 m/sec at an angle of 308 from the horizontal. 49 77. i51 i51 Write About It 105. a b 5 2! ? 1 51 4. 2 9 128 The sum does not exist. c 0 6 6 0 3.7 5.2 d b. f(x) 5 2 (x 2 3)2 1 8 2 1 76. ` b. CHAPTER 2 Section 2.1 Practice Exercises, pp. (x 2 2)2 Concept Connections 1. 14 ? Thus, x4 1 1 has no real zeros. The minimum value is 22. EXAMPLE 8 Finding a Least-Squares Regression Line The data given in the table represent the age and systolic blood pressure for a sample of 12 randomly selected healthy adults. y 5 4 3 2 x,6 1 2 3 4 5 6 7 8 5 6 7 25 24 23 22 21 21 22 23 24 25 24 25 y x2 1 1 2 y2 ,4 1 25 24 23 22 21 21 22 23 3 4 5 x 1 2 3 4 5 x b. For example, enter the function defined by Y1 5 x3 2 4x2 1 3x. (See Examples 4–5) a. h(x) 5 2x2 1 x h(2x) 5 2(2x)2 1 (2x) h(2x) 5 2x2 2 x Determine whether the function is even. sum is within 100 113. y 112. The height 50 ft from the center is approximately 97 ft. f (x) 5 (x 1 3)2 2 4 d. Determine the time required for the object to reach its maximum height. If the probability of an event is 0.0042, is the event likely to occur or not likely to occur? If Iglesias is at bat three times in a game, what is the probability that he will get a hit all three times? Section 2.3 Practice Exercises, pp. q)(x) 22. A cell tower is a site where antennas, transmitters, and receivers are placed to create a cellular network. subtracts, x 2 6 1 y y 23 57. f (21) a. $199,149.07; The value of the annuity more than doubles. First Die Each individual die has 6 equally likely outcomes. Replace (x, y) by (x, y 2 k). 338 million c. 56C12 < 5.584 3 1011 3! ? 121; Yes 23 21 57 31 ea , bf 35. x2 1 y2 2 14y 1 49 5 0 Solution: x2 1 y2 2 14y 1 49 5 x2 1 (y2 2 14y) 5 x2 1 (y2 2 14y 1 49) 5 x2 1 (y 2 7)2 5 0 249 249 1 49 0 Group the y terms and complete the square. 300 ft 5 ft 80 ft 1000 ft rafter rise and the rafter run fraction is typically written with a denominator of 12. Skill Practice 6 For an arithmetic sequence, a11 5 65 and a25 5 149. (2`, `) y 6 5 4 3 2 1 b. 5 160 16 160 16 132 33 28 7 4 4 1 99. • If c , 0, then the solution set is the empty set { }. 3x2 1 3xh 1 h2 111. an 5 a1 1 (n 2 1)d The sequence is arithmetic because the difference between each term and its predecessor is the same constant. y y 5 4 3 2 1 In Example 3(c) there is only one y value assigned to x 5 1. 3x 5 81 R.4. For h(x) 5 16x find h(0), h(1), and h(21). The graph is not smooth. an 5 57. 648: © Michael Evans/Life File/Getty Images RF; p. Center: (6, 0) b. An experiment. Write the equation in slope-intercept form. 212 b. B 5 E2117, 159, 4.3, 0, 23, 213, π, 4.9 F a. Use interval notation to write the intervals over which f is increasing or decreasing. At x 5 2, the function has a relative minimum of 24. For example, the cost to rent an office is a fixed cost. The sides are 15 in., 18 in., and 22 in. J 5 E 1 150 b. 0 d. Interpret the meaning of the slope in the context of this problem. Determine if the relation defines y as a function of x. 125% e. T 21(x) 24 represents the taxable value of a home (in $1000) based on x dollars of property tax paid on the home. (n 2 m)(x) 5 x2 2 x 2 12; Domain: (2`, `) b. 4 3 1024 87. 14m6 2 21m3 1 28m2 27. Determine whether the sequence is arithmetic, geometric, or neither. Over what interval(s) does the height increase? < 10.8 in. Skill Practice 7 Refer to the data given in Example 7. The braces { and } are used to enclose the elements of a set. In how many ways can four students be selected to act out a scene from a play involving 4 different parts? f (x) 5 2 (x 2 4)2 1 6 3 89. 2 19. (2`, 2) 7. Reflect y 5 f (x) across the x-axis. 11 3 7 4 2 3 17. c d b. Replace (x, y) by (x 2 h, y). a , `b 8 14. Round to the nearest dollar. 66151 f 3 5 25. Evaluate Finite Geometric Series The nth partial sum Sn of the first n terms of a geometric sequence is a finite geometric series. However, function g must not have an input value of 24. 2k5n2 2 10m2n 14. Graph y 5 2f(x 2 2) 2 3. The solution to Example 4 can be checked by graphing both lines and verifying that they are perpendicular and that the line y 5 22x 1 1 passes through the point (2, 23). 2 2 2.5 2 Greatest integer less than or equal to 2 is 2. Write a formula for the nth term of the sequence. 5 a3 2 3 2 3 b. m 5 (v0t)2 1 t 3 1 17 3 2 17 10. (17, 9) and (42, 26) 28. R.3. 6x 2 2y 5 10 2x 2 10y 5 22 R.4. 0.3x 2 0.4y 5 21.6 0.9x 1 0.1y 5 23.5 Concept Connections 1. 1 n a. Is 2 1 i a zero of f (x)? Determine the x- and y-intercepts of the graph of the equation. Use Gaussian elimination or Gauss-Jordan elimination to solve the system of equations. 45 12 2 24 13 2 18 77. 2 , 2 , 2 , 2 , p 3 6 9 12 53. There is a 6% sales tax on the cost of merchandise and $10.99 for shipping. 36, 18, 9, 92 , 94 25. 2n. To graph y 5 f A 12 xB, divide each x value on the graph of y 5 f(x) by 12 . Skill Practice 10 Suppose that after a tax rebate an individual spends $210. {(21, 2), (2, 5)} 43. TL (The product LT is not possible.) b. Write an expression for the nth term of the sequence representing the number of participants, where n represents the week number. c 0 3 4 d 2 21 b. on [1, 2] 89. 235 Reflection across the x-axis Reflection across the y-axis To graph a function requiring multiple transformations, use the following order. an 5 2n 1 1; The sequence is {3, 5, 7, ... , (2n 1 1), ...}. SA-48 Student Answer Appendix n 19. 8.6 3 101 10 2.998 3 10 cm/sec 71. For Exercises 69–78, use translations to graph the given functions. 0, 19 c. , 4b 5 (24, 4). However, we would be 100% certain of drawing a red, blue, or green marble from the box and the probability would be 1. (2`, a) ´ (a, b) ´ (c, `) 105. 2 1 2 log2 a 1 log2 (3 2 b) 2 log2 c 2 2 log2 (b 1 4) 2 45. (f + g + h)(x) 5 2A 1 x B2 1 1 85. The second column gives the profit for Friday, Saturday, and Sunday, respectively. P(x) 5 1.10x 2 120 d. {80} c. (2, 219) 6 2 157 6 1 157 , 0b and a , 0b d. horizontal; (a, 0); (2a, 0); R.3. y 5 2 1. {64, 62} 9 12. j. 1 x14 x2 1 1 x 14 (x 1 4)2 4x 1 1 22 1 2 x x 15 y a. 10 8 24 25 22 4 5 6 4 5 210 n c. 16 days Let Pn be the statement 6 1 10 1 p 1 (4n 1 2) 5 n(2n 1 4). (2, 9) 20 (16, 18) (25, 21) 15 10 (0, 6) 5 (0, 1) 0 1 2 3 Day Number 4 5 0 0 5 10 15 20 Day Number 25 30 Section 2.7 243 Analyzing Graphs of Functions and Piecewise-Defined Functions Technology Connections 103. In Example 1(c), it is impossible to draw a white marble from the box. Answer 3. t5 210 2b 5 < 1.02 2a 2(24.9) The stone will be at its maximum height approximately 1.02 sec after release. At that time, the health department declares a flu epidemic. 5 45. What is the slope of a line defined by x 5 2? h(x) 5 x3 1 2 Solution: a. y 5 f(x) 1 25 24 23 22 21 21 22 d. {900} 99. (h + g)(72) 57. Find (n + d)(t) and interpret the meaning in the context of this problem. TIP In Example 4(c), h(x) has a mixture of terms of the form xodd and xeven. Point of Interest Solution: Among his many contributions to mathematics, René Descartes discovered analytic geometry, which uses algebraic equations to describe geometric shapes. Use the model from part (b) to predict the amount of cholesterol for a hamburger with 650 calories. 23, , 2, 4 19. f (0) 5 2(0)2 1 4(0) 2 5 5 25 The y-intercept is (0, 25). From Figure 8-13, events A and S are not mutually exclusive. e f 2 5 25 Skill Practice 9 a. The range. 5 7 1 15! 15! 15 ? The graph of a constant function defined by f (x) 5 b is a (horizontal/vertical) line. 0 69. f (0). 5 4 3 2 1 25 24 23 22 21 21 22 24 25 26 27 28 45. Therefore, it would be natural to take the absolute value of g(x) 5 2x2 2 5. Investigate Increasing, Decreasing, and Constant Behavior of a Function 5. y 5 2f (x 2 4) 2 1 10 290 83. 1 1 2 1 3 1 4 1 5 80. d(t) 5 60t b. 11. A 5 ≥ 0 22 26 5§ 25 9 37. 2 7, 2 49, 7, 72 7, ... 4 8 16 17. 250,000 742 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 4 Counting Permutations a. 124. For example, one five-letter palindrome is: ABCBA. 1 64 2 6 2. (0, 55) g. Downward b. Online Exercises were carefully selected and developed to provide a seamless transition from textbook to technology. (22, 0) ´ (2, `) f. 1 1 2 3 4 5 x b. Show that a b 5 1 and a b 5 1. A sales person working for a heating and air-conditioning company earns an annual base salary of $30,000 plus $500 on every new system he sells. 7.2 3 10220 11 7 1.24 3 10 93. 221.7370 < 0.3 25.4800 7 85. {x 0 x # 2} 95. Section 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions 119. 29. What is meant by a viewing window on a graphing device? 2b 1 2b2 2 4ac 2b 2 2b2 2 4ac 1 2a 2a 2b 1 2b2 2 4ac 1 (2b) 2 2b2 2 4ac 5 2a 22b b 5 52 2a a 133. $245,446.68 an 5 7.50n2 22. 1 95. Then use the steps for graphing multiple transformations of functions on page 236 to list, in order, the transformations applied to the parent function to obtain the graph of g. f (x) 5 x 1 9 2 2 67. a1 2 1 1 1 ba1 2 2 ba1 2 2 b p a1 2 b 2 2 3 4 1n 1 12 2 n12 5 2(n 1 1) For Exercises 17–24, use mathematical induction to prove the given statement for all positive integers n. Under the STAT menu, select CALC and then the LinReg(ax 1 b) option. (x 1 3)(x 2 3) b. In the New York state lottery game “Lotto,” a player wins the grand prize by choosing the same group of 6 numbers from 1 through 59 as is chosen by the computer. f (x) 5 24x3 1 x 91. a b 0 6 b. R.1. r 5 1. 16.7 sec c. Shade the area bounded by the given inequalities on a coordinate grid showing 25 # x # 5 and 25 # y # 5. As x S 2`, f(x) S 2`, and as x S `, f(x) S 2`. (22, 0), (1, 0), and (3, 0) 4. 5 6 135 3 1 6 13 f 13. x 2 12z 1x 1 36z2 16 y23 3x 22. (2`, 4) ´ (4, `) y a. Find a1 and r for a geometric sequence given that a3 5 18 and a6 5 486. Use the regression line to predict the amount of cholesterol in a hamburger with 650 calories. (See Example 11) 91. We have shown that P1 is true, and that if Pk is true, then Pk11 is true. Given a geometric sequence whose nth term is an 5 25(1.6)n, are the terms of this sequence increasing or decreasing? 5 200 25 200 100 200 25 41 1 1 1 164 5 67. Aliyah invested $2760 in the stock returning 11% and $3000 in the stock returning 5%. In a business meeting, every person at the meeting shakes every other person’s hand exactly one time. z 5 4x2; This is an equation of a parabola in the xz-plane. 3x2/3 (3x 1 2)y3 A 5 x2 1 2y2; A 5 (x 1 y)(x 2 y) 91. 399 1. Linear Equation in Two Variables Let A, B, and C represent real numbers such that A and B are not both zero. Therefore, 42 , (2 1 2)!. h(x) 5 2x2 1 x Solution: a. 2552 307.52 is more circular than the inner ellipse because the eccentricity is closer to zero. The nth term of a geometric sequence with first term a1 and common ratio r is given by an 5 . x-intercept: (26, 0); y-intercept: None 1 y57 4 3 2 24 25 2y 5 25x 1 2 x 8 7 6 5 x 24 25 1 1 2 3 4 23 4 3 2 y 1 25 24 23 22 21 21 22 R.5. 22 5. Gives Your Students the ALEKS Advantage Are your students prepared for your course? EXAMPLE 2 Writing Several Terms of a Geometric Sequence Write the first five terms of a geometric sequence with a1 5 5 and r 5 22. a2`, 2 d ´ c , `b 2 2 3 23 2 159 23 1 159 , b 29. 14,097 1530 54. Use the points (1, 8) and (9, 40) to write a linear function that defines the number of attendees as a function of week number. 4! 40. T 5 4 E Bk 3 105. 8, 5, 2, 21 b. Therefore, at x 5 2, the function has a relative maximum of 1. Given f (x) 5 4x3 1 2x, find the difference quotient. Apply Function Notation A function may be defined by an equation with two variables. f (x) 5 4Ax 2 14 B(5x 1 1)(x 1 2) or f (x) 5 (4x 2 1)(5x 1 1)(x 1 2) 33. SECTION 8.2 OBJECTIVES 1. 9 F 5 10 8 7 6 5 4 3 2 C(0, 4) 10 210 F 216.1 16.1 1 25 24 23 22 21 21 33. Find all values of x for which f (x) 5 0. e , 2 f {3, 27} 9. 2 1 2x x 17 x 15 (x 1 5)2 3 3x 1 1 x25 2x 1 1 1 2 37. A softball team has 9 players consisting of 3 women and 6 men. 2 h 48 49. In many cases, we can also graph families of functions by relating them to one of several basic graphs. [2, 3) c. f (x) 5 (x 1 1)(2x 2 9)(x 1 4) b. (21, 23) and (3, 27) 13. However, we often use linear equations to analyze nonlinear functions on small intervals. (f + g)(x) 267 1 x 1 4, write a rule for each function and write it. b. 21y 2 22 2221y 2 22 71. a (5i 1 4) 94. There are 10 choices for each digit. a3 5 2a2 1 1 5 2(9) 1 1 5 19 Substitute a2 5 9. Use the binomial theorem to find the value of (3 2 2i) where i is the imaginary unit. g(x) f f (x) a b(x) 5 provided that g(x) ? P(x) 5 1.50x 2 120 5 1.50x 5 x5 0 0 120 80 The vendor will make $72. y 5 1 c. (See Example 3) 11. All x on the interval [23, 21] e. Mixed Exercises 77. R.2. 5x R.3. 8x 2 29 $8.25 $82.50 6x 1 30 R.5. 5 1 9r 10 hr $900 3. h(x) 5 2x2 16. a n b(20, d) Salesperson ... A salesperson who makes a monthly salary of $3000 along with a 5% commission on sales over $20,000 for the month. 58. Write a piecewise-defined function ... The graph is a left semiellipse with center at the origin and the major axis of length 8 units and minor axis of length 6 units. y 45. 38. a e, yb `y is any real number 12 15. 558: © Royalty-Free/Corbis; p. 3 is c. Arithmetic; d 5 27 b. In the figure, T TT 2 outcomes 4 outcomes When the coin is flipped 1 time, there are two possible outcomes. If two events A and B are not mutually exclusive, then P(A ´ B) can be computed by the formula P(A ´ B) 5 ... A delivery truck must make 4 stops at locations A, B, C, and D. 514–517 264 f 5 plane 3. Then subtract the terms corresponding to n 5 1 and n 5 2.) For Exercises 73–80, write the repeating decimal as a fraction. 80. Suppose that we place the origin at the center of the flower. If an artist anticipates working for the company for 10 yr, find the total amount she would earn from each job. (23, 7), (23, 23) d. 4 115. a 27. x1 5 250 vehicles per hour; g. 12 yr c. Objective 3: Apply the Slope-Intercept Form of a Line For Exercises 51–62, a. y 71. Write an equation that represents the boundary of the area that can receive a signal from the tower. 1.00 a. Compose and Decompose Functions The next operation on functions we present is called the composition of functions. and your students. Parallel lines m1 5 2 5 5 m2 5 2 53 3 ft Perpendicular lines 3 ft m1 5 5 ft m1 3 5 5 5 ft 3 ft 5 ft 5 ft Figure 2-20 Figure 2-21 Slopes of Parallel and Perpendicular Lines Answer 2. P4 is true because 3(4) 5 12 and 4 5 16. If two cards are drawn at random from a standard deck, what is the probability that both are hearts? b 5 1 Vertices: (5, 0), (25, 0) c. Then verify that the solution is correct by showing that x 5 f (x). A1 13 B Ax 2 13 B b. The range is [27, 1 x], B 5 {x x 0 1 x 5 3 4 5 6 7 8}. Arithmetic c. The sum of the first and second terms of an arithmetic sequence are 26 and 29, what are the first and second terms? A voter that is neither Democrat, Republican, nor Independent? False; log5 a bh AThe left side is 23 and 125 log5125 the right side is 13.B 93. The original number is 68. 6121 2 2 1 1p 3 9 55. from x1 5 1 to x2 5 2. P1 is true because (1)2 (1) 5 0, which is even. 261 120. What is the slope of a line defined by y 5 27? Write a linear function to model the cost for parking P(t) for t hours. 2(2 2 x2) 3x2 2 4xy 1 3y2 x(3x 2 14) 9. The spectators can see the shell between 1 sec and 6.75 sec after launch. • Function f is an odd function if f (2x) 5 2f (x) for all x in the domain of f. A 5 {x 0 4 . A license plate has 3 letters followed by 3 digits. 2x 2 2 . Find the sum of the integers from 2102 to 57. {2.0960} Section 4.6 Practice Exercises, pp. 5 x 242 Chapter 2 Functions and Relations Write About It 91. For the given figure, a. We can construct a list of the possible outcomes. Yes 63. 6! 6! 6! 5 5 1 d. The point (1, 23) is graphed as an open dot, because the point is not part of the rule f (x) 5 23x. (2` , `) f (1 18) 365, 412,213,89 e. f (x) 5 2 77. The intersection of the constraints defines the feasible region. $1440 43. If the slopes of the two lines are the same and the y-intercepts are different, then the lines are parallel x 5 4 3. 37. Ratio of 71 and 100), 0.6 5 0.666 p (ratio of 2 and 3). x(x 1 5) 5 22x2 1 x 1 4 For the equation x2 1 a , 2 22 for x $ 2 For Exercises 132–135, use a graphing utility to a. Self Assessment Content Project Manager: Eric Dosmann Buyer: Jennifer Pickel Design: David W. Given an arithmetic sequence with a15 5 86 and a37 5 240, find the 104th term. a 7 5 2 41. 10 137. Suppose that $25,000,000 is put into savings, and that $75,000,000 is spent. 23 5 27,600 21. 701 The nth term of an arithmetic sequence: p. 4 mg/L d. 5k 2 1) 5 14(5k11 2 1) as desired. 7 24 25 x y 5 2f(x) 25 24 23 22 21 21 22 23 y 6 26 1 1 25 24 23 22 21 21 22 5 23 25 24 23 22 21 21 22 23 y 25 1 2 3 5 4 3 2 5 4 3 2 1 4 81. (x 2 3)2 1 (y 1 1)2 5 41 a. x 1220 81. y 5 0 x 0 y 5 4 3 2 5 y 5 2x 5 x 21 22 23 x 5 24 23 22 21 22 23 24 25 25 75. 23 11 13 23 Determine the axis of symmetry. 231 11. evaluate f a 2a The y-coordinate of the vertex is given by Vertex Formula to Find the Vertex of a Parabola For f (x) 5 ax2 1 bx 1 c (a fi 0), the vertex is given by a EXAMPLE 3 2b 2b , fa bb. 729 • First prove the statement for n 5 j. (x 0 x # 1.5}) y y 33. To find a5, we write a formula for the nth term and then evaluate the expression for n 5 5. 62 Domain: [29 2 10 2 15, 442 1. The least-squares regression line, y ´ 5 mx 1 b, is the unique line that minimizes the sum of the squared vertical deviations from the observed data points to the line (Figure 2-24). Therefore, it is neither even nor odd. A function may also be stretched or shrunk horizontally. , 23 (each multiplicity 1), and 1 (multiplicity 2) 2 7 e. (Source: Internal Revenue Service, www.irs.gov) If your taxable income is over— but not over— The tax is of the amount over— $0 $8925 $0 1 10% $0 $8925 $36,250 $892.50 1 15% $8925 $36,250 $87,850 $4991.25 1 25% $36,250 Write a piecewise-defined function that expresses an individual's federal income tax f (x) (in $) as a function of the individual's taxable income x (in $). {(0, 0)} 35. Concave up b. [1, 2) 153. 4 3 2 f (x) 5 2x 2 3; x # 0 1 y R.3. 23 f(x) 5 1 1 f(x) 5 x2 2 3; x # 0 22 1 79. That is, the first DVD would not be replaced before the second DVD is selected. a (25i 2 3) i51 Mathematical Induction OBJECTIVES 1. Write the domain and range in interval notation. Solution: 1 K 1 m2 1x2 5 k1m1x2 2 a Evaluate k at m(x). A "combination" lock is opened by correctly "dialing" 3 numbers 0 0 m 39, inclusive. Show that A 32 B K11 . y 5 2x 3. 25. 389: © Ingram Publishing RF; p. 24 for Exercises 89–92, graph the function with a graphing utility on the given viewing window. At a parking garage in a large city, the charge for parking consists of a flat fee of $2.00 plus $1.50/hr. Substitute a1 5 15 and r 5 23 to get the nth term. x y 5 9 y 5 5y, 5 , [16 103. 1 , 3 2 2 y 5 y 5 2x 5 y-intercepts are a 21 2 26 2 121 5 e 2 x 2(3)3 4 in 1 n11 x 0 3 2 2x 7 2 2 278 Chapter 2 Functions and Relations For Exercises 11–14, information about a circle is given. [210, 10, 1] by [2150, 10, 10] For Exercises 89–92, graph the equation with a graphing utility on the given viewing window. for 0 # x # 20,000 for x . Standard form: (x 2 h)2 1 (y 2 k)2 5 r2 Simplify. Apply the point-slope formula. The truth of Pk implies the truth of Pk11. A2` , 215D ´ C 15, `B 3 b. (2c2 2 d5)9; Term containing d25. (2` , `) d. If the slope of a line is 23 , a. a1 5 12 and a2 5 18. 