

Problems 6 and 7 refer to the following situation. You decide to rent a car from a company that charges a \$25.50 rental fee plus \$0.05 per mile for every mile the car is driven.

6. Which of the following statements are true?
- (a) The rate charged per mile driven is a fixed quantity
 - (b) The rental fee is a fixed quantity
 - (c) The cost of renting the car is a fixed quantity
 - (d) Both (a) and (b) are true.
 - (e) Both (b) and (c) are true.
7. Let d be the miles driven in the rental car, and let c be the cost in dollars of renting the car. Which of the following formulas is correct?
- (a) $\Delta d = .05\Delta c$
 - (b) $d = 25.50 + .05c$
 - (c) $\frac{\Delta c}{\Delta d} = .05$
 - (d) Both (a) and (b) are true.
 - (e) Both (b) and (c) are true.
8. A particular cookie recipe calls for one cup of flour to start, along with an additional one-half cup of flour for every cup of sugar. Let x represent the amount of flour used (measured in cups) and let y be the amount of sugar used (measured in cups). Which of the following statements is true?
- (a) x and y are proportional.
 - (b) Δx and Δy are proportional.
 - (c) The y -intercept is the point $(0, 0)$.
 - (d) Three cups of sugar correspond to 1.5 cups of flour used.
 - (e) All of the above statements are true.

Problems 9 and 10 refer to the following situation. Cole is standing on a level playing field when he throws a ball to Janice. The height H of the ball in feet above the ground s seconds after Cole throws it is given by the function

$$H = f(s) = 5.5 - 2(s - 1)^2$$

9. The maximum height of the ball above the ground will be
- (a) $H = 2$ feet
 - (b) $H = 5.5$ feet
 - (c) $H = 3.5$ feet
 - (d) $H = 7.5$ feet
 - (e) $H = 10$ feet
10. Janice does not catch the ball. How many seconds will pass before the ball hits the ground?
- (a) $t = 1$ seconds
 - (b) $t \approx 2.5$ seconds
 - (c) $t \approx 2.66$ seconds
 - (d) $t = 3$ seconds
 - (e) $t \approx 1.87$ seconds
11. Suppose that A is the degree measure for an angle. Which of the following expressions must be equal to $\sin(A + 720^\circ)$?
- (a) $\sin(-A)$
 - (b) $-\cos(A)$
 - (c) $-\sin(A)$
 - (d) $\cos(A)$
 - (e) $\sin(A)$

12. Suppose that b is the radian or degree measure of an angle. As long as all factors are defined, which of the following expressions is equal to

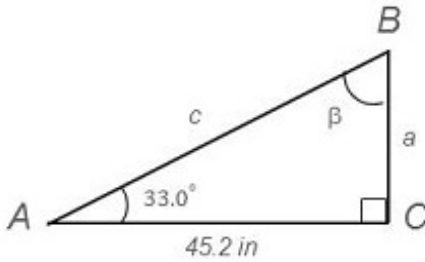
$$\frac{\cot(b) \cos(b)}{\csc(b)}$$

- (a) $\cos^2(b)$ (b) 1
(c) $\sin^2(b)$ (d) $\tan(b)$
(e) $\frac{\cos^3(b)}{\sin(b)}$
13. Carlton is drinking a glass of water. When the glass contains 18 mL of water, he places it under the water tap and starts refilling. If 4 mL of water enters flows into the glass every 2.5 seconds, how much water will be in the glass 8 seconds after he started refilling?
- (a) 12.8 mL (b) 30.8 mL
(c) 22.5 mL (d) 10 mL
(e) 38 mL
14. The implied domain of the function $y = f(x) = \ln(2x - 1)$ is the set of
- (a) all real numbers (b) all real numbers except $x = 0$
(c) all real numbers $x > 0$ (d) all real numbers $x > 1/2$
(e) all real numbers $x < 1$
15. Let a and b be distinct real numbers. Which of the following statements is true about the rational function

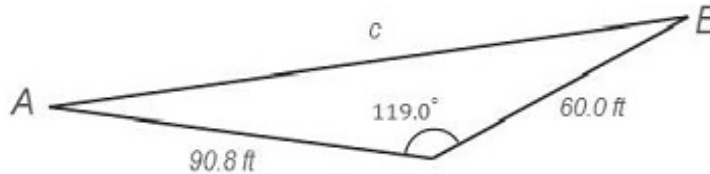
$$y = f(x) = \frac{3(x - b)}{(x - a)(x - b)}$$

- (a) The function f has a vertical asymptote only at $x = a$.
(b) The function f has a vertical asymptote only at $x = b$.
(c) The function f has a vertical asymptote at $x = a$ and at $x = b$.
(d) The function f has no vertical asymptotes.
(e) The function f has an x -intercept at $x = b$.
16. Let u and v be the values of two varying quantities and suppose that u changes at a constant rate of -4.4 with respect to v . Which of the following statements is true?
- (a) $v = -4.4r$ (b) $\Delta v = -4.4\Delta u$
(c) $u = -4.4v$ (d) $\Delta u = -4.4\Delta v$
(e) $u = v - 4.4$

22. Consider the triangle shown in the diagram below. To the nearest tenth, what is the length of Side a ?

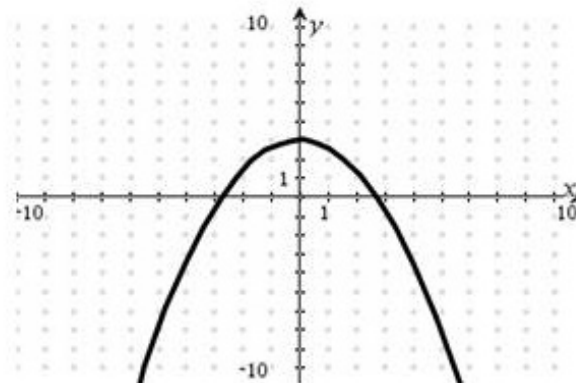


- (a) $a \approx 29.4$ inches
 (b) $a \approx 69.6$ inches
 (c) $a \approx 83.0$ inches
 (d) $a \approx 37.9$ inches
 (e) $a \approx 24.6$ inches
23. Annabeth needs to know the dimensions of a triangular piece of property whose boundaries are shown below. She can measure two sides directly, but unfortunately, one side lies in a lake and cannot be reached. To the nearest tenth of a foot, what is the length of the unknown side?



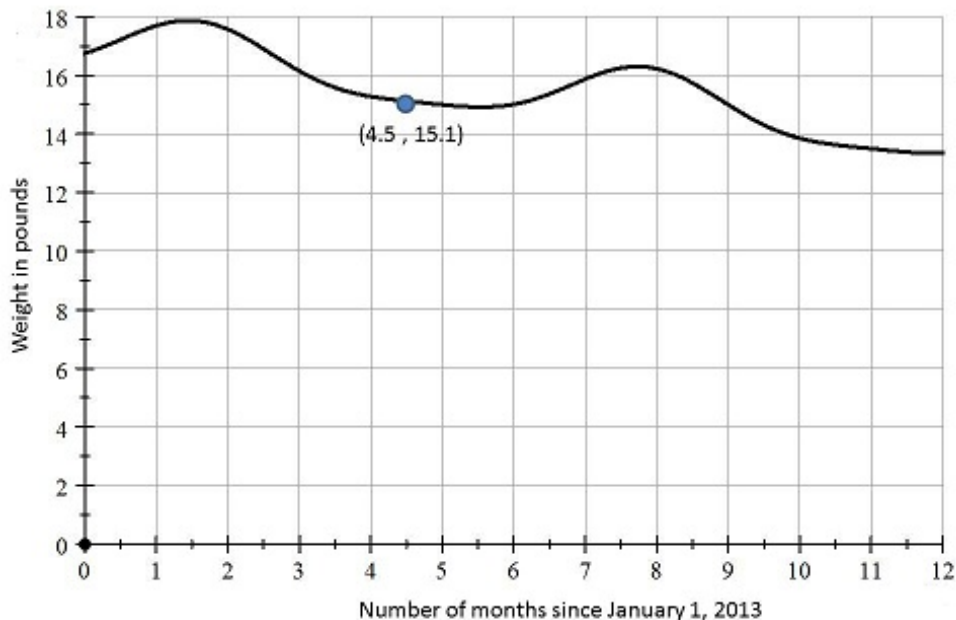
- (a) $c \approx 108.8$ feet
 (b) $c \approx 149.8$ feet
 (c) $c \approx 163.0$ feet
 (d) $c \approx 100.0$ feet
 (e) $c \approx 130.9$ feet
24. Nancy starts eating a bowl of soup at noon, and it takes her twenty minutes to finish. Which of the following is a varying quantity in this situation?
- (a) the bowl
 (b) the weight of soup in the bowl in ounces since noon
 (c) the time
 (d) the total time in minutes that passes while Nancy eats
 (e) Nancy
25. As an ice cube melts, its mass in grams changes at a constant rate with respect to the number of minutes since it began melting. Five minutes after the ice cube began to melt, its mass was ten grams. Seven minutes after the ice cube began to melt, its mass was seven grams. What was the constant rate of change?
- (a) 2 grams per minute
 (b) -1 gram per minute
 (c) -1.5 grams per minute
 (d) 0.7143 grams per minute
 (e) 1.4 grams per minute