687 1. 5 k2 1 (2k 1 2 2 1) 5 k2 1 2k 1 1 5 (k 1 1)2 as desired. a1 5 2 and a4 5 16. 2a 2a Using the Vertex Formula Given f (x) 5 2x2 1 4x 2 5, a. (3x2 2 5y)3 5 (3x2 1 (25y))3 is in the form (a 1 b)3 with a 5 3x2 and b 5 25y. 1000 rabbits after 1 yr, 1667 rabbits after 5 yr, and 1818 after 10 yr. This means that if 80 cups of lemonade are produced and sold, the revenue and cost are both $160. 2 nonreal solutions b. 170 • To find a y-intercept (0, b) of the graph of an equation, substitute 0 for x and solve for y. As a student, reads, the material continuously adapts to ensure the student is focused on the content he or she needs the most to close specific knowledge gaps. Between 4 and 5; 4.6705 5 2 b. x 5 0, x 5 2 h. The number of unique arrangements of the three letters is 11 5 1.663,200 2! 7 g(x) 5 y3 x 2 2 2 c. {(21 , 23)} 36. r ! n2r ! By the commutative property of multiplication, n! n! 5 . Now suppose that the coin is flipped two times. If no letter may be repeated, then the number of letters from which to choose must be decreased by one when the second letter is selected. a1 5 11; an 5 4an21 1 3 28. Determine Relative Minima and Maxima of a Function The intervals over which a function changes from increasing to decreasing behavior or vice versa tell us where to look for relative maximum values and relative minimum values of a function. Skill Practice 7 Find the sum of the first 50 terms of the sequence. If x is twice y, and z is four less than x, write z as a function of y. M ´ N Concept Connections 1. The blood alcohol concentration decreased by an average of 0.014% per hour during this time interval. 2(7). Such a sequence is called an alternating sequence. 240 b. (2` , 25) ´ (5, `) a 18. Both types of functions represent simple curves that can be used for modeling in a wide range of applications, including predictions for the path of a hurricane. The numbers are 7 and 23. 702 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 1 Identifying an Arithmetic Sequence and the Common Difference Determine whether the sequence is arithmetic. Never decreasing h. 7x5 n(x) 5 3x 2 7; 21 , x , 2 Objective 5: Interpret a Function Graphically For Exercises 111–114, use the following. p(x) 5 24 2 x2 2 x2 93. Mixed Exercises 72. 5 34,650 27. g(x) 5 12x Section 2.6 SECTION 2.6 229 Transformations of Graphs OBJECTIVES 1. m(x) 5 0 x 1 2 0 95. Furthermore, the vendor knows that the lemons, sugar, and cups collectively cost $0.50 for each cup of lemonade produced. 365: © Denkou Images/Getty RF; p. 1 Fk 5 Fk12 2 1. 51. These additions provide STEM students an opportunity to connect current topics to what they'll learn in calculus. Write an absolute value expression that represents the distance between the points x and 7 on the number line. 2x3 2 128 15. 51 44. m 5 x2 2 x1 9. Suppose that a person is randomly selected from the population. Center: (0, 0) 23. (x 2 3)(2x 1 5) b. (2` , 1) ´ (4, `) 83. How would you go about estimating the probability of winning the game? 23 b. { } 15. Chapter review exercises. 180 1 190 5 x1 1 x2 b. 10 1. Use the model in part (b) to predict the number of attendees in week 24 assuming that the linear trend continues. The blood alcohol concentration rose by an average of 0.03% per hour during the second hour. Explain how to determine the break-even point. 0.61 b. 1 38 b. To find 2x, take the additive inverse of each individual element of A. Ex 0 x , 2132 F; R.2 A. 2132 B. 8 3y 2 1 x 3 21 2 y 22 7. M ´ N b. Describe the general shape of the graph of y 5 xn where n is an odd integer greater than 1. (x2 1 2)(x 1 3)(x 1 3)(x 2 3) 3 (x 2 3 3 1 1)(x 1 3)(x 2 2)(x 2 3) 5 3 3 21 2 4 4 3 2 1 m(x) 1 a 3 21 2 4 . 7 (x 2 1) 5 23 2 1 2 2 (x) 4 ... 2.4. 3 17. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 5 4 3 2 1 2 3 4 1 25 24 25 c. Therefore, 7! . h(x) 5 x 1 5 2 2x x 3 1 x 2 3 x 25 4 4 x 2 3, the function has a relative minimum of 0. 23.1407 1 1 2 3 4 5 x x k(x) 5 2 (31) 24 25 26 27 b. y-axis b. g(x) 5 1x 1 1 71. The base is 10 ft and the height is 8 ft. Given h(x) 5 4x 2 2x, find h(2x). Notice that a point (x, y) on the graph of f corresponds to the point (x, 2y) on the graph of g. Write a recursive formula to define the sequence. 1 1 5 25 1 p 5 n21 5 14(5n 2 1) 25. Find the probability that the outcome is a 5 on the die followed by the coin turning up heads. {(5y 2 2z 21, y, z) 0 y and z are any real numbers} or {(x, y, z) 0 x 2 5y 1 2z 5 21}. A palindrome is an arrangement of letters that reads the same way forwards and backwards. 26 , 5, 232, 34 11 ; f(x) 5 1x 2 3 1 1 74. 2 2 129 units < 10.77 units Skill Practice 1 Find the distance between the points (21, 4) and (3, 26). (See Example 5) 15. {25, 22} 155. 25 ? an add number? {3, ` ) (2, 1) f 23 29 23 22 21 21 Answers Y2 5 x 2 5 26 23 22 21 22 Skill Practice 8 Use the graph to solve the equations and inequalities. 12 1 y2 1 10y 2 1 17 5 0 26. [213, 25] c. No 21. A21 5 F 1 6. The business will lose $322. 2 1 2 1 2 2 4 8 16 32 84 a , 5b 5 3 4 a2 , b 6 ( 5 ) ` 3 1 infinite sequence} and 5} 5 a1, a2, a3, ... A21 5 21 d. (23, 0) and (21, 0) d. (2` , 0] y 5 f(x) 8 6 4 2 21028 26 24 22 22 24 26 28 24 4 6 8 5 1. Evaluate f (x) 5 22x2 1 4x for values of x given. Otherwise, the series . C5 640m 1 200n 1 500 b. Examples: 2116 (ratio of 26 and 11) and 9 (ratio of 9 and 1). R.2 20 16. R.3. 7 13 4 R.4. R.2 22 21 1 2 3 12 R.6. 3 15 1 12 2 13 3. [1, 4] c. p(1) Solution: a. 4v2 2 4v 1 1 2 w2 73. 2y 2 1 y; Leading coefficient 21; Degree 2 15. (3.7, 24.4) 17. 0 x 0 5 2 0 x 0 . 213 67. k(x) 5 (x 2 3) 90. 0.0906 d. In this case, 500 acres of corn and 700 acres of soybeans should be planted. 260x 2 50 73. x14 Write About It 118. See Systems of nonlinear equations in two variables Nonreal zeros, 336 Nonrigid transformation, 232 Nonsingular matrix, 605 Notation/symbols absolute value, 7 addition and subtraction, 3 functions, 686, 405 factorial, 693–694 Functions, 186–188, 219 grouping, 9 inequality, 3–4 infinity, 4, 302 interval, 4–5, 145 inverse, 405 matrix, 586, 612 radical sign, 28 scientific, 22–24 set, 2, 5 set-builder, 2–4, 145 subscript, 38 summation, 695–697 nth partial sum of arithmetic sequence, 705–706 explanation of, 694, 764 of geometric sequence, 715, 765 mathematical induction and, 726 nth roots, 27–28 nth term of arithmetic sequence, 702–705, 765 explanation of, 690 of geometric sequence, 713–715, 765 Null sets. Determine the values of x must be restricted to produce real numbers for y. Determine the intercept and y-intercept and interpret their meanings in context. The goal of the calculator material is not to replace algebraic analysis, but rather, to enhance understanding with a visual approach. (22, 0) 13 11 1 2 x 1 x b. Previous editions © 2014. Skill Practice 4 Write the equation in the form (x 2 h)2 1 (y 2 k)2 5 r2, and identify the solution set. 0 (multiplicity 1), 22 (multiplicity 3), 24 (multiplicity 1) 5 9 31. Foci: AS 13, 0B, A25 13, 0B f. y 2122 1028 26 24 22 21 22 y 5 f (3 x) 2 4 6 8 10 12 5 4 4 5 4 25 24 23 22 21 21 22 23 24 25 24 25 x 0, (250) f. x 5 4 3 2 1 1 25 24 23 22 21 21 22 23 24 25 Objective 2: Write Equations of Lines in Parallel and Perpendicular to Other Lines. ... ; x 2 5 2 5 x 1 2 23 2 1 21 22 23 24 25 25 24 23 22 Part of Interest Mathematical induction is one type of mathematical proof, but there are many other techniques, including proof by contradiction. x 5 y 8 43. Yes 28. The point of intersection is (2, 1) 23. 43. 7 5 0 x 2 2 0 1 5 16. 2x 1 3y 5 6 b. Likewise, the values of f(x) are 4 less than the values of f(x) and the graph is shifted downward 4 units. 125 : 24} # (7.8, ` ) e. a 3 2b 35. Maximum: 6480 a. s 5 216t2 1 60t 1 2 b. f (x) 5 x 1 1 for 21 , x # 2 55. 133. (29, 21) ` (1, 9) 115. The player wins by choosing numbers that match those randomly selected in a drawing. h(x) 5 m1(2x) 2 86. 40 R by 80 R b. 0 , x 2 15 0 0 x 0 5 2 0 b. 5 2k2 2 2a 5 2(k2 2 a), which is an even integer. (a)1 5 0 x 1 2 0 1 x 2 5 0 x 1 2 2 1 2 2 4 7 9 3 2 ... , we see the extended principle of mathematical induction. EXAMPLE 1 Identifying Elements of a Set Given A 5 E 13, 0.83, 2197, 0.39, 216, 0, 11, 0, .2020020002p , 0 .444F, determine which elements belong to the following sets. (4a 1 1) 2 1 36a 1 9 2 1 36a 1 8 4(9a 1 2) From the inductive hypothesis, replace 9k by 4a 1 1. Graph D 11. 736 Chapter 8 Sequences, Series, Induction, and Probability kth Term of a Binomial Expansion Let n and k be positive integers with k # n 1 1. 24 g. Estimate the times and values of any relative maxima or minima on the interval (0, 70). Determine if the function is even, odd, or neither. How many arrangements of 1's and 0's can be made with one byte? y 5 12.2 x For Exercises 31–34, graph the equations by plotting points. If an inequality is true, then the function is divided by 1 on that interval and is "turned on." If an inequality is false, then the function is divided by 0. 11 0 4 3 2 25 24 23 22 21 21 22 15. 20,000 Income vs. a 3 5 3 1 3 1 3 1 3 1 3 1 3 1 9 5 18 n51 6 terms Skill Practice 6 Evaluate the sum. 24 7 (16C2) 7 (213, 25) 37. For Exercises 31–34 a. Find the slope of the secant line pictured in red. [218, `) 10 11! Sometimes we are presented with several terms of a sequence and are asked to find a formula for the nth term. Profit at (0, 0): z 5 0 100 (0, 90) (80, 90) Profit at (0, 90): z 5 21,600 80 Profit at (80, 90): z 5 34,400 (120, 60) Profit at (120, 60): z 5 33,600 60 Profit at (120, 0): z 5 19,200 40 f. 615, , 22, and 24 (each with multiplicity 1) 2 1 73. By completing the square, f (x) can be expressed in vertex form as f (x) 5 a(x 2 h)2 1 k. log ° 2b 1 2b2 2 4ac 2b 2 2b2 2 4ac ¢ 1 log ° 2a 2a 5 log ° 2b 1 2b2 2 4ac 2b 2 2b2 2 4ac ¢ a q b(x) r 26. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 23 22 21 21 22 23 24 25 24 23 101. y 68. 23(x 1 2)(x 1 1) # 2x 1 5 c. x 5 22 y 75. 75. Explain why a finite number of terms is not sufficient to determine whether an infinite sequence is arithmetic or geometric. (T + C)(x) 5 1.5794x 2 1 065 represents the total cost to buy x songs for a first-time visitor to the website. 5 4 3 2 1 Transformations involving a horizontal shrink, stretch, or reflection often introduce confusion when coupled with horizontal shift. m 5 0 43. 1 1 6 1 36 1 216 1 ... ` 2 j21 65. y 5 3.5x 2 2.95 17. (h + g + f)(x) 5 (2x 1 1)2 87. 1, $12,166.53 b. 2x 1 10)2 9y 2 2222 33. Given bn 5 b. 2 35 n 101. 1 5 b. Therefore, x 7 5 1 4 5 1 1 4 1 3.5 1 ... 1 (230.5) 52. 0 y 0 # 3 and 0 x 0 # 88. Yes y 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 25 53. Find (k + m)(x). However, the first equation represents an ellipse centered at (1, 27). 5) x 1 52 2(1) • Zero factorial is defined as 0! 5 1. a2` , 4 ´ (5, 5 (23, 4) b. four 2! 21 # x 2 0 # x a. 1 2x 2 1 4 5 2x 1 1 b. Title. Donna's bachelor of science in mathematics and master of science in mathematics are both from the University of Miami. Given n(x) 5 70 x 0 1 3x 2 1, find n(2x). Hours of Study, x Test Score, y 8 92 3 58 11 98 5 72 8 86 Solution: Table 2-1 a. [4, 6] (Hint: t 5 4 and h 5 2) e. Writing a Relation from Observed Data Points Table 2-1 shows the score y that a student earned on an algebra test based on the number of hours x spent studying one week prior to the test. 750 Chapter 8 Sequences, Series, Induction, and Probability Write About It 85. (See Example 5) 65. A law office orders business stationery. The general shape of y 5 x n is similar to the graph of y 5 x3 for odd values of n greater than 1. 40 # x1 # 90 vehicles per hour; x2 5 210 vehicles per hour; 190 # x2 # 240 vehicles per hour; x3 5 170 vehicles per hour 150 # x3 # 200 vehicles per hour R.1. y 5 25x 2 18 1. f(x) 5 249 1x2 41. 0.58 39. • If 0 , a , 1, then the graph of y 5 f (x) stretched horizontally by a factor of 1a . 9 2x 2 1 5x 1 3 2 5 5x 2x 23 5 x The parabola is the set of all points in the plane. 11 17 8 5 0 5 5 x2 2 21 4 1 x3 1 2 2 5 x 3 7 2 22 5 (x 2 5) (x 2 1) 5 1 5 ... 11 84 Slope-intercept Apply the slope-intercept form. Use the slope and y-intercept to graph the function. c. (Lx1 1 3 2 2) 1 (3, (See Example 4) 19. a1 5 3 and a5 5 243 1 2 2 1 ... e 2 f 5 5 10 133 f 9. Based on the graph, does a linear model seem appropriate? 25 33. Therefore, the factor is a raised to the n 2 (k 2 1) power. 2x 2 3 . b 29. y 5 3x 1 12y 13. 5 10 15 20 , , , , 9 16 25 Objective 4: Use Summation Notation For Exercises 57–70, find the sum. How many first-, second-, and third-place finishes are possible? (0, `) d. x2 1 y2 2 8y 1 3 5 0 28. y 5 20.9x 1 6.29 61. 3 27. a (j 4 2 j2) j51 SECTION 8.4 22. Instead we will use the principle of mathematical induction. (5) 5 24 0x 1 2 0 2 1 78. The endpoints of a diameter are (7, 3) and (5, 21). x-intercept: (24, 0); 39. f(x) 5 5 17. e. In a recent year, census results indicated that 199,500,000 Chinese were over the age of 60. (2, 4), (24, 24), (22, 4), (22, 24)} 9 87 37 7. x 5 21 22x 1 1273 b. However, a different pattern exists. Pam can row to a point 166 ft down the beach or to a point 300 ft 3 down the beach to be home in 5 min. 3 20. (k 1 h)(4)f. A test consists of 3 multiple-choice questions, each with four possible responses, and 7 true/false questions. Determine the distance Joe travels in 40 min. • The x-coordinate is the location of the relative maximum or minimum within the domain of the function. 2436(3): Mike Mcmillan? RF; p. Make a chart showing Y y the possible genotypes of Y of the offspring. 2 3 11h 3 2 42 y 63. The point (25, 23) is not included in the function as indicated by the open dot. 6 5 180 77. x 5 38 21. An equation of the form y 5 k where k is a constant represents the graph of a line. Solution: y f(x2) 2 f(x1) Average rate of change 5 x2 2 x1 f(0) 2 f(22) 21 2 3 5 5 5 22 0 2 (22) 2 y f(x) 5 x2 2 1 1 1 5 4 3 2 1 25 24 23 22 21 1 2 3 4 5 x 25 23 24 22 f(x) 1 21 22 23 22 4 5 5 x 22 23 2 24 25 Since the foci should be located 630 12 in. Determine the distance of the point. Determine whether the following inequality is true. The Fibonacci sequence is the sequence (1, 1, 2, 3, 5, 8, 13, 21, ...). 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x y 39. 8; BBB, BBG, BGB, BGG, GBB, GBG, GGB, GGG c. Show that Pk11 is true; that is, show that 2 is a factor of 7k11 2 5. (2` , 24) ´ (1, `) 14 a2` , b 30. This is the initial population in 2010. E(a) 5 20.476a 1 37.0a 2 44.6 b. 2117 , 159, 4.3, 0, 23, 213, n 4.9 [ R In Table R-2, we summarize other symbols used to compare two real numbers. Connect Math® Hosted by ALEKS Corp. (2` , 3] 2 3] b. There is 1 spade that is an ace in the deck. 8 5 11,232,000 19. a10 5 48 5. 0.2 79. (2` , 4] 8. R(x) . The customer will wait at least 90 sec but less than 120 sec. Write a linear function to model the cost S(x) (in $) of a speeding ticket for a person caught driving x mph over the speed limit. 7 y 19. {(5, 26)} 7. 1210 55. identity 7. 12 c. n(x) 5 3 0 x 0 2 (22, 17.48, 12.93) 73. a (2 2 2 a1 1 6) i51 i51 i51 i51 a i 5 n n n n n n b. The value of the account is $9010. 1 b. Predict the average monthly bill for a user with 19.6 hr of use 13. 1(x) 5 21 22 4 51, 0 27.7 b. 3 1 2. 2 4 1 4 5 6 8 60 1 1 5 1 0 1 1 7 17 33 7 1 4 5 1 1 2 f (x) 2 2 4 0 1 ... 5 1 4 22 5 ... 7 1 ... 5 2 ... 2 ... 6 1 5 .61 5 2 2 ... Horizontal asymptote: y 5 1 21 2 185 21 1 185 , 1b ~ (1.17, 1) and a , 1b ~ (21.46, 1) 16. Domain: {x 0 x # 4} or (2` , 4]; Range: {y 0 y $ 24} or [24, `) • Exclude values of x that make the denominator of a fraction zero. We can make this process generic by labeling the points P(x1, y1) and Q(x2, y2). An equation to represent this relationship is y 5 x 1 2. . . . , p 3 4 5 6 1 4 9 16 b. Explain the difference between a permutation and a combination of n items taken r at a time. 82: © Echo/Getty RF; p. Foci: A6, 2 12 B, A6, 22 12 B y x 132. 35. 1250 gal of E5 13. (0, 6) y f. Therefore, 4 is a factor of 9k11 2 1. n 3. P1 is true, and. g(x) 5 2 c. Instead, the probability can be approximated by observations. No Skill Practice 2 Determine if the relation defines y as a function of x. R 2 4(1 2 x) 2 (x 2 7 2 2x 5 0 b. Number of Views by Day Number 25 20 15 10 0 2 24 25 35 1 1 y 99. 28 (7. 308 135. Bottom semiellipse c. a b 5 65. There are several ways that we can determine if three points, A, B, and C are collinear. {664} Absolute value inequality b. Parabola c. h(x) 5x 2 1 . Not 22 # x, 0 x 0 1 x 5 b g(x) 5 0 x 2 1 0 1 0 x 1 2 1 (2k 2 1) 1 (2k 11 2 1) 1 [2(k 1 1) 2 1] (2(k 1 1) 2 1) 5 (k 1 1)2 (k 1 1)2 5 x 2 4 5 2x 5 1 Slope-intercept Apply the slope-intercept form. Given a function defined by y 5 f (x), to find the x-intercept(s), substitute 0 for ____________ and solve for x. n(x) 5 1x 2 1 a. • The vertical leg of the right triangle is y 0 y2 2 y1 0 or equivalently 0 y1 2 y2 0 . $3,105,000 SECTION 8.2 Practice Exercises Prerequisite Review R.1. Given f (x) 5 7x 2 9, evaluate f(2). 23 26 y 2 85. d(2) 5 36; Joe rides 36 mi in 2 hr. This tells us that the terms of the series form an arithmetic progression. 2 2x2y5 7y2 2 y 2 61. Find all points on the line y 5 x that are 6 units from (2, 4). 706 Sum of the first n terms of an arithmetic sequence (nth partial sum): n Sn 5 (a1 1 an) 2 where a1 is the first term of the sequence and an is the nth term of the sequence. Yes {(1, 4), (22)} 11. Domain: (2, `); Range: (2, 23) c. 2x 21. The graph of a linear function is a slanted line. Y2. There are two drawbacks to this method. (3, `) b. f(0) 5 5(0)2 1 12(0) 1 5 f(0) 5 5 f(0) 5 21 25 24 23 22 21 21 22 5 To find the x-intercept(s), find the real solutions to the equation. Yes f(x) is the greatest function value relative to other points on the function nearby. 16C3 5 560 b. The Binomial Theorem OBJECTIVES 1. 0 400 400 Calories 800 b. There is no real number x to which we add 1 that will equal 0 The same logic applies to other operations. 1 7 4 27 2 24 8 1, 11 111. Rewrite the series as an equivalent series with the new index of summation. A number less than 5 is rolled. hypothesis. One homeowner buys a house for $140,000 and finds that the value of the property increases by 3% per year thereafter. s(x) 5 0 x 1 3 0 83. (f + h + g)(8) 63. y 71. What is the probability that a player will win the grand prize by playing 1 ticket? (2, 0), (21, 0), and (24, 0) 5. • Expanding Your Skills Exercises challenge and broaden students' understanding of the material. The slopes are different. 80 20 Chapter 2 Cumulative Review Exercises, pp. {22}; The value of x is 24 and r 5 20. In this context, x represents the value of one coin. 25 24 23 22 21 21 22 y b. Tax x 5 2x 1 10 f f (x) 111, 24–27 1. Graph is stretched/shrunk vertically by a factor of a. 23x2 2 6xh 2 3h2 1 7 3 c. 2x 2 11. Normal BP Elevated BP Total Smokers 42 28 70 Nonsmokers 80 10 90 Total 122 38 160 94. In the expression (6x)0, the exponent 0 applies to a base of (6x). 2 1 1 2 2 Algebra for Calculus. 2 , 0. 271 2 1 1 0 2 3 4 5 x 5 4 3 2 1 1 18 The parabola opens downward. Each term has x raised to an even power. $68,000 57. Use the graph to find the solution set to the equation. Give an equation in one variable and the solution set. To illustrate the idea of symmetry with respect to the x-axis, the y-axis, or the origin. If replacing both x by 2x and y by 2y results in an equivalent equation, then the graph is symmetric to the origin. Preparation for algebra is comparable to an athlete preparing for a sporting event. The code has no restrictions. (3n 2 1)! 