30. The graph of a function f is shown below. Use this graph to determine the average rate of change for f as the input values change from $x = -5$ to $x = 4$.



- (a) Average rate of change is 3
 (b) Average rate of change is 0
 (c) Average rate of change is $\frac{5}{4}$
 (d) Average rate of change is $\frac{1}{3}$
 (e) Average rate of change is $\frac{1}{2}$
31. The *purchasing power* of one dollar at a point in time is the amount of money needed *today* to purchase the same item. Let P represent the purchasing power of one dollar t years from 2015, and suppose $P = f(t) = 0.97^t$. Approximately how many years from 2015 will it take for the purchasing power of the dollar to reach 79 cents ?
- (a) Approximately 7.74 years
 (b) Approximately 27.24 years
 (c) Approximately 0.81 years
 (d) Approximately 0.08 years
 (e) Approximately 5.25 years
32. Darren notices that his son has let the bathroom sink fill with water. Darren pulls the plug, and the sink drains at the constant rate of 22 mL every three seconds. Let V represent the volume of water (measured in mL) in the sink, and let t represent the number of seconds since Darren pulled the plug. When the value of t increases from 8 seconds to 20 seconds, what is the corresponding change in the value of V ?
- (a) $\Delta V = 12$ mL
 (b) $\Delta V = -12$ mL
 (c) $\Delta V = -88$ mL
 (d) $\Delta V = 264$ mL
 (e) $\Delta V = 88$ mL
33. A bag of groceries is sitting on your kitchen table. Which of the following is a quantity?
- I.** The bag
II. The volume of the bag in cubic inches
III. The groceries in the bag
IV. The temperature in degrees Celsius of the egg carton at the bottom of the bag
- (a) Only I and III
 (b) Only II and IV
 (c) Only I and II
 (d) Only III and IV
 (e) All are quantities.

Problems 34 and 35 refer to the graph below, which shows the relationship between the weight W in pounds of Milton's cat, Murgatroyd, and the number m of months since Milton started using a new cat food on January 1, 2013.



34. What is the meaning of the point $(4.5, 15.1)$ on the graph above?
- Fifteen and one-tenth months after January 1, 2013, Murgatroyd's weight was four and one-half pounds.
 - Four and one-half months after January 1, 2013, Murgatroyd's weight was fifteen and one-tenth pounds.
 - There was a change of fifteen and one-tenth pounds as the number of months since January 1, 2013 changed from 0 to 4.5.
 - There was a change of four and one-half months as Murgatroyd's weight changed by fifteen and one-tenth pounds.
 - It took Murgatroyd four and one-half months to lose fifteen and one-tenth pounds.
35. As the value of m decreases from 10 to 3 months, what is the approximate value of ΔW ?
- $\Delta W = -1.2$ pounds (b) $\Delta W = 7$ pounds
 - $\Delta W = 2$ pounds (d) $\Delta W = 1.2$ pounds
 - $\Delta W = -2$ pounds

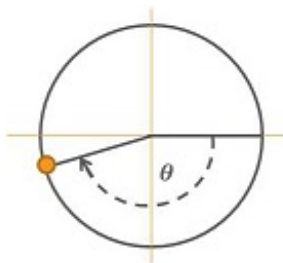
36. Denise places seven grams of yeast in a Petri dish, and the mass of yeast in the dish increases 3% per day for the next thirty days. Which of the following functions gives the mass M of the yeast as a function of the number d of days since Denise placed the yeast in the dish?

- (a) $M(d) = 7 + .03d$ (b) $M(d) = 7 + 1.03d$
(c) $M(d) = 7 \cdot (0.03)^d$ (d) $M(d) = 7.21^d$
(e) $M(d) = 7 \cdot 1.03^d$

37. The implied domain of the function $y = f(x) = \frac{\sqrt{3x+5}}{x-1}$ is the set

- (a) $[-\frac{5}{3}, +\infty)$ (b) All real numbers except $x = 1$
(c) All real numbers (d) $(0, +\infty)$
(e) $[-\frac{5}{3}, 1) \cup (1, +\infty)$

38. Based on the diagram below, which of the following statements is true?



- (a) $\theta \approx -1$ radian (b) $\theta \approx 3.2$ radians
(c) $\theta \approx 3$ radians (d) $\theta \approx -3$ radians
(e) $\theta \approx -2.25$ radians

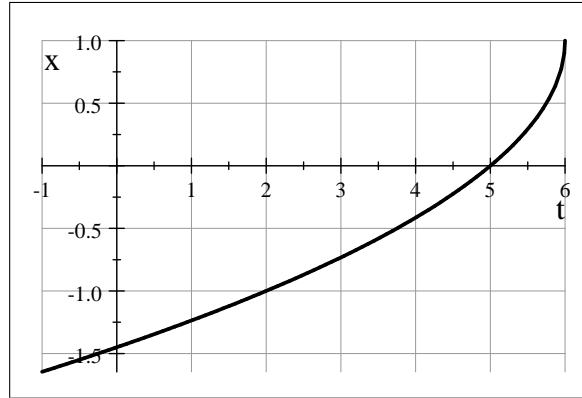
39. If the point $(3, 4)$ lies on the graph of an invertible function f , then which of the following points lies on the graph of its inverse function?

- (a) the point $(4, 3)$ (b) the point $(3, -4)$
(c) the point $(3, 1/4)$ (d) the point $(-3, -4)$
(e) the point $(4, -3)$

40. What is the formula for the inverse of the function $w = g(u) = \sqrt[3]{\frac{3u-1}{5}}$?

- (a) $u = g^{-1}(w) = \left(\frac{5w-1}{3}\right)^3$ (b) $u = g^{-1}(w) = \frac{3w^3-1}{5}$
(c) $u = g^{-1}(w) = \frac{5w^3+1}{3}$ (d) $u = g^{-1}(w) = \frac{5\sqrt[3]{w}+1}{3}$
(e) $u = g^{-1}(w) = \left(\frac{3w-1}{5}\right)^3$

41. Suppose that the function f is defined by the formula $y = f(x) = x^3 - 2$ while the function g is defined by the graph below. What is the value of $(f \circ g)(2)$?



Graph of g

- (a) $(f \circ g)(2) = -6$ (b) $(f \circ g)(2) = 1$
(c) $(f \circ g)(2) = -3$ (d) $(f \circ g)(2) = 6$
(e) $(f \circ g)(2) = -1$
42. Polly erects a vertical flagpole on a stretch of level ground. A forty-foot section of rope is attached to the top of the flagpole. When Polly pulls the rope tight so that the other end just touches the ground, she finds that the tight rope makes an elevation angle of 37.6° with the ground. To the nearest foot, how tall is the flagpole?
- (a) 21 feet (b) 31 feet
(c) 40 feet (d) 32 feet
(e) 24 feet

Problems 43 - 45 refer to the function defined below.

$$f(t) = \begin{cases} 2x - 1 & \text{if } x < -1 \\ x^2 + 4 & \text{if } -1 < x \leq 3 \\ \sqrt{x + 5} & \text{if } 3 < x \end{cases}$$

43. Which of the following statements is correct based on the formula for f ?
- (a) $f(-1) = -3$ (b) $f(-1)$ is undefined
(c) $f(-1) = 5$ (d) $f(-1) = 0$
(e) $f(-1) = 2$
44. Which of the following statements is correct based on the formula for f ?
- (a) $f(f(0)) = 16$ (b) $f(f(0))$ is undefined
(c) $f(f(0)) = 3$ (d) $f(f(0)) = 4$
(e) $f(f(0)) = \sqrt{5}$

45. Suppose that $g(t) = 5t + 2$. If f is the function defined above, then which of the following statements is true?

- (a) $(f \circ g)(-2) = 40$ (b) $\left(\frac{g}{f}\right)(-2) = 40$
(c) $(g \circ f)(-2) = 40$ (d) $(gf)(-2) = 40$
(e) $(g + f)(-2) = 40$

46. The salary of the vice president of the ShoeTunes corporation is given by $P(t) = 60000 \cdot (1.03)^t$, where P is measured in dollars, and t is the number of years since she was hired. Which of the following statements is true?