2!(3n 1 1)! c. 3 1 1 1 1 15. Given a sequence a1, a2, a3, ... , an, the arithmetic mean a is y 5 1 n a a1. The legs are 4 ft and 7 ft. Evaluate a (21)i if n is even. End of year 1 End of year 2 End of year 3 End of year 4 $P invested $P invested $P invested $P invested Value at the end of the 4th year P (interest compounded for 0 yr) P(1 1 r) (interest compounded for 2 yr) P(1 1 r)3 (interest compounded for 3 yr) The total amount A, also called the future value of the annuity, is given by A 5 P 1 P(1 1 r) 1 P(1 1 r)2 1 P(1 1 r)3 TIP In this section we study ordinary annuities. P(0) 5 2,000,000e20.1155t. Change in population over change in time 85. a (2 1 6) i51 i51 162 141 59. f(x) 5 x 2 f(x) 5 h. m 5 0.125 means that the amount of cholesterol increases at an average rate of 0.125 mg per calorie of hamburger. If he plays in a game in which he shoots 6 free throws, what is the probability that he will make all 6? Likewise (x 1 5)3 5 x3 1 3x2 1 5 1 (x) 21 x2 1 0 . f (x) 5 2x2 1 1 7. a(x 1 2(x 1 2) 5 2) 6, ... 2215, 215, 5F a. 2x 2 3 2 10 x 3 2 ... (x 1 1)(x 2 3)4 3 B 19 1 2 1 ... 211 2 1 3y 5 60 The probability of drawing a red card is 18 are black, and 2 are green. Job A 85. Then showing that any falling domino in the sequence will cause the next domino to fall is the idea behind part 2 in mathematical induction. (2x 2 5) 5 20. Ax 2 15B Ax 1 15B(x2 1 7) b. Suppose that 15 lightbulbs are in a cabinet and that 4 are defective. x 5 0 y 0 1 y2 67. Suppose further that 75% of the money is respent in the state and then respent over and over again, each time at a rate of 75%. A(57.8) 5 2.5 means that after 57.8 yr, the amount of 90Sr remaining is 2.5 μg. E3: The ball does not land on a red slot. {(3z, 22z 1 5, z) 0 z is any real number}. 2 2 5 0 129. Divide by 21 and reverse the inequality sign. a i51 4 i x 85. 2 1 8 1 32 1 128 1 ... 64. 4k , 4 ? The maximum value of f is k. x-intercept: (5, 0); y-intercept: (0, 2) 77. (2, 14) 14. 3k(k 2 3) k(k 2 1) k 1 99 d. P(x) 5 x 2 1 , that is, the calculator may graph points close to (28, 3) and (22, 3) but not exactly at (25, 3). 6 d 1 2 0 2 1 4 f 1 2 § 25 1 5. 1,000,000 times more intense e. 0, the graph of the equation is a circle with radius 5 1 5x. 360 in a. 1 x 47. What is the probability that it lands heads up twice in a row? 28. Mixed Exercises 44. These are approximately 3.3 ft to the left and right of the center. With respect to the origin. m) is a line parallel to the x-axis? 40 210 0 220 c. 4.162 75. 10 f(x) 5 2x 2 1 b 3 4 x 3 4 8 6 f (x) 5 x2 1 , x 2 1 x 1 3 1 3 19 x 3 8 3 4 3 2 . Use the probability that the multiple-choice questions each have five possible answers of which only one is correct. Write a formula for the nth term of a sequence that represents the sales person's total income for n units sold. y 5 f (x) 1. b 2 7 2 21. Caroline adopted a puppy named Dodger from an animal shelter in Chicago. 2 51 16 9 289 64 27. Completing the square results in an equation of the form (x 2 h)2 1 (y 2 k)2 5 c, where c is a constant. 2; 4; 6; 8; 10 b. (h4 2 1)12; middle term 39. Find the average rate of change in temperature between months 3 and 5 (March and May). y 5 f(x) y 5 f(x) 1 24 23 22 21 21 22 1 2 3 4 5 6 6 5 4 3 2 24 25 4 5 22 23 24 25 4 x y 115. Even 35. (23, 5), (23, 21) c. 76. 5 4 3 2 8 7 6 5 y 5 f(x) 25 24 23 22 21 21 22 23 24 25 y 5 x 13 22 21 1 1 2 5 5 5 0 x 2 1 0 5 7 2 22 1 2 3 4 5 6 7 8 9 x 25 24 23 22 21 21 22 23 24 25 Write the Terms of a Sequence a. logarithmic. y 5 1, 4, 9, 16, 225 ... b. Interpret the meaning of the y-intercept. 1. Type: Probability 01 0.374 2 0.066 1 0.357 2 0.063 B 1 0.085 B 2 0.015 A A AB 1 0.034 AB 2 0.006 75. a1 5 24, d 5 6 b. • The y-intercept is given by f (0). The graph of y 5 3f (x) is the graph of y 5 f (x) with a vertical stretch by a factor of 3. 23. 585 (screen): © Royalty-Free/Corbis; p. inconsistent 7. In how many ways can she arrange the musical selections? (3, 5) 111. x 5 7 91. {Tom Hanks, Jack Nicholson, Sean Penn, Dustin Hoffman} c. For example: Probabilities 2. Computing Empirical Probability The empirical probability of an event E is given by P(E) 5 EXAMPLE 5 Number of times the event E occurs Number of times the experiment is performed Computing an Empirical Probability Data from the Centers for Disease Control for a recent year indicate that there were approximately 4,295,000 individuals of age 20 in the United States. m 5 1 25. Suppose that an individual is paid $0.01 on day 1 and every day thereafter, the payment is doubled. 4 13 h. 7 5 5 Section 5.2 Practice Exercises, p. Domain: { } 99. (3, `) 23, (0, 3) (23, 0) 3 F 2 Section R.3 Geometric Sequences and Series T13 Skill Practice 1 Determine whether the sequence is geometric. (1, 1 c. g(22) b. (21, 3) 3 45. 2 6 5 4 3 23 24 25 1 y 102. There are approximately 3 144 turtles in the pond. 0, the parabola opens upward, and the vertex is the minimum point. Answer true or false. Now if u v, then either u , v or v , u. One such triangle is shown in the figure. $4991.25 1 25% To fully appreciate the connection $87,850 $177,850 $87,850 $17,891.25 1 28% $ 9 : Graph ... Along with several variables, we will $183,250 $398,350 $183,250 $4,663.25 1 33% investigate their relationships $398,350 $400,000 $116,586.25 1 35% algebraically, numerically, and $400,000 ________ $400,000 $116,163.75 1 39.6% graphically. If m is one-third of n, and p is two less than m, write p as a function of n. {(22 , 23)} ` (23, 0) 27. m(x) 5 2x2 2 2x 2 2. 2 4x 2 2 ... 0, 3) c. formula S 5 7. (See Example 4) 51. CD 46. 5 114 3 m2 12 11 10 3 2 55. Center: (1, 26) b. 24 (2x 2 6) 1 4 (x2) 6 1 9 x 2 249 2 12 15 or 3 12 5 2 2 2524 23 22 21 21 22 23 24 25 3 216.1 40.7 16.1 230 210 8 6 4 2 4 2 73. e 2 f 67. f(0) 5 (0)2 2 4 5 24 The y-intercept is (0, 24). a. b(x) p 121. Ellipse; Center: (21, 0); Vertices: (21, 4), (21, 24); Endpoints of minor axis: (22, 0), (0, 0); Foci: A21, 115 B, A21, 2115 B; Eccentricity: 115 4 6. 3 The distance between grid A(22, 3) 2 lines is 1 mi. Write a function that represents the distance d(t) (in miles) that the car travels in t hours. a. (k 1 2)(k 1 3) k51 To write a formula for the sequence {an} representing the number of letters after the nth cell division. x1 1 2x2 1 5x3 5 24 2(1) 1 5x3 5 24 S 5x3 5 220 S x3 5 24 27. 71. 3 x 1 4 x 3 2 ... 0 y 0 1 y 5 0 b. Answer ... Probability 22. 5 (Notice that we ...) 75. $ 7,276,000 Each multiple-choice question has four possible answers (one of which is correct). Write a function that represents the total cost C(x) (in $) for Exercises 77–88, answer the following question, a. Skill Practice 6 Let a, b, and c be real numbers. $3,000 Suppose that there are 12 contestants, in how many ways can the judge award the ribbons? In addition, a fee for the cabin cruiser is $100. Write a linear function that has a one-time coupon for $1.00 off. Suppose that function f gives the high temperature f(x) (in 8F) for day x. • Note the added restriction that x2 2 4 7 5 t 0 (t 1 5)(t 2 2) 5 1 5k 1 1 (inductive hypothesis). 22(2k) 5 (k 1 1) 2 3 $. 7. The x-intercepts of a quadratic function defined by f (x) 5 ax2 1 bx 1 c are the real solutions to the equation f(x) 5 0. $46,204.09 b. n4 49k2 12d8 c 3 1 p14 21. a , b 2 4 b. (2, 2) 2 4 b. f(x) 5 5 x2 1 0 Skill Practice 3 Use mathematical induction to prove that 2 is a factor of 5n 1 1. Write a function that represents the total cost... Write an equation that for all that line passes through the point (2, 25) and (24, 7). 197 p. 6.7 Section R.2 Practice Exercises, pp. (a 1 b)(a 1 b)(a 1 b)a(2 1 2ab 1 b)5 a3 1 2a2b 1 2ab2 1 ab2 1 b3 a3 1 3a2b 1 3ab2 1 b3 Similarly, to expand (a 1 b)4, we can multiply (a 1 b) by (a 1 b)3. Some mathematics enthusiasts have named the date March 14 (π < 3.14) as World Pi Day. 2504 ft 21. 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 x 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 f(x) 5 (x) 259 Analyzing Graphs of Functions and Piecewise-Defined Functions 1 2 3 4 5 x 23 24 25 24 25 Objective 5: Determine Relative Minima and Maxima of a Function For Exercises 97–102, identify the location and value of any relative maxima or minima of the function. Right semiellipse d. Each year thereafter, he would receive a raise of $2400. Odd 19. Rafael received an inheritance of $18,000. The first term in the form g(x) 5 a f (x) with a . 0. c. Probability 23 1 2 2 h. (x 5 3 2 5 z 2 14x 1 6 2 y 2 c 66. 2 19. Ay 22 B 2 5 2 5 z 214x 1 4 2 y 2 1 0 x 2 7 , Chapter 7 Review Exercises, pp. Absolute value inequality 3. Let Pn be the statement. $ y 2 20 c. x 1 2 5. Reflect the graph across the x-axis. 45 yd by 90 yd b. logb x 1 logb y 3. Optimized, Structured Learning Using adaptive artificial intelligence, ALEKS identifies precisely what each student knows and doesn't know, and prescribes an individualized learning plan tailored to their unique strengths and weaknesses: • • • • • Targets critical knowledge gaps Open-response environment Motivates student learning Presents only topics students are ready to learn Enhances learning with interactive resources Provides a structured learning path "I evaluated many different options, and ALEKS provided, by far, the best cycle of assessment and learning that allows for individualized instructional paths. Use the formula Sn 5 n2(a1 1 an) to show that the sum 1, 3, 5, ... (2n 2 1) is 5 n2. Steps for Graphing Multiple Transformations of Functions To graph a function requiring multiple transformations, use the following order. This relation is not a function because it fails the vertical line test. log a 3 b 63. 1 f (x) 5 2 24 2x 2x . 2 2 2 0 1 ... (x 1 1) 2 3 { 0 , 23}; [23, `); Equations and Inequalities for Calculus, p. Center: (4, 22); Radius: 9 11. State the definition of a circle. Suppose that the driver starts a trip with a full tank of gas and travels 450 mi on the highway at an average speed of 60 mph. Suppose that a person is given by k 4 1 2 ? Skill Practice 2 Graph the function defined by g(x) 5 0 x 1 2 0 2 1. Suppose that the average rate of change of a continuous function between any two points to the right of x 5 a is negative, and the average rate of change of the function between any two points to the left of x 5 a is positive. Depth of Retention Pond vs. Suppose that a sequence has a sum of terms with a variable expressed in the denominator, all equal to 1. {49} 19. Aw 3w 1 7 x y 2 3 4 5 45. $40,250.86 41. Explain why. CHAPTER 2 Review Exercises SECTION 2.1 For Exercises 1–2, a. y 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 y d. (1, 2) ... 2 (1, 3) 49. 6 4 0 5 29 26 2 6 2 7 23 6 3 10 3 23 12 6 ´ d 6 6 1 29. (p 2 n)(24) m c. What does A(1) 5 1 n(x 5 1) 2 mean? 60 mph 37. b64 5 2456, b81 5 2575, Find b105. Horizontal asymptote: y53 23. b. 25 b. Given a function for which the nth term is the average rate (x 5 5)(x 2 3) 15. For Exercises 49–54 find the formula ... No 43. 104. (2` , 1] h. (2x 1 34 12 Solution: The expression (2x 1 3)4 is in the form (a 1 b)4 with a 5 2x and b 5 3. 21 1 2 4 6(c 2 3) 5 3 3 61. 1 for n 5 5. Each suit consists of 13 cards labeled: Ace (A), 2, 3, 4, 5, 6, 7, 8, 9, 10, Jack (J), Queen (Q), and King (K). What is the total distance that the object will fall in 8 sec? The studio charges $60 for each private lesson, but has a variable cost for each lesson of $35 to pay the instructor. False 9. S(x) 5 e 2000 1 0.05(x 2 40,000) for x $ 40,000 a. 22, 3 6 i 5 3 27. If one number is selected, in how many ways can a person obtain 9. Then write the linear equation using function notation, where y 5 f(x). The common difference is d 5 24. 244 25 Skill Practice 8 Determine the domain and range for the functions shown. However, if i is used for the index of summation, do not confuse it with the imaginary number i 5 121. y 5 4 3 2 24 25 22 21 5 51. Minimum: 24 h. Then the number of distinguishable permutations of the elements of the set is n! r1! The x- and y-axes divide the coordinate plane into four regions called . 2 R.1. c2 2 8c 1 n R.2. x2 1 x 1 n r 3. Find the distance between (2, 3) and (23, 22). If replacing y by 2y in the equation results in an equivalent equation, then the graph is symmetric to the x-axis. Keeping this in mind, and I'll keep listening. 2690 e. 22 (multiplicity 2), 612 33. 5x 5 2 3(2x 1 5) 1 22 2 x 2 25 4 3 5 4 7 f(x) 5 x2 ... (2 2 5i)2 5 ... 4. Let g (x) 5 2x 2 3. Student Answer Appendix 63. a (2 2 5n) n51 30. We need to show that bx 2 5 ... Suppose that 4 batteries and 1 dead battery can be selected. This is the vertical line that passes through the vertex. 40,320 b. 690 A sequence in which consecutive terms alternate in sign is called an alternating sequence. We must show that 1 1 3 1 5 1 p 1 (2k 2 1) 1 [2(k 1 1) 2 1] 5 (k 1 1)2. Relative maximum g(21) 6 5 4 y 5 f(x) 25 24 23 22 21 21 22 1 2 3 Relative minimum g(211) 525 4 5 6 f(x) a. 13; Yes 31. For example: (0, 26), (1, 211), (22, 4) 4 71 37. e f 2 1 1 a. 6000 41 160 40 c. Circle; (x 1 1)2 1 (y 2 6)2 5 16 17. h(x) 5 x 1 5 5 3 83. Passes through (23, 9). and the slope is undefined. Rita needs to score between 77 and 100, inclusive. Then each group of 4 will represent a relationship that represents the number of minutes remaining r(x) as a function of the number of minutes used x. (f g)(0) c. h. 3 2(1)(4) 1 1(0) 3 0(4) 1 1(0) 3 0(24) 1 1(0) 3 1(24) 2114 223 216 0 1 1 3 23. Test scores vs. Not possible 27. 37. x 5 0 5y 0 61. Center: (22, 5); Radius: 18. Passes through (24, 9) and (21, 27). 23. For any x , 1 1 1 1 1 which is the same as 5 5 5 . The graph shows the number of students enrolled in public Number of Students Enrolled in Public Colleges 20 colleges for selected years. Source: U.S. National Center for Education Statistics, www.nces.ed.gov). Find the area of the region. Suppose that a coach chooses one group of six numbers, then the probability (likelihood) of winning the 1 . CHAPTER 6 3 4 5 x R.1. {16} R.2. $100 A B A Bx 1 C R.3. 1 R.4. 1 2 2 5 2t 2 3 7x x11 11. A tropical depression moved through at the beginning of the 15th day and produced rain at an average rate of 2.5 in./day for 5 days. Show that 2 1 6 1 p 1 4(k 1 1) 2 2 5 2(k 1 1)2. There are numerous variables that come into play. (x 2 4)2 2 4 y 5 25x 10 y 5 1 y 22 3 4 p(x) 5 5 2x 3 1 2 2 2 5 y 5 x 5 2f(x) 1 ; Shift the graph of f to the left 1 unit, x stretch the graph vertically by a factor of 2, and shift the graph downward by 2 units. Maximum: 23 h. y 5 6 3 3 50 yd. (3002, 2100) 39. 9 87. The y-intercept of the graph of f is (23, 2 2 4). The sample space has 38 outcomes. y 5 4 3 2 5 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 6 TECHNOLOGY CONNECTIONS Determine Relative Maxima and Minima Relative maxima and relative minima are difficult to find analytically and require techniques from calculus. a6 5 296 10. Neither even nor odd 81. y 5 f(x) y 5 f(x) 5 2x 3 x 5 1 25 22 2 4 1 2 3 4 5 x The graph of g(x) 5 f (x) is reflected across x y is reflected across the y-axis. $158.89 125. f (x) 5 20.4x3 2 1.1x2 1 2x 1 3 262 Chapter 2 Functions and Relations SECTION 2.8 Algebra of Functions and Function Composition OBJECTIVES 1. 21 c. an 5 0.01(2)n21 (dollars) b. (See Example 3) Determine the probabilities for the following events. 5(22z 1 16) 1 7(3z 2 5) 2 11z 5 45 ✓ 3(22z 1 16) 1 5(3z 2 5) 2 9z 5 23 ✓ (22z 1 16) 1 (3z 2 5) 2 z 5 11 53. 24 Skill Practice 1 Use translations to graph the given functions. Bike Week in Daytona Beach brings an estimated 500,000 people to the town. A2 5 c 27 8 18 36 d 10 22 26 22 220 $30 $225 28 π 15 2 22 25 3 81. y 23 2; 17 15 11 3 7 83. 283–284 1. 2 2 f. The equation does not affect the solution set of the system. The volume of the cone as a function of its radius is given by V1r2 5 πr2h. C(x) 5 0.40x 1 120 b. f (x) 5 2x2 1 4x 2 5 Determine the probability that the ... 0.16m 1 0.36 3n 27 e. Now the students will be selected to a committee and assigned different roles (president, vice president, and treasurer). 5 b. 3611 Therefore, (k 1 1)! . Suppose that one card is drawn from a standard deck of cards. The point (21, 1) is a closed dot to show that it is part of the function. Find the shortest distance from the origin to a point on the circle defined by x2 1 y2 2 6x 2 12y 1 41 5 0. If two events A and B are mutually exclusive, then P(A ´ B) 5 . no other program matches ALEKS." —Professor Eliza Gallagher, Clemson University, SC Learn More: Successmath.com x THE ALEKS Instructor Module includes intuitive customization and management features that can help reduce time and effort. Therefore, the equation is a D E hyperbola with center (2, 4) b. Therefore, n(E) 5 6 and n(E) 5 6 5 . t 1 (3 1 9); t 1 12 1 45 136. f(x) 5 2x2, which implies that a 5 b. How many chess matches will be played? (y 1 1)(2 y2 2 3) 2 ... y 2 1 2. The graph is a pair of intersecting lines. 4 9 y 5 32x 2 172 and y 5 232x 1 132 . Section 3.6 Practice Exercises, pp. 40. f (x) 5 x2 and g(x) 5 24 a. The axis and key features are the x- and y-intercepts of a graph. 60,000 50,000 Value (x) 6 5 4 3 SECTION 2.5 For Exercises 49–50, use graphing utility to evaluate the function. Use the graph to solve the... b. 1 1 1 4 7 1 1 1 1 1 ... Reasoning ... 29. Probability Reference Theoretical probability of an event: Let S represent a sample space with equally likely outcomes, and let E be a subset of S. Write A as a function of r. (g 2 h)(2) 11. (5 2 \ 2) 27 (1, 27) 28 Skill Practice 2 Find the slope of the line passing through the given points. 2x 1 4 $ 2x 1 92. an 5 3n 2 4 6. 4F 2 4 8 33. W c. 3 x 5 21 is on the interval 21 # x , 2. f (x) 5 2x 5 x 43 b. Yes 1 2 4 2 x 12 1 x 1 ... 1) Horizontal stretch (if 0 , a , 1) P. P 5 $200, n 5 12, r 5 5%, t 5 30 yr 86. 50 1 1 10 2 1 1 5 25 125 16. See (25, 0) 15. Use the result from part (a). (See Examples 1–2) 25. Vertex: (26, 22); Focus: (28, 22); Focal diameter: 8 49. rk! Note: The factors of r1!, r2!, ... in the denominator remove the repetition of arrangements that arise from the indistinguishable elements. u(x) 5 2(x 2 1)2 2 2 x 5 2 a. (2x 1 1) 2 (x 2 1) 5 ... 2x x 1 2x 2 x x a. 3 2; This is the region where the ... 5k12 51 1 5(5k) 5 5k 1 1 4 8 5 2 1 ... 4 and in which the repetition of units ... , p 45. The person is 60 or under. Let Pn be a statement involving the positive integer n. Identify Specific and General Terms of an Arithmetic Sequence For Exercises 91–94, use the sums a i5 2 42,925 and a i 5 1275 and the properties of summation given on page 697 to i51 i51 i51 50 For Exercises 91–94, evaluate. x Suppose that a person is selected at random... The numbers 10, 23, 25 and this is an integer. Instructor Notes to assist with Lecture Preparation ... 5 45. The person is 60 or under. Let Pn be a statement involving the positive integer n. Identify Specific and General Terms. A hospital deposits $9000 Coulter Counter at a rate of 75% per year after purchase. A2 1 13 B A2 4A2 1 13 B Ax2 1 13 B 63. Engaging. 