- (a) She will be receiving a 103% raise each year.
(b) Her salary next year will be 3% of her salary this year.
(c) Her salary next year will increase by 3% compared to her salary this year.
(d) Her salary increases by \$1,800 every year.
(e) Her salary increases by \$61,800 every year.

47. For the first six months it was in business, the number N of musical shoes that ShoeTunes manufactured in a week increased with respect to the number t of weeks since the company was founded according to the function $N = f(t) = 5000 \cdot 2^t$. Which of the following formulas will tell us the number of weeks since the company was founded (t) when we know the number of shoes made in a given week (N)?

- (a) $t = \frac{N}{5000}$ (b) $t = \log_2\left(\frac{N}{5000}\right)$
(c) $t = \frac{\log(N)}{\log(10000)}$ (d) $t = \log_{10000}(N)$
(e) $t = \frac{\log_2(N)}{10000}$

48. Writing the equation $\ln(2x - 1) = 6$ in exponential notation gives us

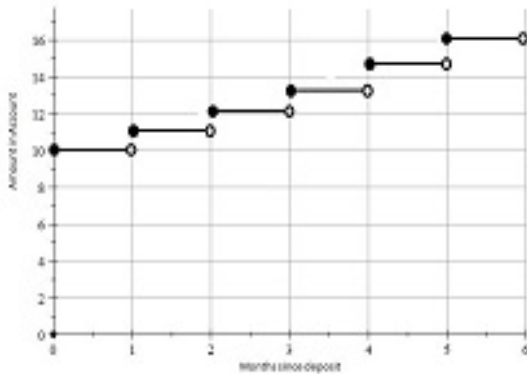
- (a) $6 = \sqrt[6]{2x - 1}$ (b) $2x - 1 = e^6$
(c) $\ln = \sqrt[6]{2x - 1}$ (d) $2x - 1 = 10^6$
(e) $2x - 1 = \frac{6}{\ln}$

49. The number of customers buying from ShoeTunes is increasing exponentially. If the table below gives some values for the number N of customers t years after the company was founded, what is the approximate growth factor for N ?

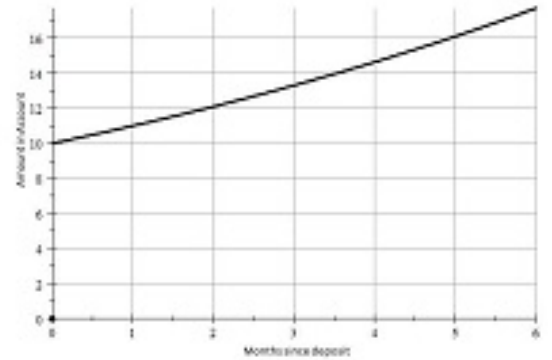
t	5	7	9
N	5,378	7,530	10,541

- (a) $b \approx 1.04$ (b) $b \approx 0.845$
(c) $b \approx 1.400$ (d) $b \approx 0.600$
(e) $b \approx 1.183$

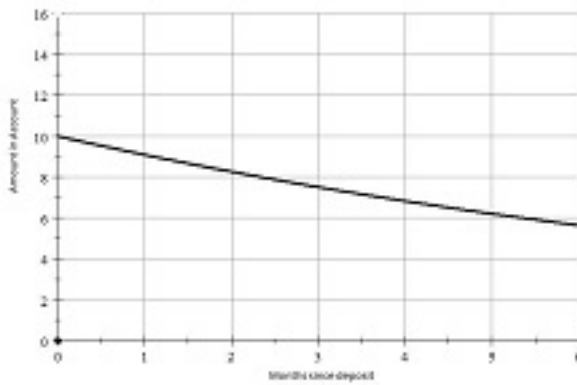
50. Max does not trust his bank and decides to hide \$10.00 in a very clean sock. At the end of each month, Max adds 10.2% of the sock money to his sock. He leaves the sock alone for the rest of each month. Let t represent the number of months since the \$10.00 was first hidden in the sock, and let A represent the amount of money in the sock. If we assume $A = f(t)$, which of the following graphs most accurately depicts the graph of f ?



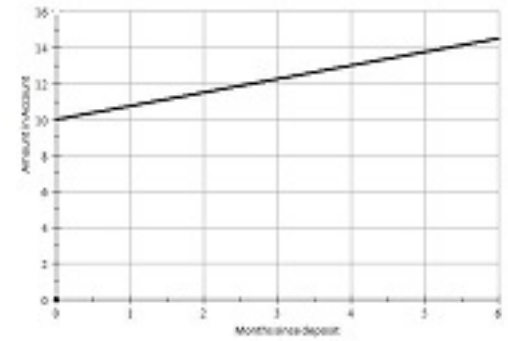
(a)



(b)



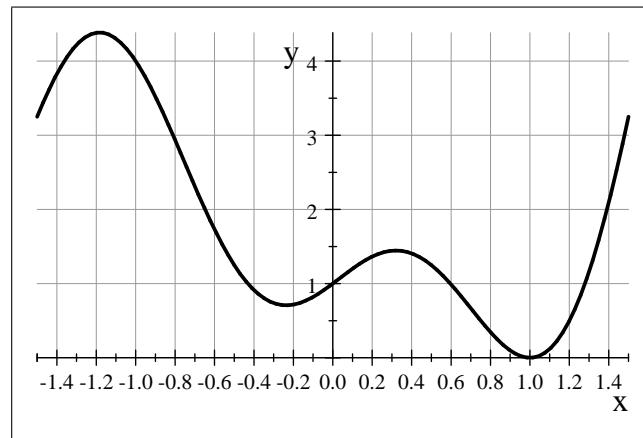
(c)



(d)

(e) None of the above

51. Use the graph shown below to solve the equation $f(x) = 1$ for the input variable x .



Graph of the function f

- (a) The solution is $x = 0$ (b) The solution is $x \approx -0.4$
(c) The solutions are $x \approx -1.0$ and $x \approx 0$ (d) The solutions are $x \approx -0.4$, $x \approx 0$, $x \approx 0.6$, and $x \approx 1.25$
(e) The solutions are $x \approx -0.65$ and $x \approx 1.4$

52. If a rational function f is known to have a horizontal asymptote at $y = 3$, then which of the following is a possible formula for the function f ?

- (a) $y = f(x) = x + 3 + \frac{1}{x^2 + 3}$ (b) $y = f(x) = 3 - \frac{1}{x + 3}$
- (c) $y = f(x) = 3x + \frac{1}{x - 3}$ (d) $y = f(x) = \frac{3}{x^2 + 3}$
- (e) $y = f(x) = \frac{3x}{x^2 + 3}$

53. A street lamp rises vertically from a patch of level ground. When a five-foot tall woman stands eight feet from the base of the lamp, she casts a ten-foot shadow. The angle of depression between the top of the lamp and the tip of her shadow has degree measure

- (a) exactly 30° (b) approximately 26.6°
- (c) approximately 63.4° (d) exactly 43°
- (e) approximately 37.5°

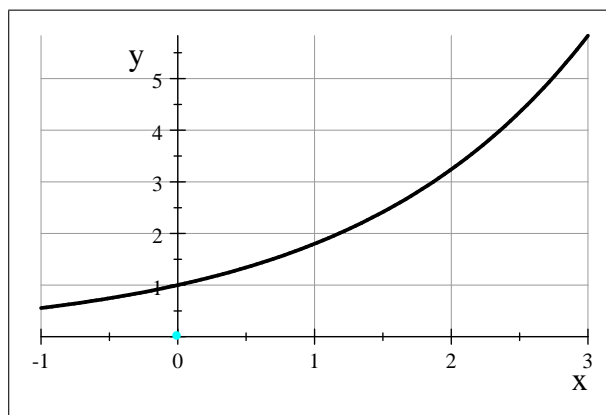
54. The terminal side of the angle in standard position having degree measure $\theta = 770^\circ$ lies in

- (a) Quadrant I (b) Quadrant II
- (c) Quadrant III (d) Quadrant IV
- (e) no quadrant — it is a quadrantal angle

55. If we simplify the expression $\log_2(x) + \log_2(x) - \log_2(9)$ so that it is a single logarithm, we have

- (a) $\log_2(9x^2)$ (b) $9\log_2(x)$
- (c) $\log_2\left(\frac{x^2}{9}\right)$ (d) $\log_2(2x - 9)$
- (e) $\frac{\log_2(x^2)}{\log_2(9)}$