12r 1 2 0 75. Theoretically, the total amount spent is $800 million. This is because the energy from the light is distributed across an area 4 times as great. a b(25) h 280 Chapter 2 Functions and Relations Test CHAPTER 2 1. N and F are not mutually exclusive (the events overlap). Expression; 35 1 12x 1 2x2 1 9 an each case, factor out x to the smallest exponent to which it appears in both terms. 8/M 32. 480 deer 29. 3k2 1 2 1 2 p 5 (2x 1 4.5)3 1 2 1.55. (2` , 0) 9 The values 2 and 18 do not e 6 , 22 f 2 check. a. b 0 3 b. a. a2 3 8d 2 5 5 p, 81 and 18 ... Each term will be greater than ... 9 2 1 r 2 , c m c. Mathematical induction is a two-part process to prove that a statement is true for all positive integers. Skill Practice 3 Suppose that two dice are rolled. In the Illinois state lottery game "Little Lotto," a player wins the grand prize by choosing the same group of five numbers 1 through 39 as is chosen by the computer. The bullseye 95 is 13.6 m 1 2 3 5 In the sequence. 102. Assume that all items fashionably match. a. a4 b 4 b. (26, 2), (3, 1), and (1, 2) Objective 3: Graph Equations by Plotting Points For Exercises 23–24, determine if the given points are solutions to the equation. 100 252 Chapter 2 Functions and Relations Intervals of Increasing, Decreasing, and Constant Behavior Suppose that I is an interval contained within the domain of a function f. f(x) y 5 f(x) (x1, f(x1)) m If f is defined on the interval [x1, x2], the slope of the secant line passing through (x1, f (x1)) and (x2, f(x2)). Write the function in vertex form: f (x) 5 a(x 2 h)2 1 k. c 20 d 2143 1 45. A C B 75. Determine Binomial Coefficients 1. Suppose that an object is dropped from rest from an airplane. y 5 23x 2 3 b. 3n 2 1 is divisible by 4. polynomial; 23 1 2 c. For Exercises 29–30, determine if the function is an equation of the function. a6 5 37. 23 19. Suppose that a geometric sequence consists of a finite number of terms in which each term is a real number, and the factor x is raised to an exponent that is a whole number. Given the relation, write it as an equation (b 5 2n 1 ... explain why the domain must be restricted to ... b. 23 3. 9.41 Find the 400th term. (2, 4) `(4, `) 85. The profit P(x) of producing and selling x items is defined by P(x) 5 . A 1 (2A) 5 c a3 2a3 2a4 a1 1 (2a1) a2 1 (2a2) d 5 5 c a3 1 (2a3) a4 1 (2a4) 5 5 1 5 5 5 87. AB, AC, AC, BC, CB b. (k 2 h)(1) c. y-axis 9. An equation of a circle written in the form x 1 y 1 Ax 1 By 1 C 5 0 is called the general form of the equation of a circle. y 76 5 4 3 2 1 7 6 5 4 3 2 1 sequence with a1 2 5 21 and a50 5 297, find a and d. Special thanks to the digital team, Rob Brieler and Victor Pareja, for keeping the digital train on the tracks. Write the first four rows of Pascal's triangle. 8 7 6 4 3 3 51 4x 2x 2. In the formula, A, c, and h are called variables and these represent values that vary. Undefined c. 0.5 0.5 5555 p 5 5 5 5 1 1 1 1 p 10 100 1000 10,000 sequence with a1 5 105 and r 5 101 0.05 5 Answers 8. For Exercises R.3–R.4, solve the inequality. 571–574 1 1 25 24 23 22 21 21 22 1 2 3 4 5 f(x) 5 x 2 ... n 2 1 6 1 3 1 11 21 4. Evaluate f (x) 5 5x2 2 3x 1 6 for each value of x. ... Write an equation ... (See Example 6) 21. Find the inverse of ... 5; Horizontal asymptote: y 5 2 3 3 y y 51. 28 y 8 7 6 5 4 3 2 (y 1 4) (x 1 2) 2 51 7 11 b. y 5 21 SA-21 Student Answer Appendix 11 21. £ 4 0 26 3 ... 58. Verify that the points A(0, 0), B(x, 0), and C(0, x) make up the vertices of an isosceles right triangle (an isosceles triangle has two sides of equal length). 21 21 22 23 C(24, 2) 4 2 11. 4 4. a. y TIP x In Example 5, we choose several convenient values of x such as 21, 0, 3, and 8 so that the radicand will be a perfect square. 3 4 y 5 g(x) 24 25 m(x) 5 2x 5 4 3 2 1 4 1 2 2 2 For Exercises 111–116, refer to the functions m, n, p, and q. The LDL level is 196 mg/dL and the total cholesterol is 266 mg/dL. x 0 2 7 x 8 b. Find the total vertical distance traveled by the ball (the ball travels up and down). If the horizontal change in temperature decreased to zero from ... is doubled (the ball traveled both ... y) Sketch the graph 2 1 2 ... 7 x231 1 2 31 13. Determine whether the graph of the function f is shifted or translated. b. (2` , `) 17. Let (x1, y1) 5 2 ... 2 5 ... Identify the vertex, equation of the axis of symmetry, and range. 6 6 4 x 10 ... 23 ... 21 22 ... 5 Write the equation of the circle in standard form ... 4. Passes through (2, 27) and m 5 3. SECTION 8.3 For Exercises 32–34, determine whether the sequence is geometric. 23) or in interval notation, [23, `). 2 real solutions 101. 3 6 x Section 1.7 Practice Exercises, pp. If so, identify the common difference d. 3 67. Write the nth term of the arithmetic sequence {an} with a1 5 219, and d 5 5. h(x) 5 x3 a. 18, 6, 2, ... 3 a2 6 1 5 1 c. a1 18 3 a3 2 1 5 5 , a2 6 3 2 a4 2 1 1 3 5 5 ? (See Examples 1–2) 7 cross 11. 476–482 3P m R.4 a. Answers may vary. a. (4i 1 3) i51 3. Assume that Pk is true; that is, assume that 2 is a factor of 7k 2 5. 4 5 x 23 on the interval x , 21. Section 8.4 Mathematical Induction 725 PROBLEM RECOGNITION EXERCISES Comparing Arithmetic and Geometric Sequences and Series For Exercises 1–10, determine if the nth term of the sequence defines an arithmetic sequence, a geometric sequence, or neither; # # y f. 5 x. Inspect the data if suggest a linear trend. {(22, 4)} 45 1. 11 4 x f y 5, (0, 210)} Skill Practice 6 Find the center and radius of the circle. f (x) 5 x3 4 (x) 5 ... Yes: The solution of the system is the point of intersection ... the graph passes through 72 4 ... y x 5 1 ... x 2 ... 2x ... 0 ... 3n For Exercises 49–56 for the nth term of a sequence whose first four terms are shown. Now let event A be the event that an ace is drawn, and let S be the event that a spade is drawn (Figure 8-13). An arithmetic sequence is a linear function whose domain is the set of natural numbers. 5 8 13 21 ... y 54. 18 y 5 7 x5 3 y-intercept: (0, 2) 23 ... Intercepts ... x-intercepts (e.g., 0.2, 2 ... g(x) 5 x3 1 5 Determine the graph of y 5 ... c. x 5 (3 2 x) 2 ... 2 1 ... 16 25 ... 3 36 ... Classify the equation as ... Linear equations in one variable; Linear equations in two variables; Quadratic equations; Systems of linear equations in three variables; Systems of linear equations in two variables; Systems of nonlinear Subject Index equations in two variables; specific types of equations absolute value, 135–136, 159 in applications, 84–85 of circle, 177–180, 275, 634 conditional, 85–86, 158, 159 dependent, 545 equivalent, 80 exponential, 452–456, 469 fifth-degree, 344 graphical solutions to, 204–207 graphs of, 169–173, 276 identities as, 85, 86 of inverse variation, 402, 407–409 literal, 88–90, 466–467 logarithmic, 457–462, 484 polynomial, 133, 159, 344 quadratic, 113–122, 158–159 in quadratic form, 130–131, 159 radical, 130–131, 159 rational, 123–125, 159 root of, 86, 169 solution set of, 84 solutions to, 80, 82, 86, 169 steps to solve, 83–84 use of graphing utility to check solutions of, 171–173 use of graphing utility to graph, 171–173 use of graphing utility to solve, 206–207 of vertical lines, 201 Equivalence property explanation of, 716 to solve exponential equations, 453 to solve logarithmic equations, 457 Equivalent equations, 82 Euler, Leonhard, 696 Even functions, 245–246 Events complementary, 753 explanation of, 750–751, 766–767 finding probability of, 751–754 mutually exclusive, 760 union of two, 755–757 Experiment, 750 Exponential equations in applications, 460–461 explanation of, 452–453 on graphing utility, 462 methods to solve, 453–456 in quadratic form, 456 Exponential expressions, equivalence property of, 429–430 Exponential form, solving logarithmic equations by using, 458–459 Exponential functions in applications, 421 base b, 415, 483 base e, 418 to compute interest, 418–420 decay, 416 explanation of, 414–415, 483, 416–417 graphs of, 414–418, 422, 433–434 growth, 416 inverse of, 424 Exponential growth/decay, 467–477 Exponential models, 474–475 Exponential notation, 8, 805 Exponents applying properties of, 20–21 explanation of, 8 integer, 22, 73 negative, 18–20, 55–56 rational, 27–29, 55–56, 74, 139 simplifying expressions with zero and negative, 18–20 Extended principle of mathematical induction, 729–730, 765 Extraneous solutions, 137 F Factorial notation, 693–694 Factors/factoring applications for, 47 binomials, 49, 52–53 expressions containing negative and rational exponents, 55–56 general strategy for, 53–54 greatest common, 47–48, 54 by grouping, 49 negative, 48 perfect square trinomials, 51–52, 115–116 polynomials, 47–58, 308 quadratic trinomials, 49–51 Factor theorem to build polynomials, 324 explanation of, 322, 392 to factor polynomials, 323 to identify factors of polynomials, 323 Feasible region, 549 Fermat, Pierre de, 730 Fermat's last theorem, 730 Ferrari, Ludovico, 344 Fibonacci (Leonardo de Pisa), 692 Fibonacci sequence, 692–693 Fifth-degree equations, 344 Finite arithmetic sequences, 705 Finite sequences, 686 Finite series, 695 First-degree equations, 80 Fixed cost, 214 Flying disk, 713, 754 Focal length, 628, 629, 630, 641, 645 Focus (foci) explanation of, 642 of ellipse, 642, 644, 645–647, 678 Fractions, 31, 32 Functions evaluation of, 225 explanation of, 190 geometric, 715–716 in graphing utility, 696 First-degree equations. ... 2 1 7. It is a power of the identity x 2 p. y 5 . The proof of Property 2 follows from the discriminant. In general, the quadratic discriminant is the nth ... identity numbers ... degree ... inequality ... 0 5 1 t. Therefore, Pk is true: 5 3 6 ... 14 ... 2. 20 x 2. These ... Write an equation in slope-intercept form for the line. ... c2 ... 2 ... Suppose that ... x 5 ... 3 2 1 1. SA-47 Student Answer Appendix By the inductive hypothesis, 1 C 7 Substitute 4 for x. 264 The difference quotient The composition of f and g, denoted f + g is defined by (f + g)(x) 5 f (g(x)). Decreasing 79. 2 109. A circle is the set of all points in a plane that are equidistant from a fixed point called the center. {5} 63. Not a function. A 141, 0B, A2141, 0B 4 3 2 1 4 3 2 1 5 4 3 2 1 ... P(E3) 5 n(S) 38 19 Credits Page C-1 ... 6. 5 4 Page 6 ... 2 21 ... 3 2 ... 2 ... 4 3 2 1 ... Using the rounded values from part (a), the screen is approximately 949 pixels by 632 pixels. {(4, 21)} 13. f 21(x) 5 x 2 2 x 20 7 x21 67. No. If x represents the measure of the smallest angle, then the equation ... Use the result ... Suppose that a sequence ... 2 ... 1 ... 5 ... 3 ... The first row has 18 seats, and each row that follows has three more seats than the row in front. (3x4 2 2)8; middle term 67. Over several weeks, management asks the driver to record the best possible route and record the time required to complete the route. 215 210 Section 7.3 Practice Exercises, pp. {16} 5 A { 5} b. a. 2 ... The value 24 does not check. (See Example 8) 66. Evaluate 10P3 and 10C3 and compare the results. If five DVDs are selected from the box without replacement, determine the probability that both are comedies. Skill Practice 6 Given the equation y 5 x2 2 4, a. y 5 x2 1 4 ... Complete the square within parentheses. Evaluate (n + d)(7) and interpret the meaning in context of the problem. rT The value of f (x) is 5 when x 5 21. ... 5.9 ... y 5 f (x) ... p 5 ... 3 b 5 4 ... 4 x 5 ... 3x 2 ... 2 ... intercept, evaluate f (0). f (6.3) For Exercises 100–101, use interval notation to write the interval(s) over which f is. a. conic 3. Discriminant is 296; no x-intercepts 71. x 5 1 h. The trainer must have more than 120 sessions with his clients for the business to make a profit. There are 2 green slots on the wheel. £ 212 213 8 224 4 41. Y1, Y2 for x , 2 Then display the table values for Y1 and Y2 for x values less than 15 Y1 and Y2 are equal. 2.01 75. 403 5 64,000 85. 0.0000261 b. 13 21. 3}. Therefore, to find P(A or K), we have TIP In Example 6(a), since A and K are not mutually exclusive, then P(A ´ K) 5 0. If the inequality is strict—that is, posed with . 0 or , 0—dash the line. d(n) 2 5 ... Graph of ... 5 x 2 ... 2 ... 3 y ... 25 24 ... 0.06 ... 1 2 ... 1 ... Test for symmetry with respect to the x-axis. (5) f (2) 1 ... 5x 2 9 ... 3 ... 2 ... ... Table ... represents the Equation 1. 5 a ax 1 bx 2 bx 2 4a 2a Obtain a common denominator and simplify. Answers vary 1. Skill Practice 11 Suppose that an employee contributes $100 to an annuity at the end of each of the next 25 yr. f(t) c. Average Monthly Temperature for Cedar Key, Florida Value of $5000 with Continuous Compounding at 5% y 100 Temperature (°F) (25, (7,452) 20,000 Value ($) y x (20, (20, 13,591) 16,000 12,000 (10, 8244) 8,000 4,000 0 0 5 10 15 20 Number of Years 30 5 (5x 2 1) ... x 2 ... 5x 2 1 ... 2 ... 24 ... Median household income ... Suppose that an individual wants to purchase ... 0.5 ... y 5 ... Yes 2 x 6 22. Center: (29 1 22); Radius: 3 and a 0.0 4.95 ... ; 7.5 3 2 ... Find ... x 2 ... (x1, y2) on a line ... 5 ... not a geometric sequence. No 25. Here we will give the basic premise and use a graphing utility to perform the calculations. The y-intercept is (0, 14,820) and means that the amount owed after the initial down payment is $14,820. For Exercises 15–32, determine if the function is a function of x. The antigens of the blood donor and recipient must be compatible. This user-friendly program enables instructors to search for questions by topic, format, or difficulty level; to edit existing questions, or to add new ones; and to scramble questions and answer keys for multiple versions of a single test. Left semiellipse 87. Directrix: y 5 252 ; Axis of symmetry: x 5 0 c. x(x 2 5 0 x 2 5) ... Arithmetic Sequences and Series Objective 1: Identify Specific and General Terms of an Arithmetic Sequence For Exercises 7–14, determine whether the sequence is arithmetic. Translations (Shifts) 3. y 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 27. For example: y 5 d(t) represents the distance that an object travels in time t. Find the average amount earned per year between the 5th year and the 10th year. If we assume that all elements in a sample space are equally likely to occur, then we define the theoretical probability of an event as follows. Reflection across the x-axis. (21, 0) 22 (x 1 2)2 1 (y 2 2)2 5 A 18B 2 (x 2 2)2 1 (y 1 2)2 5 (Standard form) 23 24 Figure 2-12 Skill Practice 2 Write the standard form of an equation of the circle with endpoints of a diameter (23, 3) and (21 25). P1 is true because (3y)1 5 y 5 y1. 21, , 2 4 f 2 67. Compute the result to part (a). (See Example 3) b. (x3 2 12x 1 40 for x 5 2 b. Graph the indicated function. Suppose that line L1 is tangent to the given circle at the point (4, 3) Since the y-intercept is a (0, 25) ... 5 ... 5 ... Round to the nearest whole number. ... Use a graphing utility to find a ... Find an equation of the line tangent to y 5 1x at the point A2, 12 B. Find the difference quotient. EXAMPLE 5 f (x 1 h) 2 f (x) . 168 Chapter 2 Functions and Relations EXAMPLE 2 Determining if Three Points Form the Vertices of a Right Triangle Determine if the points M(22, 23), P(4, 1), and Q(21, 27) form the vertices of a right triangle. solution R.4. 10 y 5 E 4 3 2 C 15. (x 2 10)(x 1 1) f. The right side is not factorable. (See Example 6) a. (22, 10) 49. (x 2 h) 5 ... 8. Vertices: (24, 10), (24, 26) c. 427 million d. For this reason, the two events are called independent events. 5 4 3 2 5 4 3 2 5 log3x 1 1 21 22 23 ... 48 1 ... 21 22 23 24 25 log3 25 log3 1 ... The total cost to ... The plot ... $ ... x 5 ... y ... 2 ... 4 ... x ... 1 ... 3 ... 8. 2219 b. The table lists four Olympic athletes and the number of Olympic medals won by the athlete. 0.158 31. {20} 1. c. c y 5 4 3 2 5 4 3 2 ... TIP Relative Minimum and Relative Maximum Values Note that relative maxima and minima are also called local maxima and minima. Alternatively, the number of first-, second-, and third-place ordered arrangements can be found by taking the number of permutations of 8 horses taken 3 at a time, 8P3. k(x) 5 x11 2 73. log3 (80 1 1) 5 log3 81 5 4 ✓ a. x 2 1 2x 2 1 4h ... 39. The graph of f(x) 5 ... shows the value of $8000 invested at 6% interest compounded continuously, x years after the money was originally invested. Each swing (one-way) of the pendulum makes an arc of 90% of the length of the previous swing. Domain: (2` , `); Range: (23, ` ) e. There are 4 kings in a standard deck of 52 cards. The first coin cannot be ... y 5 f (x) 5 ... x 5 ... 5 ... 4 and 4 is the solution. (2` , 1] ... Yes: (5 ... Objective 1: Prove a Statement Using Mathematical Induction For Exercises 3–16, use mathematical induction to prove that the statement is true for all positive integers n. 3 is a factor of ... 5 yr 67. We call each selection a combination of n elements taken r at a time and denote the number of combinations as nCr. Number of Combinations of n Elements Taken r at a Time The number of combinations of n elements taken r at a time is given by nCr 5 EXAMPLE 7 5 n! nPr , or equivalently, nCr 5 r! He borrowed $20,000 at 3% and $4000 at 5.5%. The point (23, 5), for example, is placed 3 units in the negative x direction (to the left) and 5 units in the positive y direction (upward). Use a recursive formula to find the cost in an for a subsequent year, if the ... 2 ... a = ... 1, then the graph of y 5 f (x) ... Is a ... c. Graph the data in a scatter plot. Never decreasing c. An experiment is a test with an uncertain outcome. (See Example 3) 28. y 28 27 f(x) 5 2 x 3 2 1 ... 7 ... 3 ... 25. Parent function: y 5 x2 1. 23x 5 12 2. Domain: (2` , `); Range: [24, `) 2 5 4 3 2 1 21 22 25 24 23 22 21 21 22 23 24 25 x 17. The domain of f is all real numbers. For Exercises 22–25, graph the equation. The set of x values in the relation is called the ____________ of the relation. x 5 20 y 0 55. (1, 26) m 5 23 68. y 5 4x 5 24 5 (x 2 3 4 ... 5 x 2 ... 3 2 3 0 ... SA-26 Student Answer Appendix 27. Parabola; (x 2 1)2 5 10(y 1 3) (y 2 1)2 5 ... The user who knows the code turns the dial to the right to the first number in the code, then to the left past the first number ... y 5 ... 2 ... likely to have the Rh factor [2, `) a. Center: (4, 23); Radius: 2 y 7 6 5 4 45. 20. y 5 f (x) 5 22x2 1 6x y 5 6x y 5 x 2 3 ... x 5 0 ... 7 4 ... 5 ... S. The perimeter of a rectangle ... 2 ... 1 ... Write d as a function of s. Odd 43. Yes (x 0 f (x)) 37. 1 real solution 105. g(23) d. (x 1 2)2 1 (y 2 1)2 5 32 f(x) 5 ... Use the model in part (a) to approximate the average height of 11-yr-old girls. 7 21 x1k11)21 or equivalently, (x(2x 2 1) 5 ... For Exercises 8–9, graph the function. {(8, 1), (5, 22)} 135 4 2 2 43. 4 26. Therefore, the upper and lower semicircles may not "hook up." Section 2.2 SECTION 2.2 181 Circles Practice Exercises Prerequisite Review For Exercises R.1–R.2, find the value of n so that the expression is a perfect square trinomial. Write an expression S1(x) that represents the area of the rectangle. {(2, 24)} 2. 2n 3 2 for n $ 7. E2: The ball lands on a red slot. $10 and $24 a. 0.00 d. A5 2 15B A5 1 15B a. a1 5 27 17 1 b. 13 14 15 1n 1 2 The series contains n terms whose terms are 1 1 1p1 for the nth term. Yes; (24)2 5 16 . Yes; 1 3 1 31 19 27 d c. f (x) 5 x2 and g(x) 5 x 1 7 93. J 5 C 2 1 b. (n + d)(7) 5 represents 28 7 the number of gallons of gasoline used in t hours. (See Example 6) f (x) 5 x3 2 4x g(x) 5 12x f (x) 5 2x 1 3 47. (2` , 1) b.