56. The figure below shows the graph of an exponential function $f(x) = b^x$. Based on this graph, the solution to the equation $1.5 = b^x$ is



- (a) $x \approx 3.25$ (b) $x \approx 2.50$
- (c) $x \approx 3.50$ (d) $x \approx 1.41$
- (e) $x \approx 0.75$

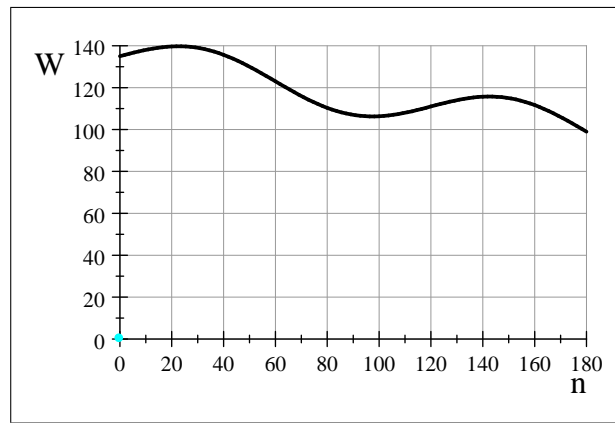
57. Suppose that an angle in standard position has radian or degree measure A . If the point $(2, -3)$ lies on the terminal side of this angle, which of the following statements is true?

- (a) $\tan(A) = -\frac{2}{3}$ (b) $\csc(A) = -\frac{3}{\sqrt{13}}$
(c) $\sec(A) = \frac{\sqrt{13}}{2}$ (d) $\sin(A) = 3$
(e) $\cos(A) = -\frac{3}{\sqrt{13}}$

58. After completing a pit stop, a racecar pulls back onto the racetrack. Let f be the function that gives the distance in feet that race car has traveled since leaving the pit with respect to the time t in seconds since the racecar left the pit. What is the meaning of the expression $f(5) - f(3)$?

- (a) the change in distance traveled from $t = 3$ to $t = 5$ seconds
(b) the average speed of the racecar between $t = 5$ and $t = 3$ seconds
(c) the change in distance traveled for $\Delta t = 2$ seconds
(d) the change in distance traveled as the racecar moved from the 3-mile marker to the 5-mile marker
(e) the change in time as the racecar moved from the 3-mile marker to the 5-mile marker

Problems 59 and 60 refer to the graph below. The graph gives Veronica's weight W in pounds as a function f of the number n days after January 1, 2012.



59. Which of the following statements is a correct interpretation of $W = f(n)$?

- (a) The expression means W equals f times n .
(b) The expression means an input of n days since January 1, 2012 produces an output of W pounds.
(c) The expression means an input of W pounds produces an output of n days since January 1, 2012.
(d) Both Statements (a) and (b) are true.
(e) Both Statements (a) and (c) are true.

60. What is the solution to the equation $120 = f(n)$?

- (a) $n = \frac{120}{f}$ days since January 1, 2012 (b) $n = 110$ days since January 1, 2012
(c) $n = 63$ days since January 1, 2012 (d) Both Statements (a) and (b) are true.
(e) Both Statements (a) and (c) are true.

61. If $f(t) = \sqrt{t} + 8$ and $g(u) = 2u - 1$, then what is the rule defining the function $h(t) = (g \circ f)(t)$?

- (a) $h(t) = \sqrt{2t+7}$ (b) $h(t) = (2t-1)(\sqrt{t}+8)$
(c) $h(t) = 2t-1$ (d) $h(t) = \sqrt{2t-1}+8$
(e) $h(t) = 2\sqrt{t}+15$

62. Suppose that $y = f(x)$ defines the values of y as a function of the values of x . Which of the following expressions gives the average rate of change for f as the values of x change from $x = 4$ to $x = 1$?

- (a) $\frac{f(1) - f(4)}{1 - 4}$ (b) $f(4) - f(1)$
(c) $\frac{y(1) - y(4)}{1 - 4}$ (d) $1 - 4$
(e) Both (a) and (c)

63. The number D of deer present in Strawberry Field x years after 2000 is given by the function

$$D = f(x) = 250 + 65 \cdot 2.135^{-x}$$

As the number of years since 2000 increases, what happens to the deer population?