{1, 32} 3 115 2 3 111 2 216 3 2 1 1 1 2 1 10. Equation; e , 2 f 2 3 b. Determine the probability that a 20-yr-old will survive to age 21. Given A 5 £ 0 1 2 1 0 21 3 § , find A21. Time 0.10 f(x) (2.5, 0.095) 0.08 BAC (%) a. True 57. Using a1(1 2 r n) , the total amount invested for t years is given by the relationship Sn 5 12r P[1 2 (1 1 r)t] P[(1 1 r)t 2 1] P[1 2 (1 1 r)t] 5 or simply A 5 A5 2r r 1 2 (1 1 r) If deposits are made n times per year, then the interest rate per compounding period is nr , and the total number of times the money is compounded is nt. Simplify. f (t) e. 2! 3! This formula can be used to evaluate binomial expressions raised to noninteger exponents. Hash Content Licensing Specialist (Image): Carrie Burger Cover Image, Photo Image: Antonio Iacobelli/Getty Images Compositor: Aptara®, Inc. 2 1 1 23 y 3 4 5 6 7 x 23 24 25 37. The graph in Exercise 64 shows the number of students y enrolled in public colleges for selected years x, where x is the number of years since 1990. Prove that a c 5 cn. If this linear trend continues during Dodger's growth period, how long will it take Dodger to reach 90% of his expected full-grown weight of 70 lb? g(x) 5 • 1 for 22 # x , 0 x2 1 1 for x $ 0 For Exercises 13–17, solve the equation or inequality. For Exercises 83–86, determine the distance between the two given points in space. log8 a 3 2 b Ax 2 1 np x 29 (x 1 2)3 x6 3 61. g(x) 6 5 4 y 5 g(x) 3 2 1 26 25 24 23 22 21 21 22 23 24 25 26 1 2 3 4 5 6 x 254 Chapter 2 Functions and Relations Solution: Avoiding Mistakes Be sure to note that the value of a relative minimum or relative maximum is the y value of a function, not the x value. h(x) 5 (x 2 2) 3 72. Now we look at sequences defined recursively, using a recursive formula. 42x 6 2 3x21 10. Determine the break-even point. 2(k 1 1) as desired. That is, n(E) 5 5C2 5 10 The sample space S consists of all possible ways in which 2 people can be selected from 8 people without regard to order. Assume that 2 1 4 1 ... 1 2k 5 k(k 1 1) (inductive hypothesis). 2x 2 5 3 2 1 95. Nonvertical parallel lines have the same slope and different y-intercepts (Figure 2-20). __________. y 5 29 2 x2 y 5 2 29 2 x2 x 5 29 2 y2 x 5 2 29 2 y2 67. Number of Years Since Height (m) 1960, x y SECTION 2.6 68. e 3, 24, 2 f 5 Section 3.4 Practice Exercises, pp. Because 0 r 0 5 0 0.75 0 , 1, we have S5 a1 200 5 5 800. 30 lb 31. The maximum profit is $34,400. 10 210 Figure 2-10 EXAMPLE 7 distance between tick marks x-axis distance between tick marks y-axis Graphing Equations Using a Graphing Utility Use a graphing utility to graph y 5 0 x 0 2 15 and y 5 2x2 1 12 on the viewing window defined by [220, 20, 2] by [215, 15, 3]. One year later 3887 of these individuals had died and 4,291,113 had lived. Take the cube root of both sides. The domain of h is (2`, `). Expression; 4x2 2 12x 1 1 b. A0, 254 B 5 1 1 c. f A 18 B 5 23 93. 3 4x 2 5y # 20 2 c. (f 2 g)(3) 14. 20.014 b. {(2.017, 20.015)} 99. a1 5 80 and r 5 245 23. For Exercises 91–98, find two functions f and g such that h(x) 5 (f + g)(x). Real Numbers Use Inequality Symbols and Interval Notation Find the Union and Intersection of Sets Evaluate Absolute Value Expressions Use Absolute Value to Represent Distance Apply the Order of Operations Simplify Algebraic Expressions Write Algebraic Models The numbers used in day-to-day life such as those used to determine fuel consumption come from the set of real numbers, denoted by R. 1 f (x) 5 x 2 4 h(x) 5 1x 2 5 g(x) 5 x23 21. f)(24) 99. y 6 5 y 5 f(x) The graph of f has the following "strategic" points that define the shape of the function: (24, 22), (22, 4), and (2, 22). Write a piecewise-defined function to model the salesperson's total monthly salary S(x) (in $) as a function of the amount in sales x. y(20) 5 140.3 means that with 20,000 plants per acre, the yield will be 140.3 bushels per acre; y(30) 5 172 means that with 30,000 plants per acre, the yield will be 172 bushels per acre; y(60) 5 143.5 means that with 60,000 plants per acre, the yield will be 143.5 bushels per acre. (22, 2) a. 4.2 3 100 L a. {26} (2`, 26) ´ (26, `) e. 24.27 Cumulative Review Exercises 29. P(S) 5 13 52 . 1 4 12 7 12. E3: A white marble is selected. Graph A 7. (0, 15) y d. 1.6569; 1.9524; 1.9950; 1.9995 c. 0 which means that x fi 62. 24x 1 2 for x , 21 for 21 # x # 2 f (x) 5 • x2 5 for x . t(x) 5 • 21 for 22 # x , 0 1 for 0 # x , 2 21 for 23 , x # 21 68. 7 same as exponent on b The eighth term of (2x 1 y4)10 is a 10 b(2x)3(y4)7 5 120(8x3)(y28) 5 960x3y28. Guidelines to Find Domain of a Function To determine the implied domain of a function defined by y 5 f(x), Answers 8. f (x) 5 • x x for x . 10 2 21028 26 24 22 22 24 28 210 F 29. h(x) 5 (x 1 3)2 13. Then to perform the reflection across the y-axis, we replace x by 2x to get y 5 12x 1 2. Based on the speed of compression waves, scientists estimate the distances from the study areas to the epicenter of an earthquake to be 13 mi, 5 mi, and 10 mi, respectively. H1L a b(x) represents the average of the high and low temperatures 2 for day x. Graph n(x) 5 2x 1 1 for x . E2: The ball lands on a green slot. CHAPTER 2 130. k(x) 5 20 x 0 1 2 2 80. f (x) 5 x2 1 b. (3, 6) and (24, 21) 15. L 5 2 80 2 2x 80 2 2x 160 2 4x or y 5 b. 21x2 2 x1 2 2 1 1y2 2 y1 2 2 5 d 2(x 2 h)2 1 (y 2 k)2 5 r (x 2 h)2 1 (y 2 k)2 5 r2 Distance between (h, k) and (x, y) Squaring both sides of the equation results in the standard form of an equation of a circle. f (x) 5 x2 2 3 a. 4, 21 13 31 , , ,p 4 2 4 20. (f + g)(0) d. g(22) 5 2(22) 1 1 Substitute 22 for x. 216 d. p 5 9 b. f(x) 5 2x 2 5 x 14 d. 600 3 3 c. set real, numbers 0 a 2 b 0 or 0 b 2 a 0 (a 1 b) 1 c; (ab)c a. (6, `) 28. 2k for k $ 7. 121. Skill Practice 1 Determine whether the graph is symmetric with respect to the y-axis, x-axis, or origin. {(4, 23)} 23 57. AI3 5 £ 9 11 23 5 26 4 1 3§ £0 24 0 0 1 0 69. 141. Given functions f and g, explain how to determine the domain of (f + g)(x). sides of the statement are equal for n 5 1. Vertices: (10, 0), (210, 0) d. Find (d + r)(t) and interpret the meaning in the context of this problem. k(x) 5 x3 2 2 a. a1 5 5; an 5 1 an21 31. x2 1 y2 2 x 2 y 2 5 0 3 3 9 Mixed Exercises 55. 3 b 2y 4 ; y ? Let c represent a positive real number. 4.4% b. 228 55. The plural of maximum and minimum are maxima and minima. f (21) d. { }; The value 23 does not check. • The graph of y 5 f (x) 2 k is the graph of y 5 f (x) shifted k units downward. The sales tax for online purchases depends on the location of the business and customer. { }; The value 2 2. b 5 2a2 2 c2 t5 v0 6 2v 02 1 128 32 29. or 100 ft. x 1 14x 1 64x 1 96 57. 3x 1 4y 5 4 4y 5 23x 1 4 3 y52 x11 4 3 b. For example, the ordered pairs (3, 1) and (3, 24) do not make up a function. 2,610,000 c. 7 1 1 n(2n 1 1) n(n 1 1)(4n 1 5) 5 6 11. How many 3-digit numbers can a player choose? P(10) 5 341 means that in the year 2020, the U.S. population will be approximately 341 million if this trend continues. A21 5 £ y 7 6 y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 22 23 24 25 25 1 2 3 4 5 x 49. What is the probability that a given offspring will have yellow peas? Each year thereafter, she would receive a $3200 raise. The studio needs more than 60 private lessons per month to make a profit. {ln 5, ln 3} y y 17. 79. y 6 The graph of p (shown in blue) is the graph of f shifted to the right 3 units and downward 2 units. Minimum: 2 5 2 4 4 h. Discriminant is 57; two x-intercepts 69. h(x) 5 1 2x 1 1 95. {22, 24} 3. Passes through (24, 0) and m 5 . The sequence a11, a12, a13, a14, p can be written as a11, a11r , a11r2, a11r3, p or 55. 1117 2 Yes 21. We have: Check: Answers 10. (22, 1) y 72. Parabola; (y 2 5)2 5 2(x 1 2) 25 9 y 9. 5 4 3 2 2 3 4 5 25 24 23 22 21 21 22 23 24 25 24 25 22. Fundamental Principle of Counting If one event can occur in m different ways and a second event can occur in n different ways, then the number of ways that the two events can occur in sequence is m ? If A and B are mutually exclusive, then P(A ´ B) 5 P(A) 1 P(B). Day 10: $5.12; Day 20: $5242.88; Day 30: $5,368,709.12 c. 1 25 24 23 22 21 22 24 23 12 4.4 in. 0.24 87. Note: For any point (x, y) on the graph of y 5 f (x), the point 1 ax , y2 is on the graph of y 5 f (ax). y 5 g(x) 5 3 2 4 3 35. Given a number a 3 10n, log (a 3 10n) is between n and n 1 1, inclusive. 9.3 mCi c. Relation Is a Function Apply Function Notation Determine x- and y-Intercepts of a Function Defined by y 5 f(x) Determine Domain and Range of a Function Interpret a Function Graphically • The cost of mailing a package is related to the weight of a package. If replacing x by 2x in the equation results in an equivalent equation, then the graph is symmetric to the y-axis. 746–750 R.1. 362,880 R.2. 1 R.3. 42 R.4. 210 1. an 5 2n21 61. {3} c. 36 25 c. The value (n 2 r)! is (3 2 5)! 5 (22)!, which is undefined. y 5 4 3 2 1 2 3 4 5 1 x 25 24 23 22 21 21 22 23 2. y2 x2 2 51 9 16 23. 12 h. From Figure 8-8, it appears that the sum will be 1 whole unit. 22x2 2 4xh 2 2h2 1 7x 1 7h 2 3 c. Write the diameter d of the sphere as a function of the radius r. Determine the area enclosed by the equations. A21 5 c 45 3d 28 1 0 8 b. (2`, 1) ´ (3, `) 119. EXAMPLE 3 Writing an Equation of a Line Parallel to Another Line Write an equation of the line passing through the point (24, 1) and parallel to the line defined by x 1 4y 5 3. (2`, `) 11. 25a 1 10ab 1 b 6 d. q2 q q p 15. 2A 113 2 110B 2t 27. 3 13. This is consistent with the statement that the total resistance is always less than the resistance in any individual branch of the circuit. {2}; The value 26 does not check. {(25, 216), (3, 0)} 45 23 38. 2 16 b. Use Factorial Notation We now introduce factorial notation to denote the product of the first n positive integers. Similarly, we may refer to a y-intercept as the y-coordinate of a point of intersection that a graph makes with the y-axis. w 1 (23) 93. If Zippy had an "accident" in the house, what is the probability that it would happen on the expensive rug? Let r represent a positive real number. The data in Exercise 65 give the amount of cholesterol y for a hamburger with x calories. If two cards are drawn at random with replacement from a standard deck, what is the probability that both are kings? 18. 201 b. Use the first rule in the function: f (x) 5 2x 2 1. EXAMPLE 11 Finding Relative Maxima and Minima For the graph of y 5 g(x) shown, a. The equation cannot be written in the form ax 1 b 5 0. a 2 bi 5. y 49. 7 6 5 4 3 2 1 25 24 23 22 21 21 22 28 27 26 25 24 23 22 21 21 22 23 24 8 7 6 5 4 3 2 x y b. Center: (24, 7); Radius: 3 6. (1, 2) b. a25.1, 2 b 2 or 4. 24C5 5 42,504 b. 1 1 3 1 32 1 33 1 p 1 3n21 5 (3n 2 1) 2 1 1 1 1 n 1 1 1p1 n512a b 2 4 8 2 2 ... 14. a 35. (2`, 18) ) 18 1 33. y 5 x2 1 6x 1 1 2 18. i 14 5 i2 136 5 21 ? No 1 2 x SA-33 Student Answer Appendix 41. t21x2 5 x13 Domain: 12`, 232 ´ 123, 22 ´ 12, 32 ´ 13, `2 29. h(x) 5 f (g(x)) 5 (g(x))2 5 (x 2 3)2 EXAMPLE 11 Decomposing Two Functions Given h(x) 5 0 2x 2 5 0 , find two functions f and g such that h(x) 5 (f + g)(x). In Exercise 103 from Section 8.3, we learned that if a fair coin is flipped n times, the number of head/tail arrangements follows a geometric sequence. Identify Specific and General Terms of a Geometric Sequence The sequence 2, 4, 8, 16, 32, ... is not an arithmetic sequence because the difference between consecutive terms is not the same constant. True 97. Given a line defined by x 5 4, what is the slope of the line? Write the formula for the slope of a line between the two distinct points (x1, y1) and (x2, y2). A jack or a queen. 0 c. Y2 to the right of x 5 2. Ay 1 34 B 2 5 (x 2 3) 3 b.Vertex: A3, 24 B; Focus: A 134, 234 B; Focal diameter: 1 53. Not likely 87. (2`, 27) ´ (7, `) 45. 2 8 9. a8 5 33 33. (See Example 5) y 1 1 33. • Section 2.7 for investigating increasing, decreasing, and constant behavior of a function now presents open intervals. Find an equation of line L. E3: The ball does not land on a green slot. For positive integers n and k (k # n 1 1), the kth term of (a 1 b)n is given by a baubu. That is, n(S) 5 8C2 5 28 The probability that both positions will be filled by women is P(E) 5 n(E) 10 5 5C2 5 5 5 < 0.3571 n(S) C 28 14 8 2 Skill Practice 4 Suppose that a committee of three people is to be formed from a group of 8 men and 6 women. 1.86 3 1016 89. y 5 3x 2 1; f(x) 5 3x 2 1 or f(x2) 2 f(x1) x2 2 x1 x2 x1 ¢y y 2 2 y1 5 x2 2 x1 ¢x Determine the average rate of change of blood alcohol level Answer Secant line 0.06 (2, 0.09) (1, 0.06) 0.04 0.02 (8, 0.02) (0, 0) 1 2 3 4 5 Time (hr) 6 7 8 9 x 204 Chapter 2 Functions and Relations Solution: a. floor(22) f. The person is 31 or older. (8, 29) c. Center: (0, 1) {(1, 2), (1, 22), (21, 2), (21, 22)} 31. There were 600,000 organisms approximately 9 hr and 39 hr after the culture was started. To our colleague and friend Kimberly Alacan, we're so grateful for your creativity in preparing the chapter openers and the group activities. {(6, 28, 2)} {(1, 12, 17)} 29. (26C6) < 1.367 3 1011 c. Using the entries of the seventh row of Pascal's triangle as the coefficients, the expansion of (a 1 b)6 is: 1 1 1 5 2 3 4 10 1 3 6 1 4 10 1 5 1 1 6 15 20 15 6 1 (a 1 b)6 5 1a6 1 6a5b 1 15a4b2 1 20a3b3 1 15a2b4 1 6ab5 1 1b6 Skill Practice 1 Expand. h(0) a. Find the sum of the first 20 terms. 2 6 24 120 1 1 1 1 1 x11 x12 x13 x14 x15 For Exercises 87–88, rewrite each series as an equivalent series with the new index of summation. From Example 3, the discriminant of 2x2 1 4x 2 5 5 0 is (4)2 2 4(21)(25) 5 24 , 0. With decades of scientific research behind its creation, ALEKS offers the most advanced adaptive learning technology that is proven to increase student success in math. Suppose that an infinite series a1 1 a2 1 a3 1 1 an approaches a value L as n S `. Infinitely many solutions; The equations are dependent. Based on the data given, if a customer is selected at random, find the probability that Number of Customers vs. The person has elevated cholesterol or is 30 or under. a 1 2yb 2 For Exercises 65–67, find the indicated term of the binomial expansion. an TIP In some cases, we may define a sequence with a domain beginning at zero or some other whole number. The procedure to find the least-squares regression line is discussed in detail in a statistics course. In how many ways can the coach arrange the batting order if the men must bat consecutively and the women must bat consecutively? y 5 23x and y 5 223x 3 2 1 F 25 24 23 22 21 21 22 23 24 25 19. 0, 23, 213 [Z d. 11i 7. an 5 5A 15 B n21 n21 n11 9. The sequence has 11 terms. Use the model from part (a) to estimate the wind speed for a Barometric Pressure (mb) hurricane with a pressure of 900 mb. $66,438 c. Vertex: (4, 21); p 5 23; Focus: (1, 21); Focal diameter: 12 b. Let K be the event that a king is drawn: {K Let S be the event that a spade is drawn: ,K ,K ,K }. y 3 4 5 x 25 24 23 22 21 21 22 y 5 f21(x) 23 23 24 25 24 25 b. 36z 2 12 15z 1 5 87. (See Example 7) 94. Write a nonrecursive formula for the nth term of the arithmetic sequence {an} based on the given information. 1 29. y 4 3 2 1 2 3 4 5 6 x y 67. Center: (2, 0); Vertices: (2, 4), (2, 24); 3 F 2 Endpoints of minor axis: (21, 0), (5, 0); 1 C x Foci: A2, 17B, A2, 217B; 23 22 21 1 2 3 4 5 6 7 21 22 17 F 23 Eccentricity: 24 4 25 y 10. (2`, 2) ´ (2, `) b. 228 1. (See Example 6) 41. (x 2 2)2 1 (y 1 1)2 5 0; The graph is a single point: (2, 21). Is h(2x) 5 2h(x)? Determine the number of ways that the airline can select 4 people at random to place on a different flight. 5, 2 , , 2 , ... 3 9 27 13. 22.0842 f. 1 is the lower limit of summation. 6 3 2 1 25 24 23 22 21 21 1 2 3 4 5 x y 5 x2 2 2x 22 23 11. 2x 1 y 5 1 (standard form) Write the equation in standard form by collecting the x and y terms on one side of the equation. x2 1 y2 2 4x 1 6y 2 12 5 0 b. 25 2 1 2 12 i51 [Hint: Rewrite the expression within the summation so that the base of 2 appears to the (i 2 1) power.] ` 1 n21 71. f(x) 5 x2 5 d. 22 f. (x 2 4)2 1 (y 2 1)2 5 16 y c. Find the sum of his yearly salaries over a 20-yr period. 9 39. in the first second, 8 in. The range is (2`, 23]. And SmartBook delivers. 7.9 m a. Evaluate: h(2x) Evaluate: 2h(x) 2 h(2x) 5 2(2x) 1 (2x) 2h(x) 5 2(2x2 1 x) not the same 5 2x2 2 x 5 22x2 2 x Since h(2x) ? x1 5 128 vehicles per hour; x2 5 173 vehicles per hour b. {28, 3} 11. g(x) 5 x2 2 c. x 5 , x 5 23 2 43. g)(0) y 5 4 3 2 d. Section 8.4 Practice Exercises, pp. For example, if a y-intercept is (0, 2), then it may be stated simply as 2. (4x 2 5)2 (x2 2 9)3y2 6x(3x 1 1) 5 c. Horizontal asymptote: y 5 3 31. y-axis 93. 6 5 7 6 5 4 3 f(x) 5 ex 2 2 1 1 2 13 25 23 † 1 § 2 6 3 2 4. Shift 5 units to the left. (x 2 2)2 5 12(y 2 1) 2 65. After a service call by a plumber, the company follows up with a survey to rate the service and professionalism of the technician. ceil(22) Write About It 115. The second job offers $60,000 in the first year. 4 1 7 1 10 1 13 1 16 1 19 1 22 1 25 1 28 1 31 1 34 1 37 50. Show that 1 1 2 1 22 1 p 1 2k21 1 2(k11)21 5 2k11 2 1. If we use two different data points, we may get a different equation. (g + f)(24) 59. $17,097 1. y5 3 24 x11 To graph the line, first plot the y-intercept (0, 1). The difference between any term after the first and its predecessor in an arithmetic sequence is called the and is denoted by d. f (21.5) y a. 236 23. 3C 2 A 43. A > C 5 {x 0 x , 2} e. Explain why the sequence a1, a3, a5, ... is also geometric and determine the common ratio. The sum of two squares will equal zero only if each individual term is zero. P(E1) 5 n(S) 38 19 b. 1}; 12`, 26 4 ´ (1, `) b. The graph of y 5 x 1 2 is shown in Figure 2-6. Find the total earnings for job B over 20 yr. Solution: The graph of v(x) 5 2 12x 1 2 is the same as the graph of f (x) 5 1x, with three transformations in the following order. 2 1 b 2 3 53. When money is infused into the economy, a percentage of the money received by individuals or businesses is often respent over and over again. d SA-14 Student Answer Appendix 57. £ 5 3 22.3 d 6.5 25 27 12 b. e f ; t < 2.4925 e f 9 ln 6 log 128,100 2 3 ln 1020 f ; x < 2.3528 21. (y 2 3)2 x2 1 5 0; The graph is a single point: (0, 3). f (4). y 113. Domain: {23, 22, 21, 2, 3}; Range: {24, 23, 3, 4, 5} 89. Write a function based on the given parent function and transformations in the given order. SA-46 Student Answer Appendix 117. 22a7b3 4 8 25. 5 The input value for function m must not be 5. I think that applications and hands-on experience made math come alive for me, and I'd like to see math come alive for my students." Donna Gerken is a professor at Miami Dade College where she has taught developmental courses, honors classes, and upper-level mathematics classes for decades. x by the inductive hypothesis. The company will make money. x 5 8 y 5 29 z 5 32 25. 9. vii Graphing Calculator Coverage Material is presented throughout the book illustrating how a graphing utility can be used to view a concept in a graphical manner. an 5 5(2)n21 27. 5000 y 5 4 3 6 p(x) 5 x 2 2 9 2 1 x 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x 5 x 0 0 1000 c. 2x2 1 2x 1 4 1 2 x 2 3x 1 1 b. Apply Vertical and Horizontal A function defined by f (x) 5 mx 1 b is a linear function and its graph is a line in a rectangular coordinate system. y 5 x4 2 3 d. x; y 1 {4} 7. y 5 23 b. Apply Arithmetic Sequences and Series In Example 9, we use an arithmetic sequence and series in an application. Given an equilateral triangle with sides of length x, write a relationship that represents the perimeter P(x) as a function of x. • Find the y-intercept(s) by substituting 0 for x in the equation and solving for y. Solution: Let Pn denote the statement 1 1 3 1 5 1 7 1 p 1 (2n 2 1) 5 n2. S(x) 5 20.4x 1 109.6 The value S(x) represents the estimated systolic blood pressure for an adult of age x years. n(x) 5 12 2 x 35. 23.7797 b. C(x) 5 x b. A car has a 15-gal tank for gasoline and gets 30 mpg on a highway while driving 60 mph. Yes 53. {16} 4. Table 8-3 Sums of Powers Let n represent a positive integer. The graph of y 5 13 f (x) is the graph of y 5 f (x) with a (choose one: vertical stretch, vertical shrink, horizontal stretch, horizontal shrink). 15 ft/sec; 30 ft/sec; 2.7 ft/sec; and 1.4 ft/sec 53. 4 2(x2 1 2) (2t 1 5) (x 1 4) (x2 1 4)1/2 2(x 2 1)(x 1 1) 6(2x 2 1) 1 20. 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Events A and K have no elements in common (a single card cannot be both an ace and a king). Determine Whether a In the physical world, many quantities that are subject to change are related to other variables. 