- (a) The population increases, approaching 185 deer.
(b) The population decreases, approaching 250 deer.
(c) The population decreases, approaching 111 deer.
(d) The population increases, approaching 250 deer.
(e) The population decreases, approaching 0 deer.
64. For the table below, which of the following statements is correct?

x	0.0	1.0	7.5	1.0
y	1.0	2.0	6.0	7.5

- (a) In the relation, x is **not** a function of y , and y is **not** a function of x .
(b) In the relation, x is a function of y , and y is a function of x .
(c) In the relation, x is a function of y , but y is **not** a function of x .
(d) In the relation, x is **not** a function of y , but y is a function of x .
(e) There is not enough information to tell whether one variable is a function of the other.
65. Let f be the function that gives the annual salary S in dollars for Arial with respect to the number m of months she has been on the job. What would the function $g(m) = f(m+2)$ represent?
- (a) The salary of Arial after two months on the job
(b) Two dollars more than the salary of Arial when she has been on the job for m months
(c) The salary of Arial two months after she has been on the job for m months
(d) An employee who has been on the job two months longer than an Arial, who has been on the job for m months
(e) The salary of $m+2$ employees

66. If $y = h(x) = 5x - 4$, then what steps must be followed to create the rule defining the function h^{-1} ?
- Take the reciprocal of y .
 - Divide y by 5, then add 4 from the result.
 - Add 4 to y , then divide the result by 5.
 - Add 4 to y , then divide the result by x .
 - Take the reciprocal of y , multiply the result by 5, and then add 1.

Problems 67 and 68 refer to the table below. Let f be the function that gives the number N of cats (in millions) owned in the US with respect to the number B of cat food brands available in the US. Let g be the function that gives the number N of cats owned (in millions) in the US with respect to the number t of years since 2000. The tables below provide some data for these functions.

Number of Brands	Number of Cats (Millions)	Years since 2000	Number of Cats (Millions)
1	4.0	1.0	5.0
4	5.0	1.5	9.1
6	10.2	2.5	9.1
7	9.7	4.0	9.7
8	11.3	5.0	10.2

Table for the function f

Table for the function g

67. Based on the tables, what is the value of $f^{-1}(g(5.0))$?
- 10.2
 - $\frac{1}{4}$
 - $\frac{1}{10.2}$
 - 4
 - 6
68. Based on the tables, what is true about the expression $g(f(4))$?
- $g(f(4)) = 5.0$
 - $g(f(4)) = 9.7$
 - $g(f(4)) = 4.0$
 - $g(f(4)) = 10.2$
 - $g(f(4))$ has no real-world meaning.
69. Suppose an ant is sitting on the tip of a fan blade that is three feet long. The fan starts slowly rotating, and the ant rotates through an angle having measure -143° before it falls off the blade. Approximately how far did the ant travel from its starting point to the point where it fell off the blade?
- about 6.27 feet
 - about -2.50 feet
 - about 7.49 feet
 - about 4.29 feet
 - about 2.50 feet
70. Nichelle places an eleven-gram sample of bacteria in a Petri dish and applies a probiotic which causes the mass of the bacteria to increase continuously at 11.5% per day. To the nearest tenth gram, what will be the mass of the bacteria after one week?
- 26,981.2 grams
 - 33.5 grams
 - 12.3 grams
 - 4.9 grams
 - 24.6 grams

ANSWERS

(1) D	(21) A	(41) C	(61) E
(2) B	(22) A	(42) E	(62) A
(3) B	(23) E	(43) B	(63) B
(4) C	(24) B	(44) C	(64) C
(5) B	(25) C	(45) D	(65) C
(6) D	(26) D	(46) C	(66) C
(7) C	(27) B	(47) B	(67) D
(8) B	(28) C	(48) B	(68) E
(9) B	(29) A	(49) E	(69) E
(10) C	(30) D	(50) A	(70) D
(11) E	(31) A	(51) D	(71) A
(12) A	(32) C	(52) B	(72) D
(13) B	(33) B	(53) B	(73) C
(14) D	(34) B	(54) A	(74) A
(15) A	(35) C	(55) C	(75) B
(16) D	(36) E	(56) E	(76) E
(17) A	(37) E	(57) C	(77) C
(18) E	(38) D	(58) A	(78) A
(19) E	(39) A	(59) B	(79) E
(20) E	(40) C	(60) C	(80) E