5 21. x 5 22 Increasing: (2`, 0) ´ (1, `); Decreasing: (0, 1); Never constant 0.1x 127. {0, 3, 4, 6, 8, 9, 12} b. n n Stirling's formula is n! < 12πn a b . f(x) 5 5x 2 15x 1 3 2 4 10 8 h. $92,408.18; The value of the annuity doubles. n(x) 5 103. Therefore, x2 1 4 . (3x 1 1)5 16. , 23, 12, 212 3 3 y h. 2730 243x5 2405x4y2 1 270x3y4 2 90x2y6 115xy8 2 y10 1 8C2 ? (y 1 2)2 5 28(x 1 6) b. The farmer should plant 900 acres of corn and 300 acres of soybeans. Write the diameter d of the cone as a function of the radius r. The value 5 is not defined within two of the expressions in the equation. The value n is called the upper of summation. Therefore, P(E1) 5 n(S) 10 5 b. A baseball player with a batting average of 0.291 has a probability of 0.291 of getting a hit for a given time at bat. —Julie Miller and Donna Gerken Applications Index Agriculture & Gardening Corn plants per acre for maximum yield, 398 Costs for farmer to run tractor, 426 Crop acreage and maximum profits, 556 Dimensions and area of corrals/chicken coops, 293, 297, 394 Dimensions and area of garden in yard, 297 Dimensions of garden based on area, 380 Dimensions of triangular portions of garden, 163 Fencing and pens enclosed by farmer, 132 Height of tree and age, 481 Length of garden from footage of fencing used, 155 Nursery's inventory and profits, 555 Plant fertilizer makeup, 515 Seeds selected from package, good versus defective, 749 Sunflower height, 16 Animals & Pets Animal's mass in relation to tidal volume, 413 Animal's mass in relation to weight of heart, 396 Deer population, 94, 101, 488 Dog's "accident" on rug probability, 763 Gestation and longevity for selected animals, 225, 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and average rate of change, 210 Wind pressure on wall, 398 Review of Prerequisites Chapter Outline R.1 Sets and the Real Number Line 2 R.2 Integer Exponents and Scientific Notation 18 R.3 Rational Exponents and Radicals 27 R.4 Polynomials and Multiplication of Radicals 38 Problem Recognition Exercises: Simplifying Algebraic Expressions 47 R.5 Factoring 47 R.6 Rational Expressions and More Operations on Radicals 59 Algebra for Calculus 72 A thletes know that in order to optimize their performance they need to pace themselves and be mindful of their target heart rate. Write the first five terms of a geometric sequence with a1 5 120, and r 5 23 . Positive: 0; Negative: 2 or 0 5 39. (a 2 b)(a2 1 ab 1 b2 2 1) 5. Round the slope to 3 decimal places and the y-intercept to 2 decimal places. an y 11 10 9 8 7 6 5 4 3 2 an 5 2 (32) 11 10 9 8 7 6 5 4 3 2 n21 ( ) 1 22 21 21 f(x) 5 2 (32) x21 ( ) 1 1 2 3 4 5 6 7 8 n 22 21 21 2 3 4 5 6 7 8 x Figure 8-6 Figure 8-5 EXAMPLE 4 1 Finding a Specified Term of a Geometric Sequence Find the fifth term of a geometric sequence {an} given that a1 5 15 and a2 5 29. log(a2 1 b2) 2 4 5 ln x 1 2 ln y 2 ln w 2 ln z 3 2 3 2 a6 2 c b 24. Minimum: 2 4 h. C(x) 5 16x b. Age (yr) 17 21 27 33 35 38 Systolic blood pressure (mmHg) 110 118 121 122 118 124 125 43 51 58 60 64 70 130 132 138 134 142 a. The expansion of (a 1 b)n is given by pp. h(x) 5 3 0 x 0 17. a3 1 3a2b 1 3ab2 1 b3 37. 54. 5 acx 2 a 2b 2 4ac 2 b2 bd 1 2a 4a f (x) 5 a(x 2 h) The vertex is a 2 1 k f (x) is now written in vertex form. Event E is as likely to happen as not to happen. 5 14a 1 30 5 2(7a 1 15) Therefore, 2 is a factor of 7k11 2 5 as desired. Show that 10a1, 10a2, 10a3, 10a4, p is a geometric sequence and find the common ratio r. x(2x 1 3) 5 629 b. d1 5 2, d2 5 2, d3 5 5, d4 5 5 b. e , 22 f 43. 5P5 11P3 37. 5 4 3 2 1 2 3 4 5 x 25 24 23 22 21 21 22 1 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 6 7 5 x 4. Given y 5 f (x), the domain of f is the set of real numbers x that when substituted into the function produce a real number. 26 5 35,152 b. 3, 9, 27, 81, ... 2 3 4 5 51. 123 mi Cassandra invested $8000 in the Treasury note and $12,000 in the bond. (f + g)(5) f b. 5 4 3 2 1 89. 140–144 R.1. (x 2 3)(3x 1 4)(3x 2 4) R.2. a ? 220.04t , where t is the number of months since the outbreak began. h(x) 5 19. This matches equation (1). Reflect the graph across the x-axis. What is the probability that this individual's blood can be used for a transfusion for a person with type B1 blood? 62i, 4 6 i b. 0 67. How much money is infused into the local economy during Bike Week? t(3.001) c. That is, a byte is a sequence of 8 binary digits. Solve for b. n(x) 5 12x 2 1 77. If the 6 numbers match the numbers in the drawing, then the player wins the grand prize. Prove that F1 1 F2 1 F3 1 ... 1 Fn 5 Fn12 2 1 for positive integers n. ,2 , ,2 , ... 5 5 5 15 31. If the population had 300,000,000 people at that time, estimate the probability of being killed in a motor vehicle crash. EXAMPLE 2 Translating a Graph Horizontally Graph the function defined by g(x) 5 (x 1 3)2. {(21, 4), (2, 3), (3, 4), (24, 5)} No two ordered pairs have the same x value but different y values. What type of symmetry does an even function have? In either case, f (u) fi f (v), and f is one-to-one. decreases 7. {(5, 10)} 10x 2 3 6. 24 33. Arithmetic; d 5 ln 2 Problem Recognition Exercises, p. 139. The Instructor's Solution Manual provides comprehensive, worked-out solutions to all exercises in the section exercises, review exercises, problem recognition exercises, chapter tests, and cumulative reviews. (4, 10) 13. e f 91. Expression; ; for x ? C1x2 5 e 7.99x 799 1 6.991x 2 1002 for 1 # x # 100 for x . (25, 21] 1 9 7. t2 1x2 s 28. z 5 2.4x 1 0.55y 35. {2} Linear inequality b. Domain: R or in interval notation: (2`, `). False 6. {(24, 3)} 17. 8 d. g(1) 5 3 e. y 5 2 29 x2 5 5 • If m1 and m2 represent the slopes of two nonvertical parallel lines, then m1 5 m2. Chapter 4 Test, pp. What does A2(x) 5 πx2 represent? Given an arithmetic sequence with first term a1 and common difference d, the nth term is represented by the formula or by the recursive formula an 5 for n $ 2. Shift the graph of f to the right 2.1 units, shrink the graph vertically by a factor of 13 , and shift the graph upward 7.9 units. The function g is the "inside" function and f is the "outside" function. 1, then the graph of y 5 af (x) is the graph of y 5 f (x) stretched vertically by a factor of a. Arithmetic Sequence An arithmetic sequence {an} is a sequence of the form a1, a1 1 d, a1 1 2d, a1 1 3d, a1 1 4d, p • The value a1 is the first term, and d is called the common difference of the sequence. i51 Objective 1: Write Terms of a Sequence from the nth Term For Exercises 7–14, the nth term of a sequence is given. 2 nonreal solutions 7. For two independent events A and B, P(A and B) 5 . Suppose that a box of DVDs contains 10 action movies and 5 comedies. 20,000 x Section 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions 251 Therefore, a piecewise-defined function for monthly income is I(x) 5 e 3000 3000 1 0.05(x 2 20,000) Alternatively, we can simplify to get 3000 for 0 I(x) 5 e 0.05x 1 2000 for x A graph of y 5 I(x) is shown in Figure 2-35. View data for individual students up to the multi-campus level. {25}; The value 25 does not check. 178 an 5 22n 1 8 vn11 2 vn 5 [v0 1 a(n 1 1)] 2 (v0 1 an) 5 v0 1 an 1 a 2 v0 2 an 5 a The difference between two consecutive terms is the constant a. It travels 60 mph for 1 min and then decelerates for 20 sec until it comes to rest. It falls 16 ft in the first second, 48 ft in the second second, 80 ft in the third second, and so on. Write an expression for the nth term of the sequence. 714 Chapter 8 Sequences, Series, Induction, and Probability In fact, a geometric sequence with r . 0.98 b. To graph a piecewise-defined function, graph each individual function on its domain. g(2) 37. (See Example 7) b. For example, for a recent year, a single person with taxable income of more than $36,250 but not more than $87,850 pays $4991.25 plus 25% of the amount over $36,250 in federal income tax. Write the first five rows of Pascal's triangle. e f 14. f(25) is not defined. Which blood type is most rare? { } 3 3. (22, 23) b. {(1, 1)} 5. Row 1 of matrix B is 2 times row 1 of matrix A. How many identification codes are possible if letters and digits may not be repeated? This may give the graph a jagged look (Figure 2-10). The axis of symmetry is the vertical line through the vertex: x 5 1. The value g(x) represents the number of years since the year 2010 based on the number of applicants to the freshman class, x. zero; undefined 1 25 24 23 22 21 21 22 y5 57. x 105. f (x) 5 e 25 24 23 22 21 21 22 23 5 4 3 2 y 5 r(x) 2 23 y 5 1 1 23 61. (228, 218] 2 12 9 6 1 2 4 6 8 10 k(x) 5 x 25 24 23 22 21 21 22 2 x x2 2 x 2 12 1 2 3 4 5 x 23 24 25 53. a , b 21. The first is for $1000 and the second is for $500. Expanding the series, there are n terms and each term is c. 2 73. Explain why the relation defined by 2x for x # 1 y5 e 3 for x $ 1 118. 15, 0.3, 0.33, 20.9, 212, 114 , 6, π6 a$5 17. (a 1 c) 1 (a 2 c) 5 2a 21028 26 24 22 22 24 26 28 210 15. Find the sum of the first 40 terms of the sequence. 3, 12, 48, 240, ... a. There are no restrictions on the letters or digits? It follows that P(E) 1 P(E) 5 1. 15 yr e. Every point (x, y) on the bird has a mirror image (x, 2y) below the x-axis. 3.5 3 105 b. Is m(2x) 5 m(x)? x $ 0 d. To visualize the composition of functions (f + g)(x) 5 f (g(x)), consider Figure 2-41. Therefore, the number of permutations of 4 distinct letters is given by 4 ? g(x) 5 y c. 5 h 5 24x 2 2h 1 4 266 Chapter 2 Functions and Relations Given f (x) 5 2x2 2 5x 1 2, Skill Practice 5 a. [4, 9] 90. 39. TIP The slope-intercept form of a line can also be used to write an equation of a line if a point on the line and the slope are known. Evaluate S(15) and interpret the meaning in the context of this problem. 22 d. Expanded Chapter Summary available at . 13x 2 2y 5 11 5x 1 3y 5 6 40. E 5 J 2 150 9. The variables Xmin, Xmax, and Xscl relate to [220, 20, 2]. This is called the binomial theorem. 70 mph 65. e 23, 2 f 91. 2 1 2 x24 x 1x14 x 12 x 13 4 23 4 25 2x 2 5 1 1 41. a , 24 12b a. x2 2 8x 1 16 R.3. 1. e , 215 f e 4 2 2 {0}; The value 23 does not check. { } 3 9 4 1 110 4 2 110 d ´ c , `b a2`, 2 2 {9}; The value 23 does not check. Investigate Increasing, Decreasing, and Constant Behavior of a Function The graph in Figure 2-36 approximates the altitude of an airplane, f(t), at a time t minutes after takeoff. z1y2 5 2y 2 4 3 m(x) 5 1 x, n(x) 5 x 1 1, h(x) 5 4x, k(x) 5 x2 Chapter 2 Review Exercises, pp. Let (x, y) be any other point on the line. i c. Day number Water level (in.) 1 2 3 4 5 54.0 53.2 52.4 51.6 50.8 Section 8.2 703 Arithmetic Sequences and Series a. 7k 2 5 5 7 ? Days after Adoption Weight (lb) 40 30 (0, 11) 20 (40, 22) 10 0 0 10 20 30 40 Number of Days 50 60 a. Section 3.7 Practice Exercises, pp. Then the rate of new cases dropped more rapidly between months 4 and 6 (perhaps as health department officials managed the outbreak). f 21(x) 5 10x19 2 7 95. Any real number. 260 Chapter 2 Functions and Relations Mixed Exercises For Exercises 105–110, produce a rule for the function whose graph is shown. Solution: We must find the number of ways that 3 horses can be selected from 8 horses in a prescribed order (first, second, third). finite 5. (x 2 5)2 1 (y 1 5)2 5 25 y b. The speed v(L) (in m/sec) of an ocean wave in deep water is approximated by v1L2 5 1.22L, where L (in meters) is the wavelength of the wave. Solve this system using either the substitution or addition method. x 5 21 2 29 2 (y 2 2)2 x 5 21 1 29 2 (y 2 2)2 y 5 2 2 29 2 (x 1 1)2 y 5 2 1 29 2 (x 1 1)2 68. Center: (0, 0) a55 c. a78 5 2783 11. f(x) 5 x 2 10x 1 9 b. (1, `) 28 27 2625 24 23 22 21 21 22 23 c. Two Variables Determine the Slope of a Line Apply the Slope-Intercept Form of a Line Compute Average Rate of Change Solve Equations and Inequalities Graphically 60,000 bachelor's degree y 5 1261x 1 33,296 40,000 y 5 642x 1 22,128 20,000 high school degree 0 0 5 10 15 20 Number of Years Since 1990 25 Figure 2-15 The graph in Figure 2-15 is called a scatter plot. 1 x 2 2 2 y y x x 2 51 43. impossible; certain 5. 2 x2 1 x 1 6 12 23. Multiplying both sides of the equation (xy)k 5 xkyk by (xy) gives (xy)k(xy) 5 xkyk(xy). In this situation, the students will serve indistinguishable roles on the committee. 3x 2 y 5 6 53. Graph y 5 2f (x). (y 2 120) x 2 51 b. f (x) 5 0 x 0 and g(x) 5 24 2 7. V(x) 5 240x2 1 240x b. Given f (x) 5 22x2 1 7x 2 3, find 1 b. m 5 f (b) 2 f (a) b2a y52 1 2 3 4 45. y 5 4 3 2 2 45 40 1 1 2 3 4 5 x 23 24 25 34. (g + f)(0) y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x e. 3(x 1 3) 2x 2 22 3600x2 2. 6 69. $750,000 b. m 5 3 3 4 1 1 25 24 23 22 21 21 22 2 y 5 4 3 2 5 4 3 2 1 5 4 3 5y 1 1 5 11 2 1 5 63. 1x 2 2 ? ? 3 15. The average rate of change between P and Q is the slope of the secant line and is given by: m5 5 f (x 1 h) 2 f (x) (x 1 h) 2 x f (x 1 h) 2 f (x) (Difference quotient) h The expression on the right is called the difference quotient and is very important for the foundation of calculus. The distance d(t) (in ft) that the car travels t seconds after the brakes are applied is given by d(t) 5 24.84t2 1 88t, where 0 # t # 9.09. xn21. 7 13 P(A ´ K) 5 P(A) 1 P(K) There are 4 aces in the deck out of 52 cards. 1 2 3 4 5 6 7 8 y 9 25 24 23 22 21 21 5 4 1 2 3 4 5 3 2 1 x 22 23 24 26 25 24 23 22 21 21 1 2 3 4 x 22 23 25 y 25. 0 g g(x) f The domains of the functions f 1 g, f 2 g, f ? Is the point (3, 5) on the circle defined by (x 2 3)2 1 (y 2 5)2 5 36? Find the x-intercept(s). a 1 b 63. Objective 4: Find the Probability of Sequential Independent Events 67. 30 23 22 21 230 260 290 2120 1 2 3 4 5 6 7 x 2150 2180 2210 2240 2270 f(x) 5 x5 2 8x4 1 13x3 13. { } 59. n For Exercises 17–20, the nth term of a sequence is given. Values of a between 0 and 1 stretch the graph horizontally away from the y-axis. Gerken, Donna. a Answers 1. Using the endpoint (21, 0) as (x1, y1) and the center (1, 2) as (x2, y2), apply the distance formula. The number of letters is decreased by one for each letter in the sequence. No a. y 5 x 1 3.01 Section 2.5 SECTION 2.5 Applications of Linear Equations and Modeling 213 Applications of Linear Equations and Modeling OBJECTIVES 1. B ´ C f. This is equivalent to saying that b is greater than a (written symbolically as b . 9, 22, 213, 224, ... 13. 633: Nick M Do/Getty RF; p. y 25 24 23 22 21 21 22 3 4 1 x 23 85. Finding the Midpoint of a Line Segment Find the midpoint of the line segment with endpoints (4.2, 24) and (22.8, 3). • The function has a relative minimum of f (b). 26 1 121 , 0b 3 26 2 121 , 0b or approximately 3 (20.47, 0) and (23.53, 0). 2, , 2 , 3, ... t t t 18. 8418 28. (0, 3) y 9 8 7 6 c. 1s ? The angles are 328 and 588. ln c d 2 1x 2yz 67. Section 8.2 Practice Exercises, pp. Recall that 0! 5 1. Division by zero is undefined. I2A 5 c 5 c 278 5.1 15 d ✓ 8 1 0 278 dc 0 1 5.1 278 5.1 15 d ✓ 8 1A278 B 1 0(5.1) 15 d 5 c 0A27 B 1 1(5.1) 8 8 278(02 1 15(1) d 5.1(0) 1 8(1) 1A 15 B 1 0(8) 0A 15B 1 1(8) c 3.1 65. f 21 represents the conversion from x feet to f 21(x) miles. y 3 x 24 25 9 8 1 2 4 5 y 3 2 1 1 2 3 5 4 25 24 23 22 21 21 25 24 23 22 21 21 x y 5 4 3 2 7 6 5 4 7 1 25 24 23 22 21 22 22 y 25 24 23 22 21 21 22 5 6 10 8 6 4 7 6 35. a2 , b 2 2 5 15 b. x 5 4, y 5 10 c. f (0) 3 4 e. One of the goals of this text is to identify families of equations and the characteristics of their graphs. A number less than 1 is rolled. log4 C 2 pAq 1 4B D 65. That is, count 13 spades plus the 3 aces that are not spades. $30,740 $29,150 b. Graph iv f(x) f(x) 59. y y If a plant with two yellow genes (YY) is crossed with a plant with two green genes (yy), the Y Yy Yy Parent 1 result is four hybrid offspring with genotypes Yy. The offspring will be yellow, but will carry Y Yy Yy the recessive green gene. In this case, the order in which the students are selected matters. h(a) 5 5 8 1 Za 2 2Z 1 116 2 t 1 3 1 t25 1 5 1 x23 2 195 196 Chapter 2 Functions and Relations 107. 4833 25. 26 c. Chapter test. There are two scholarships available. 3 dead batteries can be selected. x 24 25 26 24 25 , , , , x x x x #1 #2 #3 # 3.5 2000 for 0 # x , 40,000 87. a12 5 4096 81 3 39. To Laurie Janssen and David Hash, many thanks for a beautiful design, and to Carrie Burger for the beautiful photos and art. 12! n(n 2 1)(n 2 2) 3 p n(n 2 1)x2 1 x 1 , for 0 x 0 , 1. (2, 23) 3. True 103. {29, 2} 41. 2 1 19. 27. Write a linear revenue function that represents the revenue R(x) for selling x items. 5C5 11C3 45. 98 39. Between 26 and 25; 25.4949 e. y 101. S(8000) 5 1380; The salesperson will make $1380 if $8000 in merchandise is sold for the week. • If c 5 0, then the graph will be a single point, (h, k). 131: © Gaja Snover/Alamy Images RF; p. 3.1536 3 1011 gal 2 3 104 songs 97. an 5 n 3 4. An introduction to modeling is presented here in Chapter R along with the standard order of operations used to carry out these calculations. 25 7. Find the frequency for C one octave below middle C. Answer 9. g(0) d. 4 hr 35. 30 5 38 19 38 38 3 1 33 11 29. Composition of Functions The composition of f and g, denoted f + g is defined by (f + g)(x) 5 f (g(x)). Create Linear Functions to Model Data 4. Solve the equation 3x 2 (x 1 4) 2 1 5 0 and verify the solution graphically on a graphing utility. One weakness of the point-plotting method is that it may be slow to execute by pencil and paper. e a , , b f 157 157 471 2 2 2 3y 2 z 1 6 , y, zb ` y and z are any real numbers f or 45. Determine the probability of each event. 675–680 R.1. 5 22 R.2. y 5 3 R.3. x 5 2 1. (x 2 1) 5 16(y 2 2) (y 1 3)2 (y 2 3)2 (x 2 4)2 (x 2 4)2 1 51 24. {22} 4 4 55. EXAMPLE 1 Writing an Equation of a Line Given a Point on the Line and the Slope Use the point-slope formula to find an equation of the line passing through the point (2, 23) and having slope 24. e a , 2 b f 61 61 31 24 22 4 3 g(x) 5 ln(x 1 4) 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 2 3 4 5 x 24 y b. Use the points (0, 166) and (40, 650) to write a linear function that defines the height y of the volcano, x years since 1960. (2`, `) i. 0.52, 0.68, 0.84, 1.00, ... 5. 562i, 626 3. Whether f is even, odd, or neither. The population of a city was 320,000 in the year 2000. Yes 33. y 5 7x1 1 10x2 1 24 b. 3069 51. y 0 0x0 x 5 5 5 5 0x0 2 1 0x0 2 1 1 1 or x 5 21 To find the x-intercept(s), substitute 0 for y and solve for x. Even 5. (0, 8) and (12, 18) if 0 , x # 8925 if 8925 , x # 36,250 if 36,250 , x # 87,850 if 0 , x # 8925 if 8925 , x # 36,250 if 36,250 , x # 87,850 10 10 23 23 0.44 for 0 0.61 for 1 85. Given f (x) 5 1x 1 3, a. The x-coordinate of the midpoint is the average of the x-coordinates from the endpoints. A sled accelerates down a hill and then slows down after it reaches a flat portion of ground. 3 109. P1 is true because 2 is a factor of (5)1 2 3 5 2. 4 1 9 1 14 1 p 1 (5n 2 1) 5 (5n 1 3) 2 ... 8. 268 Chapter 2 Functions and Relations EXAMPLE 9 Composing Functions and Determining Domain x 6 and m1x2 5 2 , find 1k + m2 1x2 and write the domain in x22 x 21 interval notation. After two half-lives, the amount of substance has been halved, twice. (Source: U.S. Census Bureau, www.census.gov) 3. False 27. The student answered "Yes" or "No." b. f (x) 5 0.4x2 2 3x 2 2.2 134. 2x 2 2 5 2x 2 5 b. Notice that the graphs of both equations appear. Cherise has a job that pays $48,000 the first year. We call each arrangement a permutation of n elements taken r at a time and denote the number of such permutations as nPr. Number of Permutations of n Elements Taken r at a Time The number of permutations of n elements taken r at a time is given by r factors n! , or equivalently, nPr 5 n(n 2 1)(n 2 2) p (n 2 r 1 1) nPr 5 (n 2 r)! Note: nPr counts the number of permutations of n items taken r at a time under the assumption that no item can be selected more than once, and that each of the n items is distinguishable. (See Example 5) a. The statement that Pk is true is called the hypothesis. Foci: A0, 2 12 B, A0, 22 12 B g. Skill Practice 6 Refer to the graph in Example 6. 3.8% compounded continuously for 30 yr results in more interest. Solve Equations and Inequalities Graphically In many settings, the use of technology can provide a numerical and visual interpretation of an algebraic problem. The number N(t) of new cases of a flu outbreak for a 2 given city is given by N1t2 5 5000 ? Yes 25 19. Shift the graph to the left 2 units. Use i as the index of summation. An 3. c 1 23 4 3 4 5 23 d 1 c 2 21 22 0 0 3 23 21 23 d 21 2 d 1 1 3 5 d ; This matrix 21 24 22 represents the reflection of the triangle across the x-axis. Writing the expression 5 bM2N in y b x logarithmic form, we have logb a b 5 M 2 N, or equivalently, y x logb a b 5 logb x 2 logb y as desired. A visual representation of the data can be helpful in determining the type of equation or function that best models the data. Skill Practice 2 Write the first five terms of the sequence defined by: c1 5 5, cn 5 3cn21 2 4 Answer 2. Marilee needs to score at least 96 on the final exam. y 5 f(x) b. The expression 0 4 1 a 0 is a real number for all real numbers a. 39 59. Write an equation of the line passing through the points (8, 23) and (22, 1). Undefined 25 89. Admission to the fair is $5.00. x 2 10 1x 1 1 1 26 93. a 7 7 17. R.2. {x 0 x , 8} R.3. {x 0 22.4 # x , 5.8} 9 R.4. e x ` x $ 2 f 2 Concept Connections 1. Effective. Directrix: x 5 2 Axis of symmetry: y 5 3 c. n14 , find b45. r(x) 5 (x 2 4)2 3 22. Use this information for Exercises 81–82. x(x 1 2) 5 120 b. 127. A . S1 5 45,000 1 2250x b. n 5. Graph the equation by plotting points. a c 5 cn i51 n n 2. 2x 1 1 , 2x 1 4 Y1 5 2x 1 1 22 c. y 5 24x 2 10 24 6 1 12 square units 59. Apply the distributive property. Reference SECTION 2.2 Circles The standard form of an equation of a circle with radius r and center (h, k) is (x 2 h)2 1 (y 2 k)2 5 r2. 23 131. y 2 0 x 0 5 2 38. A number greater than 10 is rolled. For example, the equation y 5 x2 2 defines y as a function of x. x2 1 11x 2 34 A2y 2 1B 3y4 A9 2 x2 B 1y2 2. Find all points on the line y 5 2x that are 4 units from (24, 6). Once he reaches $40,000 in total sales, he earns an additional 5% commission on the amount in sales over $40,000. The maximum value is 23. (23, 0) and (3, 0) d. 4 x 23 24 25 99. 94: © Design Pics/Raven Regan RF; p. 770–772 1. n a15n 2. 5 2 13. In Example 5, we use the general formula for the nth term of an arithmetic sequence to find the number of terms in an arithmetic sequence. Evaluate a (ai 2 a)2. 23x 1 1 # 2x 2 3 1 2 3 4 5 x 25 24 23 22 21 21 22 23 y Y1 5 4x 2 2 (1, 2) 1 23 24 25 2 3 4 5 23 22 21 21 22 x 1 2 3 4 5 6 x 7 Y2 5 23x 1 1 23 24 25 26 27 Y2 5 23x 1 5 24 25 Y2 5 2x 1 1 94. y 5 26x 2 52; 6x 1 y 5 252 5. a(x) 5 1x 1 9 b. [2, `) 7 67. To verify, we can write several terms of the sum. 2 C F 21421221028 26 24 22 22 24 26 28 F 2 4 6 5 4 3 2 C 1 18. If the number of reported cases increases by roughly 30% each week thereafter, find the number of cases 10 weeks after the initial report. 277–281 3 3. 1 5 2 27 y 3 4 x 7 6 5 4 26 5 4 3 2 2 5 y 27 26 25 24 23 22 21 21 25 24 23 22 21 21 22 87. The cards consist of four aces. Section 8.4 SECTION 8.4 Mathematical Induction 731 Practice Exercises Prerequisite Review For Exercises R.1–R.4, factor completely. Each multiple-choice question has 4 possible responses of which exactly one is correct. Upward c. 227 81. Write a function that represents the total cost T(a) for a dollars spent on tickets. 141 c. 2 e. { } 22. 2 4x2 b. The cost and revenue functions C and R are shown for producing and selling x items. e 2 6 f 49. Find the probability that all three children will be boys. 2.7 3 1028 7. x 5 22, x 5 2 e. f(t) 29,000 Altitude (ft) y 5 f(t) t (min) 20 40 60 80 100 120 140 160 Figure 2-36 Notice that the plane's altitude increases up to the first 40 min of the flight. g(x) 5 3x2 1 c. Let P be an arbitrary point (x, f (x)) on the function f. an 5 1n 1 3 3ln n 12. (2`, 21) ´ (21, `) 3 (x) 5 4 2 9x 43. If one person is chosen at random, find the probability of the given event. Therefore, the term x is not first degree and the equation is not a first-degree equation. x 5 4 3 2 1 25 24 23 22 21 21 22 y 22. Shift 1 unit to the left. For example: 2 y5 x25 3 y5x14 y 5 2x (or y 5 2x 1 0) y56 (or y 5 0x 1 6) 2 3 m51 m52 m50 m5 y-intercept: (0, 25) y-intercept: (0, 4) y-intercept: (0, 0) y-intercept: (0, 6) If the slope and y-intercept of a line are known, we can graph the line. For example, in the last row of Figure 8-9, we have 1, 1 1 4 5 5, 4 1 6 5 10, 6 1 4 5 10, 4 1 1 5 5, and 1 EXAMPLE 1 Expand. Shift upward 2.1 units. f (x) 5 3x2 2 4x 1 9 119. 1 25a2 1 10ab3 1 b6 b. 0 for x . {(21, 4), (2, 3), (3, 4), (24, 5)} Solution: TIP A function may not have the same x value paired with different y values. A sales person makes a base salary of $400 per week plus 12% commission on sales. Write an equation representing line L. 28 9. a A5 1 12iB i51 31. a0, 2 b 2 7 6 5 8 10 3 x 2 2 5 x 22 x 21 1 6 4 2 1 x 8 10 10 8 6 85. It probably seems more reasonable that someone would select two different DVDs from the box. Therefore, every other term is obtained by multiplying by r 2. [24, 7.8] 113. 22 23 25 24 23 22 21 21 22 1 2 3 4 5 3 4 5 x 1 5 6 7 8 91. Round to the nearest pixel. Job

1 for 5 yr: $352,000; Job 2 for 5 yr: $350,000 b. 207 276 Chapter 2 Functions and Relations If f is defined on the interval [x1, x2], then the average rate of change of f on the interval [x1, x2] is the slope of the secant line containing (x1, f (x1)) and (x2, f (x2)) and is given by m5 p. For Exercises 45–50, write an equation of the line that satisfies the given conditions. C(x), or equivalently P(x) . Printer: R. 3 f (x) 5 2x 1 1 g(x) 5 x2 h(x) 5 2x 83. Average rate of change 5 f(x2) 2 f(x1) f(1) 2 f(0) 06 2 0 5 5 x2 2 x1 120 1 5 0.06 f(x2) 2 f(x1) f(2) 2 f(1) 0.09 2 0.06 5 5 x2 2 x1 221 1 5 0.03 c. Given the sequence defined by bn 5 n3 2 3n2, find the fourth partial sum. Section 8.5 Practice Exercises, pp. We also know that the outcome of the first event (heads up) does not affect the outcome of the second event (also heads up). 57). Airlines often oversell seats on an airplane. The tick marks on the axes are 1 unit apart. CHAPTER 8 For Exercises 100–103, refer to the sample space for a card drawn from a standard deck. Number of Absences (x) Average in Class (y) Answers 8. Round to the nearest tenth of a year. x 5 quadratic 3. Y b. Suppose that player A is located at (36, 315) and player B is located at (410, 53). In this case, the slope can be interpreted as the following two ratios: Move down 3 units. 23, 2 , , 3; each of multiplicity 1 2 2 37. Never increasing. g. (f 1 g)(3) b. {(21, 0, 4)} R.1. b. 5x 2 9y 5 6 b. y f(x) 75. Therefore, we might suspect that the function is neither even nor odd. c , 2b 5 (22 21 3. b. {23} 95. Graph 7 79. (2`, `) g. If the employee invests $500 per month in the annuity at 5% interest, find the value of the annuity after 36 yr. 141: © Julie Miller, p. 5! (3 7 EXAMPLE 10 Identifying Characteristics of a Function Use the function f pictured to answer the questions. Technology Connections For Exercises 128–131, use a graphing utility to graph the piecewise-defined function. 0 A 0 44. log[12 p 2 log(12 p 13. How many triangles can be formed from three of the six points on the circle? 7 y 65. 753 Empirical probability is computed based on observed outcomes of the relative frequency of an event to the number of times an experiment is performed. (y 2 2)2 x2 1 5 1. 22 No solution; No solution. Graph a Quadratic Function Written in Vertex Form 1. Write 0.5 as a fraction. 2 15 19. n 20. These exercises provide students with an opportunity to synthesize multiple concepts and decide which problem-solving technique to apply in a given situation. Number of Attendees by Week 80 60 Number 47. After making a down payment of $2000, the remaining cost of the car including tax and interest is $14,820. 198 Chapter 2 Functions and Relations In Example 1, we demonstrate that the graph of a linear equation Ax 1 By 5 C is a line. Write an equation of the circle with center (3, 21) and radius 4. Graph Equations Using a Graphing Utility Answers 6. Qr 2 f (r23) 5 g(23) 2 f (23) (g 2 f)(23) is undefined. 12 73. See also Binomials; Factors/ factoring; Monomials; Trinomials addition of, 39 complex, 321–322 degree of, 38 depressed, 330 division of, 316–320, 392 explanation of, 38 factor theorem and, 322–324 geometric applications of, 42 Subject Index on graphing utility, 310, 340 multiplication of, 39–40 prime, 55 quadratic, 344 reduced, 330 remainder theorem and, 320–322 special case products of, 40–42 subtraction of, 39 zeros of, 321–324, 329–340, 393 Population growth model, 469–470 Power functions, 301–302 Power property of logarithms, 444, 445 Powers, 8 Prime polynomials, 55 Principal square root, 8 Principle of mathematical induction, 726, 765 Probability empirical, 754, 757 of event, 751–754 explanation of, 750 review of, 766–767 of sequential independent events, 758–759, 767 theoretical, 750–757, 767 of union of two events, 755–757 Problem-solving strategies, 94 Product property of logarithms, 445 of radicals, 30–32 Products inner, 591 special case, 40–41, 43, 74, 109 Projectile motion, 286, 291 Proof by contradiction, 730 Proper rational expressions, 523 Property of equivalent fractions, 62 Proportions, 99 Pythagorean theorem, 127, 167 Q Quadrants, 166 Quadratic equations. 2,000,000 c. a ban2(k21)bk21 k21 a. 1 2 Chapter R Review of Prerequisites SECTION R.1 Sets and the Real Number Line OBJECTIVES 1. Yes. e. In how many ways can the questions on the test be answered? True 5. Y 47. Arithmetic; d 5 2 3 5 Geometric; r 5 21 4. Use the Distance and Midpoint Formulas 5. (k3 2 11)); middle term 3¢. Why do the probabilities from parts (a) and (b) not add up to 1? Y2 for x . Is the point (2, 7) on the circle defined by (x 2 2)2 1 (y 2 7)2 5 4? Julie Miller Daytona State College Digital contributions from Donna Gerken Miami-Dade College Kendall COLLEGE ALGEBRA, SECOND EDITION Published by McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121. The domain of a(x) is [1, `). a1 5 6 d 5 9 27 19. (f(x) 2) 5 18,900 85. 3 1 2 x 5 6, y 5 3, z 5 8 31. {(4, 7)} 45. What does a negative rate of change mean? 3 # 22x 1 1 , 7 For Exercises 18–20, perform the indicated operations and simplify. 22x 5 3y 59. 125 1. a b 2 80. Write About It 105. Center: a , 2 b; Radius: 2 4 7 17. b. f. Suppose y 5 2b2 or y 5 . 2 d 24 24 d ; This matrix represents the reflection of the 2 21 0 4 triangle across the y-axis. Write a piecewise-defined function that expresses the cost C(x) (in $) to buy x shirts. 67. Write the radius r as a function of the diameter d. An employee identification code for a hospital consists of 2 letters from the set {A, B, C, D} followed by 4 digits. 7 a. a. 2ln (23, 17) 4 a. 10, 230, 90, 2270, ... 100 a (4i 2 2) 5 2200 1 4 a i51 i51 17. 2 is a factor of 7 a 2 3. 0),   y 1 27 26 25 24 23 22 21 21 22 Vertex 23 (22, 23) 24 f(x) 5 2x2 2 4x 2 7 1 7f b2 4ac 5 0, the graph of y 5 f (x) has one x-intercept. Explain how you can determine from a linear equation Ax 1 By 5 C (A and B not both zero) whether the line passes through the origin. Determine the interval(s) over which f is increasing. In for n $ 7. How many 4-letter arrangements are possible assuming that the letters may not be repeated? Skill Practice 3 Fill in the blank. Find the 20th term. a . 6b 71. Two fire observation platforms are located at points A and B. 9 The solution set is {2 . do f 2g 9 107. • The second rule for f (x) 5 23 is a horizontal line for x $ 1. 754 767 Review Exercises Two events are mutually exclusive if they share no common elements. A ´ C 5 {x 0 x , 11} d. Answers 2. 2x3 1 15x2 1 37x 1 30 79. $26,997.18 b. $9568 and $3135 53. A2111, 2313B and A111, 2513B 35. The probability of rolling a sum of 7 is 16 . EXAMPLE 5 Finding the nth Term of a Sequence Find the nth term of a sequence whose first four terms are given. x 2 5 23. 5 1 5 Term3 2 6 3 1 1 1 1 1 3 Call this statement P3. For example, use the mean nCr function found in the under PRB. (undefined) Skill Practice 2 Use the definitions in Example 2 to find a. (r 2 p)(x) 20. Neither 1 1 65. A21 5 c 23. 1 1 $ 2x 2 2 1 8. f(x 1 h) 56. Find the difference quotient, f (x 1 h) 2 f (x) . Suppose that {a1, a2, a3, . . .} is an arithmetic sequence with common difference d. Instead the measures of the angles would be even integers. 3 (n 2 m)(26) b. Objectives 2–3: Count Permutations and Combinations 25. y 5 4 3 2 1 24 23 22 21 21 22 23 24 x 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 {23} 39. f(a) b. f(x) 5 2x 1 9 f(x) 5 2x 1 4. 9 5 y 5 f(x) 3 f(x) 5 2x2 1 0x 1 0 or y 5 f(x) 10 23. Find the expression that defines f (x). e.2 24 Practice Exercises Prerequisite Review R.1. Solve the equation using the square root property. R.1. 2 17 R.5. 1 Suppose that a phone card has 400 min. a(b) 45. 15 21 0. © Justin Lewis/Getty RF; p. To write h as a composition of two functions, we have h(x) 5 (f 1 g)(x) 5 f (g(x)). 112. f (x) 5 3x3 2 5x2 1 12x 2 20 37. EXAMPLE 3 Writing an Equation of a Circle in Standard Form Write the standard form of the circle. y 47. 8 63. 1a ? e 67. 27} 31. Evaluate f (21), f (1), and f (2). {(1, 3), (1, 23), (21, 3), (21, 23)} (y 2 30)(x 2 40). Minimum value: 22 6 5 i. on [22, 0] 87. 98. 7! b. The cards are four of a kind (four cards with the same face value). Find the Value of an Annuity In Section 4.2, we studied applications of exponential functions involving compound interest. Minimum degree 3 b. Identify Specific and General Terms of an Arithmetic Sequence 2. g(x) 5 2x2 1 2 a. 558–560 1. Yes 27. 41 5 { d2 5 , d3 5 5 , d4 5 5 5 5 b. 1 2 x x15 2x (x 1 5)2 x 19 Ax 1 B Cx 1 D A Bx 1 C 15. (0, `) c . (27, 3) c. i d. (x 1 1)(x 2 4)(2 1 5x) 2 x 1 51 5 9 101 29 17 13 , d2 5 , d3 5 , d4 5 b. f(x) 5 x2 5 x , < 84466 0 0.2 2 5 ln 3 f ; x 5 21.6286 e 2 ln 5 2 4 ln 7 f ; x < 20.7093 31. , 3 , 1 6 2i (each with multiplicity 1) 2 5 7 f. Use the graph and the average rates of change found in parts (a) and (b) to discuss the pattern of the number of new cases. 6(x 1 5). Find the number of permutations of 7 numbers taken 5 at a time. 14 a. 14b 11. (x 2 3) A retired couple has $200,000 in a savings account, and alcohol rehabilitation program performs outreach for members of the community. 46. f (x) 5 3x 2 2 5 2 x Cholesterol Total 30 and under 14 4 18 31–60 5 22 28 61–70 12 4 16 Normal Cholesterol Elevated Cholesterol Total 30 and under 14 4 18 31–60 5 23 28 61–70 20 102 Total 88 112 200 59. y 5 x f(x) TIP Touch the function in Example 7 has a gap at x 5 21, and therefore, we say that f is discontinuous at 21. 2x2 1 3x 2 20 4 2 2 4 29. The sum of the numbers showing on the dice is not 7. a. 80, b B B B B SA-11 Student Answer Appendix 109. 10,112 51. e 4 6 i, f 3 4 b. p f (y3 1 2z2)14]; tenth term 35. Solution: Enter the equations using the Y5 editor. n(E3) 0 5 5 0. 5 2 t 4. x15 5. y y 5 4 3 2 1 25 24 23 22 21 22 23 24 25 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 y 5 4 3 2 1 1 2 3 4 5 x A relation can also be defined by a figure showing a "mapping" between x and y, or by an equation in x and y. If a relation has two y-intercepts, then it would fail the vertical line test and the relation would not define y as a function of x. Column matrix 212 3 27. EXAMPLE 1 Graphing Linear Equations Graph the line represented by each equation. A 5C 5 25 b. Infinite geometric series 5 4 3 f 2 1 ft 1 2 ft Time Determine the total vertical distance traveled by the ball. y 5 x 2 4 Student Solutions Manual includes comprehensive worked-out solutions to odd-numbered exercises. 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 y 5 4 3 2 1 1 2 3 4 5 x B. Skill Practice 2 Use the definition of an arithmetic sequence to write the first four terms. 7 c. 1 4! c. 1 1 6 . 5 25 5 2 5 (x b. 4x f. 13 1 1 4 21 25 3 5 f. 34 3 1 1 24 18 6 3 5 21 5 1 2 3 4 5 6 1 1 4 3 2 1 1 1 1 1 1 2 3 4 5 Chapter 8 Sequences, Series, Induction, and Probability 7 f x 25 22 2 3 2 b. 1 2 3 4 5 6 4 3 2 1 3 7 e. 17 2 2 1 4 2 35. $2.50 0. A 3 4 6 9 12 1 1 1 4 1 0 6 0 0 4 1 6 0 0 0 1 1 4 4 9 2 1 9 1 , 6 f 4 5 6 7 8 9 3 d. 0 1 2 3 4 5 6 0 0 1 2 3 4 5 6 0 ... 2 5 1 4 x(x 2 4) 5 0 (27, 0) 25. 90. 2x 2 3y 5 6 b. 1 2 2 4 6 , 4x 1 4y 5 8 2. The point (3, 0) 2 (2) 6 (23) 5 . Z 2 3z 2 2 25 24 23 22 21 21 22 23 24 25 y 5 4 3 2 1 1 2 3 4 5 x 1 2 3 ; x 5 3 1 2 21. f(x2) f(x1) 5 5. x2 2 x1 4 2 1 1 3 The average rate of change on [1, 4] is 1/3.

In ... 3 TIP Factor out the GCF to simplify. Skill Practice 7 Solve 5x 2 3 $ 3. Graph f(x) 5 2x3 1 4x. (x 2 2)(x2 1 2x 1 4) 23 1 2 0 5 2. The time required for a home to sell is related to the price of the home. 2 4 1 2 3 4 ... Neither 5. Find the distance between the points (4, 2) and (1, 26). The endpoints of the diameter are the points (2, 3) and (26, 5). Suppose that P(x) 5 x2 1 6x 2 7 and Q(x) 5 x 1 1. Evaluate (f ∘ g)(2). 6 23 $ 5.60 0. Write the domain in interval notation. 22 11 b. 3 1 5 n. Find the fourth term. 21. x 5 1 1 ln 7 3 23. ...

For Exercises 11–14, use the given functions to find the indicated values. f (x) 5 x2 1 2 and g(x) 5 3x 2 1 f (g(2)) 5 f (5) 5 27 g(f(2)) 5 g(6) 5 17 Evaluate. c. {23, 21, 1, 3} 57. {21} 59. a. 2, 4, 8, 16, 32; 62 b. Geometric; r 5 2 Solve 4x 1 5 5 13 for x. 8 CHAPTER 8 Sequences, Series, Induction, and Probability 1.3 Linear Equations and Rational Equations 89 Solve the equation. 2x 2 5 5 7 x 5 6 Subject Index A Absolute value, 5 Absolute value equations, 127–130 Absolute value functions, 230 Absolute value inequalities, 139–141 Addition of complex numbers, 119 of functions, 266 of matrices, 626–628 of polynomials, 39 of radicals, 32–33 of rational expressions, 62–64 Addition property of equality, 90 of inequality, 96 Additive identity, 14 Additive inverse, 14 Algebraic expressions, 15 Annuities, 722–724 Arithmetic sequences, 694–700 Arithmetic series, 697–700 Associative properties, 14 Asymptotes horizontal, 370–374 oblique (slant), 374–376 vertical, 366–370 Augmented matrices, 604–606 Average rate of change, 253–255 Axis of symmetry, 286

In an ordered pair, the first coordinate is called the x-coordinate and the second is called the y-coordinate. y 90. The total cost is $4 f2. b. 20! f(1) 5 m(1) ? The graph of f is the graph of y 5 |x| shifted to the right 1 unit, stretched vertically by a factor of 2, and shifted up 3 units. x 5 3 ; x 5 23 b. The variable cost per item is the rate at which cost increases for each additional unit produced. bn 5 2n3 1 5 10. b. k 5 972 25. F1 F2 1 ... Comparing the results in parts (a) and (b), what does a positive rate of change mean in the context of this problem? Write a formula for the nth term of the sequence. 20. Find the 13th term. 2 C 4 R 3 x. Nonlinear c. Is the product of two odd functions even, odd, or neither?

A. x 5 2 ln 3 b. Write the equation 2x 1 3y 5 9 in slope-intercept form. a 4 6 2 1 7 1 1 3 SECTION 8.4 For Exercises 53–56, use mathematical induction to prove the given statement for all positive integers n. 1 1 3 1 5 1 ... 1 (2n 2 1) 5 n2 Prove that 2n $ n 1 1 for all positive integers n. b. h(x) 5 x2 2 4 2x2 1 1 c. A theater has 30 seats in the first row and 2 more seats in each subsequent row. How many seats are in the 20th row? 68 seats 11. x2 y2 1 5 1 16 9 42. The domain of f is (2`, `). The range is [22, `). 12. Find the sum 1 1 2 1 3 1 ... 1 100. 5050 d. 1 2 1 2 1 2 ... Determine whether the function is even, odd, or neither. f(x) 5 x3 2 x Odd. Suppose that a person deposits $100 per month into an account earning 4% interest compounded monthly. 0 0.08 12 5 100 1a1 1 12 b 12(10) 2 1b < $14,724.98

A coin is tossed three times. Find the probability that exactly two heads come up. 3/8 ... P(A or B) 5 P(A) 1 P(B) 2 P(A and B). There are 52 cards in a standard deck. 13 of the cards are hearts. What is the probability of drawing a heart or a king? 16 4 52 5 13 ... Use the Binomial Theorem to expand (x 1 2)4. x4 1 8x3 1 24x2 1 32x 1 16 ... The fifth row of Pascal's triangle is 1 4 6 4 1. 8.6 Principles of Counting 8.7 Introduction to Probability ...

Chapter 2 Functions and Relations The slope of a line passing through two distinct points (x1, y1) and (x2, y2) is given by m 5 (y2 2 y1)/(x2 2 x1) provided that x2 2 x1 ≠ 0. Vertical line x 5 a Horizontal line y 5 b Slope-intercept form y 5 mx 1 b Point-slope form y 2 y1 5 m(x 2 x1) Standard form Ax 1 By 5 C Parallel lines have the same slope. Perpendicular lines have slopes that are opposite reciprocals. 2.3 Functions and Relations 2.4 Linear Equations in Two Variables and Linear Functions 2.5 Applications of Linear Equations and Modeling 2.6 Transformations of Graphs 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions 2.8 Algebra of Functions and Function Composition ... Job 1 for 10 yr: $784,000; Job 2 for 10 yr: $825,000 67. 15. an 5 4. a 5 2 13 c. (g 1 h 1 f)(x) Section 2.8 273 Algebra of Functions and Function Composition 87. In mathematics we can express the relationship between two variables as a set of ordered pairs. 5C2 57. The second ellipse with h 9. Write the domain in interval notation. floor(20.1) e. {(8, 4), (3, 21), (5, 4)} b. 35 116 In Example 7, we practice composing functions and identifying the domain of the composite function. an 5 2 3n (n 1 1)! n 2 an 5 (21) n (3 n) b. 5, 10, [0, 2] (Hint: t 5 0 and h 5 2) c. 2! ? 750: © Ingram Publishing RF; p. Let B represent the event that a coin lands heads up on the second toss. 25. Which of the values can represent the probability of an event? 4 1 12 1 36 1 ... 1 78,732 57. y 5 4 c. 1 1 2 4 32 1 1 p 1 3 9 243 58. That is, 1. (4, `) 2 4. Given a line L1 defined by L1: 2x 2 4y 5 3, determine if the equations given in parts (a)–(c) represent a line parallel to L1, perpendicular to L1, or neither parallel nor perpendicular to L1. mn 5n 1 m 109. 1 2 24 25 24 25 26 h(x) 5 2x3 26 25 24 23 23 43. Next, assume that Pk is true for k $ 4, and show that Pk11 is true. 56. Copyright © 2017 by McGraw-Hill Education. From an equation in x and y, explain how to determine whether the graph of the equation is symmetric with respect to the x-axis, y-axis, or origin. To Patricia Steele, the best copy editor ever, thank you for mentoring us and for ensuring consistency throughout our work. 23.1 is not an element of the set of whole numbers. a1 1 (n 2 1)d; an21 1 d 5. {(z 1 3, 2z 1 5, z) 0 z is any real number} Chapter 6 Review Exercises, pp. 91. Center: A 12, 0B; Vertices: A 12, 5B, A 12, 25B; 16 25 Endpoints of minor axis: A272, 0B, A 92, 0B ; Foci: A 12, 3B, A 12, 23B (y 2 1)2 (x 2 3)2 1 51 11. Yes; The model gives a mean surface temperature of approximately 29.18C. At a hospital, the dinner menu consists of 4 choices of entrée, 3 choices of salad, 6 choices of beverage, and 4 choices of dessert. Determine the time required for the object to hit the ground. Skill Practice 6 Repeat Example 6 in the case where the vendor can cut the cost to $0.40 per cup of lemonade, and sell lemonades for $1.50 per cup. The Binomial Theorem Let n be a positive integer. E23 6 i 131F 1 3 114 5 197 e 4, 2 f 47. 239 b. Write a rule for a linear function y 5 h(x), given that h(1) 5 6 and h(23) 5 2. R.2. 3 23, `2 R.3. 12`, 32 R.5. k1x 1 32 5 x2 1 4x 1 6 f (x 1 h) 2 f (x) f (x); g(x) 3. For Exercises 41–54, write the equation in the form (x 2 h)2 1 (y 2 k)2 5 c. If a horizontal line intersects the graph of a function in more than one point, then the function has at least two ordered pairs with the same y-coordinate but different x-coordinates. Make a chart showing Y y the possible genotypes of the offspring. Show that 5 1 8 1 p 1 (3k 1 2) 1 [3(k 1 1) 1 2] 5 (k 1 1)(3k 1 10) k11 [3(k 1 1) 1 7] 5 . 89 75. n Let Pn be the statement 5 1 8 1 p 1 (3n 1 2) 5 (3n 1 7). (5x 1 3)5 17. 3n 26. In how many ways can a jury of 12 people be selected? Do they learn at different paces? Neither 39. (x 2 1)2 1 (y 2 2)2 5 8 x2 2 2x 1 1 1 y2 2 4y 1 4 5 8 x2 1 y2 2 2x 2 4y 2 3 5 0 Standard form (center-radius form) Expand the binomials General form General Form of an Equation of a Circle An equation of a circle written in the form x2 1 y2 1 Ax 1 By 1 C 5 0 is called the general form of an equation of a circle. 2m(x) 5 24x2 2 2x 1 3 c. The customer will wait at least 30 sec. The slope is 4 and means that the number of attendees has increased by approximately 4 people per week. 124 5 i 19 ? m6 4n18 2y4 x7 61. Circle; (x 2 3)2 1 (y 1 7)2 5 25 14. g(x) 5 5. Evaluate Infinite Geometric Series n For a positive integer n, the series a ai 5 a1 1 a2 1 a3 1 p 1 an is called a finite i51 1 32 ... 1 16 1 8 1 2 1 4 Figure 8-8 ` series because there are a finite number of terms. Find all x for which f (x) 5 3. 4, 20, 100, 500, ... 7 7 7 11. In how many ways can 5 students be selected from the 24? t 2 5 5. 10 215.7 28 210 12 10 8 6 71. y 210 210 10 10 210 210 133. 752 Chapter 8 Sequences, Series, Induction, and Probability The number of outcomes in an event is a nonnegative number less than or equal to the number of outcomes in the sample space. 2123 218 d 54 7 9 213 § 48. p(x) 5 0 x 2 1 0 2 2 2 1 68. Approximate 12 by substituting 2 for x and finding the first four terms of the sequence. y 5 23x 2 13 214 Chapter 2 Functions and Relations Solution: To apply the point-slope formula, we first need to know the slope of the line. Student Answer Appendix 40 20 0 0 3 6 9 Week 12 15 18 Student Answer Appendix b. 2 1 Skill Practice 8 Find the sum if possible. A 1 5 £1 1 0 212 212 3 31. c21 5 211.16, c116 5 27.36; Find c505. 0, then the graph will be a circle with radius r 5 1c. a23, b and a4, b 5 10 32. The solution set is {x 0 x , 3 or x . a 1 16 e. If player A moves three times faster than player B, where will they meet? Explain how cost and revenue are related to profit. 621–624 1(23) 1 0(5) 1 0(26) 0(23) 1 1(5) 1 0(26) 0(23) 1 0(5) 1 1(26) 23 5 26 0.29 20.09 71. Equation; e , 210 f 3 11 6 2233 f 2 7 b. Explain why a b is undefined. No 4. Use the third rule in the function: f (x) 5 1x 2 2. f (x) 5 c. g(21) 5 2(21) 1 1 Substitute 21 for x. {(6, 3)} 43. 2 26. Arithmetic; d 5 2 1 16. After a nationally televised trial, a poll of viewers indicated that 68% thought the defendant was guilty, 22% thought the defendant was not guilty, and the rest were undecided. No 33. Then the probability of event E, denoted by P(E), is given by P(E) 5 Avoiding Mistakes The probability 12 does not mean that exactly 1 out of every 2 rolls of a die will result in an even number. a a b n52 3 63. Find (n 2 m)(x) and write the domain of n 2 m in interval notation. (23, 21] uw 2w 1 u 5 R.2. a. If there are 9 women and 7 men in the class, in how many ways can the instructor choose 3 men and 3 women? Assume that (xy)k 5 xkyk (Inductive hypothesis). For example, use the menu nPr function found in the under PRB. Sales 5000 Income ($) 4000 3000 y 5 0.05x 1 2000 y 5 3000 2000 1000 0 0 20,000 40,000 Sales ($) 60,000 Figure 2-35 Skill Practice 9 A retail store buys T-shirts from the manufacturer. How many 5-letter palindromes are possible from a 26-letter alphabet? Determine the average rate of change of blood alcohol level from x1 5 2.5 to x2 5 8. (p2 2 w4)6 24. 2 1 6 1 10 1 ... 1 (4n 2 2) 5 2n2 4. No 65. an 5 64A214 B n (Exercise 9) (Exercise 10) For Exercises 115–116, use a graphing utility to find the sum. (c 2 2a 2 11)(c 1 2a 1 11) 7w2 1 2w 1 4 2 2 2 4 31. 1 111. 3x 1 12 1 b. In how many ways can the commercials be aired? m 5 2 4 1 40 23. R 79. Hyperbola; D y2 (y 1 3)2 (x 1 1)2 (x 2 2)2 1 51 73. Yes 21. g(6) 5 6 2 4 5 2. (25, 22] 2 75. 28 5 256 25. {25, 1} SA-25 Student Answer Appendix CHAPTER 4 Section 4.1 Practice Exercises, pp. 5 5 < 0.00879 b. Passes through (0, 26) and (11, 0). In how many ways can 3 students from a group of 15 students be selected to serve on a committee, if the students will hold the offices of president, vice president, and treasurer? h)(x) and write the domain in interval notation. y x13 5 b. c 2c 3 59. The graph shows the wait times (in seconds) for a sample of customers. Between 21 and 0; 20.6198 d. per year during this time period. (Hint: Show that vn11 2 vn is constant.) 30. 4 10 210 Y1 5 6x 2 2(x 1 2) 2 5 10 210 Section 2.4 207 c. There is a 5.5% sales tax on the cost of merchandise and a fixed cost of $4.99 for shipping. {(22, 1, 3)} 13. 26 ? 12 59. 726 1. 690: © David Lees/Getty Images RF; p. Hit ENTER and the approximate coordinates of the relative maximum point are shown (0.45, 0.63). T 21(x) 5 c. She receives a 4.5% raise each year thereafter. y¿ 5 79. 134 133. 0 x 0 1 y 5 3 39. Test for symmetry with respect to the origin. 23 for x , 1 for x $ 1 17. 26 1 2 3 4 5 x 1 23 25 24 23 22 21 21 24 25 22 23 1 2 x 17. Consider a set of data points (x1, y1), (x2, y2), (x3, y3), ... , (xn, yn). The coordinates of the ordered pair give the number of pixels horizontally and vertically from the origin. See also Polynomials explanation of, 38 method to factor, 49, 52–53 square of, 40, 41 Binomial theorem, 734–735, 766 Branches, of hyperbola, 651 C Calculators. (x 1 1)2 1 y2 5 24; The solution set is { }. 52C5 5 Chapter 8 Review Exercises, pp. 1r + t21x2 5 5 ; x2 2 4 Domain: 12`, 232 ´ 123, 222 ´ 122, 22 ´ 12, 32 ´ 13, `2 Solution: a. 9 3 2 ; aw 2 b 4 2 39. Find a. £ 4 2 61. 4 67. {5000} 22 21. It would take Joan approximately 5.5 hr working alone, and it would take Henry approximately 6.5 hr. 2 51 25 49 16 5 2 2 (y 2 2) (x 2 1) 2 51 49 25 5 a. 1 real solution 55. 2x(3x 2 1)(5x 1 2) 28. e 21. For example, a circle can be described by the algebraic equation (x 2 h)2 1 (y 2 k)2 5 r 2. 185 Given a function defined by y 5 f (x), p. e , 5 f 3 73. Endpoints of minor axis: (5, 0), (7, 0) d. 5 4 3 2 1 25 24 23 22 21 21 47. Inserting k equally spaced values between c and d, yields the arithmetic sequence c, x1, x2, x3, x4, p , xk, d. Show that the sequence log a1, log a2, log a3, ... is arithmetic and find the common difference d. (0, 29) e. Suppose that a single cell of bacteria divides every 20 min for 4 hr. 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 11. TIP The graph of a vertical line will have no y-intercept unless the line is the y-axis itself. 70% b. 733–734 n n n n n b abn21 1 a bbn (a 1 b)n 5 a ban 1 a ban21b 1 a ban22b2 1 p 1 a 0 1 2 n21 n n n 5 a a ban2rbr r50 r n n n n The values a b, a b, a b, ... , a b are called the binomial coefficients of the expansion of (a 1 b)n. 3x 2 2 5 4 17. c(x) 5 0.125x c. y . If the employee invests $1000 per month in the annuity instead of $500 at 5% interest, find the value of the annuity after 18 yr. 5! 2 1 5 119 75. In Example 2, we demonstrate that the fundamental principle of counting can be applied for a sequence of many events. 8 b. x x2 x3 x4 1 1 1 (Hint: Note the pattern produced 1 2 6 24 by n! for n 5 1, n 5 2, and so on.) 86. 2 1 81 Student Answer Appendix 2x 1 1 10. To find the y-intercept(s), substitute 0 for x and solve for y. Functions and Relations y 96. None of these 19. However, with the second job, José would have to pay $100 per month out of his paycheck for health insurance. relation; domain; y 3. Not possible 43. g(x) 5 2x 45. 1 2 x 10 8 6 h(x) 5 24 26 28 210 2 4 2x 2 4 x 13 6 8 8 25 24 23 22 21 21 22 x x 21 7 x 1 1 0 x13 2 3 f(x) 5 1 2 3 4 5 x 23 24 25 26 y 89. (f + g)(18) 52. If AB 5 In and BA 5 In, then the matrices are inverses. 25 x 24 25 25 24 23 22 21 21 22 y51 1 23 5 y 5 4 3 2 23 5 4 3 2 11. • The point (4, 2) on the graph of f corresponds to (4 1 3, 2 2 2) 5 (7, 0) on the graph of p. 1 2 3 4 x 5 14. a 12 3 12 e5 69. 2x 1 8 5 2 x 1 3 2 6. This is demonstrated in Example 2. The sum S of such a sequence is called an infinite series and is represented by S 5 a1 1 a2 1 a3 1 ??? The sum of the numbers on the dice is 6. (See Example 2) 19. a1 5 212, d 5 5 b. h(x 1 h) 51. c , `b 2 SECTION 2.4 Practice Exercises Prerequisite Review R.1. Determine the x- and y-intercepts for h1x2 5 6x 2 42. {x 0 x , 28} e. C(x) 5 52x 1 480 b. z(x) 5 Zx 1 1Z 2 4 106. x 5 261.5 y52 4 a. 50 lux 1 The intensity is 100 as great. This means that the average increase in BAC is greater over the first hour than over the second hour. By how much do the results of part (c) differ from the result of Exercise 62(d)? For what value(s) of x is f (x) 5 21? 4i 12 91. (x 2 y)9; sixth term 33. 7x 2 1 6x5/6 15. R.3. { } R.6. 5 4 3 2 1 ln A AP B ln A 2 ln P t 5 e(922S)yk 2 1 38. y 5 24 5 2 3 11 x5 21. This is demonstrated in Example 5. 1 Fk 1 Fk11 5 F[(k11)12] 2 1 5 Fk13 2 1. y 5 28. Yes 113. an 5 1.03an21 1 1000; n $ 2 101. [1, 37] 15. 1 can be graphed by 94. a 5a2 b 5 5 2 1 2 1 1p 3 3 9 27 81 i51 The sum is an infinite geometric series with a1 5 5 and r 5 213 . 72. 2 2 2 5 1; This is an a c equation of a hyperbola in the xz-plane with transverse axis on the x-axis. 5 a 3i 5 3(1) 1 3(2) 1 3(3) 1 3(4) 1 3(5) 5 3 1 6 1 9 1 12 1 15 5 45 i51 4 a 3(j 1 1) 5 3(0 1 1) 1 3(1 1 1) 1 3(2 1 1) 1 3(3 1 1) 1 3(4 1 1) j50 5 3 1 6 1 9 1 12 1 15 5 45 6 a 3(k 2 1) 5 3(2 2 1) 1 3(3 2 1) 1 3(4 2 1) 1 3(5 2 1) 1 3(6 2 1) 5 3 1 6 1 9 1 12 1 15 5 45 k52 EXAMPLE 7 Write a Series Using Summation Notation Write each sum using summation notation. Given x 1 y 1 14x 2 10y 1 70 5 0, a. 2 is a factor of 5n 2 3. 201 a. 2119 1 120i 71. At 1 hr: 4.8 ng/mL; At 12 hr: 3.9 ng/mL; At 24 hr: 1.0 ng/mL; At 48 hr: 0.3 ng/mL b. Explain why g(x) 5 2x 1 1 1 shifting the graph of f (x) 5 one unit to the left and x reflecting across the y-axis, or by shifting the graph of f one unit to the right and reflecting across the x-axis. {3, 23, 4, 22, 1} d. a b(x) 5 p 1x 2 2 1 ; Domain: (2`, 21) ´ (21, 5) ´ (5, `) 115. u2 1 2uv 1 v2 2 w2 51. (x 2 1.5)2 1 y2 5 2.25 13. 3A 5 £ 18 26 § 3 9 35. c d 0 3 0 0 5.6 3 c. Next, assume that Pk is true and show that Pk11 is true. 544–546 y R.2. 5 4 3 2 R.4. {e } 5 4 3 2 R.5. {4} 23 24 25 26 1 25 24 23 22 21 21 22 1 2 3 4 5 x 13. 81 Sn 5 4C1 2 A 12 B 6 D 4A1 2 a1(1 2 r n) 5 5 1 1 12r 122 2 5 63 8 1 i21 9a a 3b i51 7 Skill Practice 6 Find the sum. k)(4) k c. To set up a table, enter the starting value for x, in this case, 23. Assume that Pk is true; that is, assume that k2 2 k is even. Let Pn be the statement 1 1 4 1 p 1 4n21 5 13 (4n 2 1). h(g(2)) 49. x2 1 (y 2 3)2 5 4 1 2 3 4 5 24. Apply the Fundamental Many states have lotteries as a means to raise income. 0, 24, ; each of multiplicity 1 27. 22. The sidewalk moves at 1 ft/sec and Josie walks 4 ft/sec on nonmoving ground. (See Examples 4–5) 31. For example, h(x) 5 (x 2 3)2 can also be written as h(x) 5 f(g(x)), where g(x) 5 x2 2 6x and f(x) 5 x 1 9. Morris, Houston Community College Dorothy Muhammad, Houston Community College Linda Myers, Harrisburg Community College Julie Nation, Mississippi State University Mandri Obeyesekere, Houston Community College Victor Obot, Texas Southern University Charles Odion, Houston Community College Donald Orr, Miami Dade College Victor Pambuccian, Arizona State University–West Stan Perrine, Georgia Gwinnett College David Platt, Front Range Community College Wendy Pogoda, Hillsborough Community College John Polhill, Bloomsburg University of Pennsylvania Jonathan Poritz, Colorado State University Didi Quesada, Miami Dade College Brooke Quinlan, Hillsborough Community College xvi Acknowledgments Carolynn Reed, Austin Community College–Rio Grande Denise Reid, Valdosta State University Nancy Resseguie, Arapahoe Community College Shelia Rivera, University of West Georgia Ken Roblee, Troy University Haazim Sabree, Georgia Perimeter College Haazim Sabree, Georgia Perimeter College Fatemeh Salehibakhsh, Houston Community College Fary Sami, Harford Community College Linda Schott, Ozarks Technical Community College Mary Schuster, University of Cincinnati Lisa Shannon, Meridian Community College Giorgi Shonia, Ohio University Andrew Siefker, Angelo State University Jennifer Siegel, Broward College–Central Randell Simpson, Temple College Premjit Singh, Ohio University Sounny Slitine, Saint Philips College David Slutzky, University of North Georgia Mary Ann Sojda, Montana State University Shannon Solis, San Jacint College Scott Sorrell, University of Louisiana Lafayette Malgorzata Surowiec, Texas Tech University Vic Swaim, SE Louisiana University Paula Talley, Temple College Rae Tree, Oklahoma State University Chris Turner, Pensacola State College Phil Veer, Johnson County Community College James Wan, Long Beach City College Walter Wang, Baruch College Emily Whaley, Georgia Perimeter College Changyong Zhong, Georgia State University Author Acknowledgments: An editor once told us that publishing a book is like making a movie because there are so many people behind the scenes that make the final product a success. c 61. [24, 5] 115. 2x 2 1 , x 1 5 The solution set is the set of x values for which Y1 , Y2. s(tA) 5 s ? a1 5 6, d 5 5 17. 1 25 24 23 22 21 21 22 1 2 3 4 5 23 24 25 e. 13.2 ft y 23. Parabola; Vertex: (1, 23); Focus: A1, 212 B; Directrix: y 5 2112 ; Axis of symmetry: x 5 1 7. (2`, 3] c. f (0.09) 78. an 5 3 n d. The ball lands on an even number (do not include 0 and 00). C 1 23 22 21 21 22 13. 2k. The average water level in a retention pond is 6.8 ft. 4x3 1 6x2h 1 4xh2 1 h3 b. Output f(g(x)) Figure 2-41 EXAMPLE 6 Composing Functions 2 Given f (x) 5 x 1 2x and g(x) 5 x 2 4, find a. a 5 5, b 5 3, c 5 0 3 6 137 f 57. (21 1 19)(21 2 19); 80 3 Expand the square of any binomial. Suppose that we superimpose the x-axis at the waterline. ≥ 6 6 6 ¥ 4 3 6 0 0 2 1 6 6 6 x 2 45 § 53 c. Yes 39. {210, 2} 103. 756 Chapter 8 Sequences, Series, Induction, and Probability Probability of (A or B) Given events A and B in the same sample space, P(A or B) is given by P(A ´ B) 5 P(A) 1 P(B) 2 P(A ¨ B) Note: If A and B are mutually exclusive, then P(A ¨ B) 5 0 and we have P(A ´ B) 5 P(A) 1 P(B). w1z x1y 2 1 3 2 3 3 2 2a 1 1ab 1 2b 129. Undefined d 1 a. However, g(x) can also be written as g(x) 5 0 2 0 ? y 5 0 x 0 8. If four people are randomly selected, find the probability that all four have the A antigen. 2, indicating that 4 is indeed a factor of 8. Passes through (3.6, 1.2) and is perpendicular to the line defined by 4x 5 9 2 y. Interpret the meaning of the slope in the context of this 25 0 5 10 15 20 problem. The axis of symmetry is x 5 22. g(1) 5 2(1) 1 1 53 Substitute 1 for x. For f and g pictured, estimate the following. Minimum value: 48 (12, 36) 35 30 25 20 15 10 5 (48, 0) (0, 0) 0 5 10 15 20 25 30 35 40 45 50 x 37. a1 5 36 and an 5 12an21 for n $ 2 24. A combination of n items taken r at a time is a group of r items taken from a group of n items in no particular order. Find a n b(x) and write the domain of n in interval notation. Explain how you would evaluate 1206! 1204! on a calculator. 10 e. Determine if the given ordered pair is a solution to the equation 4 0 x 2 10 1 y 5 18. q16 u13 ; q fi 6, q fi 22 R.2. 2 ; u fi 0, u fi 3 q12 2u 3 ; m fi p, x fi 23 2 x13 q(x) 3. Determine f (1). Examples • The examples in the textbook are stepped-out in detail with thorough annotations at the right explaining each step. What is the probability of randomly selecting a jury of all men? Perpendicular 35. Let h be a positive real number and let Q be the point (x 1 h, f (x 1 h)). 1.036 77. 2 3 2 b. How much more will Cherise earn than Jacob over the 20-yr period? The graph is a parabola opening upward with vertex at the origin. 2y 2 6 5 8 y x 61. The graph of g(x) 5 21x has the shape of the graph of y 5 0 x 0 the shape of the graph of but is reflected across the x-axis. 21.7037 c. 653: © Bruce Dale/ National Geographic/Getty; p. 1 65. The numbers are 12 and 10. not the same Replace x by 2x and y by 2y. The graphs have the shape of y 5 1x with a horizontal shift. r1d2 5 c. an 5 5(0.8)n a. The sequence of salaries for the first 5 yr is Year 1 $75,000 Year 2 $79,000 Year 3 $83,000 Year 4 $87,000 Year 5 $91,000 Notice that each term after the first results from adding a fixed constant ($4000) to its predecessor. 15 19. a 2 b 1 a 2 b 1 a 2 b 1 a 2 b 1 a 2 b 1 p 1 3 2 4 3 5 4 6 5 7 3 c. constant; variation a. Because 129 and 124 are imaginary numbers, the correct logic for simplification would be 129 ? (3n 2 1)! 4. [Hint: The nth term of the sequence is the difference between the sum of the first n terms and the first (n 2 1) terms.] SECTION 8.3 OBJECTIVES 1. 387: Courtesy of NOAA; p. h(x) 5 x2 2 4 10. Determine the Slopes of Parallel and Perpendicular Lines Lines in the same plane that do not intersect are parallel lines. y 5 1x 3. a b(7) f g 17. {23, 21, 1, 3} e ,2 f 2 5 3125 43. e a , y, zb ` y and z are any real numbers f or 2 {(x, y, z) 0 2x 1 3y 1 4z 5 12} 12 2 3y 2 4z Section 6.2 Practice Exercises, pp. 1 2 3 4 5 B(1, 23) The position of an object in a video game is represented by an ordered pair. f (x) 5 x3 2 4x 1 2 For Exercises 63–70, refer to the function f 5 {(2, 3), (9, 7), (3, 4), (21, 6)}. y 5 4 3 2 39. This is because the “prizes” are indistinguishable; that is, the outcomes AB and BA are the same because student A and student B would each receive $500. A(28.9) 5 5 means that after 28.9 yr, the amount of 90Sr remaining is 5 µg. • References to even-numbered exercises appear in the margin next to each example for the instructor to use as Classroom Examples. Never constant 103. 21 e. 4 44. Second Die Solution: 1 2 3 4 5 6 1 (1, 1) (2, 1) (3, 1) (4, 1) (5, 1) (6, 1) 2 (1, 2) (2, 2) (3, 2) (4, 2) (5, 2) (6, 2) 3 (1, 3) (2, 3) (3, 3) (4, 3) (5, 3) (6, 3) 4 5 6 (1, 4) (2, 4) (3, 4) (4, 4) (5, 4) (6, 4) (1, 5) (2, 5) (3, 5) (4, 5) (5, 5) (6, 5) (1, 6) (2, 6) (3, 6) (4, 6) (5, 6) (6, 6) Figure 8-11 a. 20 15 10 5 4 3 2 5 23 22 21 25 210 1 2 3 4 5 6 7 x 0 0 5 99. y 8 1 1 22 21 21 22 1 2 3 4 5 6 7 8 x y 45. m 5 2 c. For a large number of terms, adding the terms individually would be a cumbersome process, so instead, we observe the following pattern. a1 5 5, d 5 23 For Exercises 19–24, a. Therefore, the graph touches but does not cross the x-axis at 5. y 2 0 x 0 5 21 Solution: y 2 0 x 0 5 21 y 5 0x 0 2 1 x 23 22 Answers 21 5 3. Decreasing b. x2 5 60y for 24.1 # x # 4.1 b. Given f (x) 5 4x 2 3x, a. • 1200 new questions were added to the TestGen testbank. However, lowercase letters such as f, g, h, and so on are often used. If an antigen is absent from the recipient’s blood, then the recipient cannot receive blood from a person who has that antigen. The ALEKS® Initial Assessment is an artificially intelligent (AI), diagnostic assessment that identifies precisely what a student knows. See Figure 2-40. The equation is a contradiction. 288 Chapter 3 Polynomial and Rational Functions EXAMPLE 2 Writing a Quadratic Function in Vertex Form Given f (x) 5 3x2 1 12x 1 5, a. No 2. Nonlinear e. 8 u 5 u 87. f (x) 5 x 13. g(x) 5 1x 1 5 20. Each plant has two genes, one from the female (seed) and one from the male (pollen). Vertex: (3, 4); Focus: (5, 4); Endpoints of latus rectum: (5, 0), (5, 8) Directrix: x 5 1; Axis of symmetry: y 5 4 6 y 24. (29, 4) and (21, 26) 29. Notice that the slope of the secant line between x 5 0 and x 5 1 (shown in red) is greater than the slope of the secant line between x 5 1 and x 5 2 (shown in green). Write 0.7 as a fraction. For example, we can rename y as S(x). (2.6, 4.1) and (9.5, 23.7) 2 3 34. Answers y 5. 4 5 32,768 Section 8.6 Principles of Counting 741 Skill Practice 3 A quiz has four true/false questions and six multiplechoice questions. Our intuition tells us that the probability should be less than 12 because it is more unlikely that the desired outcome will happen twice in a row than one time. This is because for any real number x, the value of y is the unique number that is 2 less than x. sum 101 Sum of the first 100 positive integers: 50 pairs, each summing to 101. 2` c. However, finding taxable income is not always trivial. e f 2 2 3 7. 3yw4 2 3y2z2 10 1 x 2 a. ALEKS® Prep for College Algebra ALEKS Prep for College Algebra focuses on prerequisites and introductory material for College Algebra. (1 23 24 25 c. Each day, you lead by example to unlock our full potential and inspire our best work. f (x) 5 0x 0 1 1 16. Show that n2 2 n is even for all positive integers n. Jesse travels 6 km/hr in still water. {(3, 1), (3, 21), (23, 1), (23, 21)} F 20. Approximately 82 mg 0 12 120 y 5 0.118x 1 4.97 0 0 750 8 7 77. 0 61. Passes through (1.1, 5.3) and (20.9, 7.1). g(x) 5 x3 2(x 2 1)3 Objective 3: Graph Piecewise-Defined Functions For Exercises 47–50, evaluate the function for the given values of x. Vertex: A23, 32 B; Focus: A2132, 32 B ; Directrix: x 5 12 37. { } a. Between 22 and 21 b. 15 41. 15 1 5 1 1 1 3 9 27 81 2 2 2 54. 0 2 8i b. q21(x) 5 (x 2 1)5 1 4 5 4 3 2 25 24 23 22 21 21 22 9 8 1 24 25 61. x2 5 y2 1 1 b. 2 3 Section 1.5 Practice Exercises, pp. 1200 in. Center: (2, 4); Vertices: A2, 4 1 15 B, A2, 4 2 15 B; Foci: A2, 4 1 114 B, A2, 4 2 114 B (y 1 5)2 51 b. x 5 3 Geometric; r 5 2a3 51. Frank needs to drive 250 mi from Daytona Beach to Miami. y 5 2 x 1 5 5 212 214 c. No b. (23, 4) e. How many groups of 6 numbers are possible? What is the slope of a line perpendicular to a line with equation y 5 1? Therefore, we have no formula readily available to evaluate the sum of the first n terms. 191 85. Yes 17. y 5 0 x 1 4 0 2 3 59. The manager should mix 4 lb of peanuts with 16 lb of the 45% mixture. 5 9 5 S5 a1 10 5 5 12r 1 2 101 5 10 9 10 5 59 718 Chapter 8 Sequences, Series, Induction, and Probability b. g(x) f f (x) a b(x) 5 provided that g(x) fi 0 g g(x) The difference quotient represents the average rate of change of a function f between two points (x, f (x)) and (x 1 h, f (x 1 h)). Suppose that four people are to be randomly selected from a group of 8 women and 5 men. Outcomes B BBB Solution: Each birth is independent of the birth that precedes it. f(x) has no variation in sign, nor does f (2x). 9.2 m T 2 Tf 1 1 t 5 2 lna b or Cln T0 2 ln AT 2 Tf B D k T0 k a. y 5 24x 1 1 on [210, 10, 1] by [210, 10, 1] 91. 2t(t 2 4)(t 2 10) 27. 2,400,000 35. If n items are arranged in order, then each arrangement is called a of n items. 3.96 m b. A child drops a ball from a height of 4 ft. Interpret the results from part (a). (2, `) c. x2 1 y2 5 9 (2x)2 1 y2 5 9 x2 1 y2 5 9 x2 1 y2 5 9 x 1 (2y)2 5 9 x2 1 y2 5 9 x2 1 y2 5 9 (2x) 1 (2y)2 5 9 x2 1 y2 5 9 2 same 2 same same The graph is symmetric with respect to the y-axis, the x-axis, and the origin. For further information on McGraw-Hill and Accessibility, please visit our accessibility page or contact us at accessibility@mheducation.com File loading please wait... (23, 2), (5, 2) c. 2n 145. {1, 24} 91. Skill Practice 9 A teaching position has a starting salary of $60,000 with a raise of $3000 every year thereafter.

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