Review Test 4

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

For the given functions f and g, find the requested composite function value.

1) $f(x) = \sqrt{x + 2}$, $g(x) = 2x$;   Find $(f \circ g)(1)$.

    A) 2   B) $\sqrt{6}$ C) $2\sqrt{3}$ D) $2\sqrt{6}$

1) _____

2) $f(x) = 4x + 4$, $g(x) = 4x^2 + 3$;   Find $(f \circ f)(2)$.

    A) 579   B) 52   C) 80   D) 1447

2) _____

3) $f(x) = 5x + 5$, $g(x) = -1/x$;   Find $(g \circ f)(3)$.

    A) $-\dfrac{1}{20}$ B) $\dfrac{59}{3}$ C) $\dfrac{10}{3}$ D) $-\dfrac{20}{3}$

3) _____

4) $f(x) = 15x^2 - 6x$, $g(x) = 18x - 9$;   Find $(f \circ g)(5)$.

    A) 6201   B) 27,945   C) 91,728   D) 97,929

4) _____

For the given functions f and g, find the requested composite function.

5) $f(x) = 5x + 11$, $g(x) = 3x - 1$;   Find $(f \circ g)(x)$.

    A) $15x + 16$ B) $15x + 32$ C) $15x + 6$ D) $15x + 10$

5) _____

6) $f(x) = \dfrac{2}{x + 5}$, $g(x) = \dfrac{7}{5x}$;   Find $(f \circ g)(x)$.

    A) $\dfrac{10x}{7 + 25x}$ B) $\dfrac{2x}{7 + 25x}$ C) $\dfrac{7x + 35}{10x}$ D) $\dfrac{10x}{7 - 25x}$

6) _____

7) $f(x) = \dfrac{5}{x - 8}$, $g(x) = \dfrac{4}{7x}$;   Find $(f \circ g)(x)$.

    A) $\dfrac{5x}{4 - 56x}$ B) $\dfrac{35x}{4 + 56x}$ C) $\dfrac{35x}{4 - 56x}$ D) $\dfrac{4x - 32}{35x}$

7) _____

8) $f(x) = 4x^2 + 5x + 8$, $g(x) = 5x - 6$;   Find $(g \circ f)(x)$.

    A) $4x^2 + 25x + 34$ B) $4x^2 + 5x + 2$ C) $20x^2 + 25x + 46$ D) $20x^2 + 25x + 34$

8) _____

9) $f(x) = x^2 + 9$, $g(x) = x^2 + 5$;   Find $(f \circ g)(x)$.

    A) $x^4 + 18x^2 + 86$ B) $x^4 + 86$ C) $x^4 + 34$ D) $x^4 + 10x^2 + 34$

9) _____

Decide whether the composite functions, f ∘ g and g ∘ f, are equal to x.

10) $f(x) = x^2 + 2$, $g(x) = \sqrt{x} - 2$

    A) Yes, no   B) Yes, yes   C) No, yes   D) No, no

10) _____

11) $f(x) = \sqrt{x}$, $g(x) = x^2$

    A) No, no   B) Yes, yes   C) No, yes   D) Yes, no

11) _____

12) $f(x) = 3x, \quad g(x) = \dfrac{x}{3}$

    A) Yes, no   B) No, yes   C) Yes, yes   D) No, no

Find functions f and g so that f ∘ g = H.

13) $H(x) = \sqrt[3]{x+1}$

    A) $f(x) = x + 1$; $g(x) = \sqrt[3]{x}$ B) $f(x) = \sqrt[3]{x}$; $g(x) = x + 1$

    C) $f(x) = \sqrt[3]{x}$; $g(x) = 1$ D) $f(x) = \sqrt{x}$; $g(x) = x + 1$

14) $H(x) = \dfrac{1}{x^2 - 7}$

    A) $f(x) = x^2 - 7$; $g(x) = \dfrac{1}{x}$ B) $f(x) = \dfrac{1}{x}$, $g(x) = x^2 - 7$

    C) $f(x) = \dfrac{1}{x^2} - 9$; $g(x) = \dfrac{1}{x}$ D) $f(x) = \dfrac{1}{x}$; $g(x) = \dfrac{1}{x^2} - 9$

15) $H(x) = |2x + 10|$

    A) $f(x) = x$; $g(x) = 2x + 10$ B) $f(x) = |x|$; $g(x) = 2x + 10$

    C) $f(x) = -|x|$; $g(x) = 2x + 10$ D) $f(x) = |-x|$; $g(x) = 2x - 10$

16) $H(x) = \sqrt{\dfrac{1}{x - 2}}$

    A) $f(x) = \dfrac{1}{x - 2}$; $g(x) = \dfrac{1}{\sqrt{x}}$ B) $f(x) = \dfrac{1}{x - 2}$; $g(x) = \sqrt{x}$

    C) $f(x) = x - 2$; $g(x) = \dfrac{1}{\sqrt{x}}$ D) $g(x) = \sqrt{x}$; $f(x) = \dfrac{1}{x - 2}$

Solve the problem.

17) The population P of a predator mammal depends upon the number x of a smaller animal that is its primary food source. The population s of the smaller animal depends upon the amount a of a certain plant that is its primary food source. If $P(x) = 2x^2 + 7$ and $s(a) = 2a + 2$, what is the relationship between the predator mammal and the plant food source?

    A) $P(s(a)) = 4a^2 + 8a + 11$ B) $P(s(a)) = 4a + 9$

    C) $P(s(a)) = 8a^2 + 16a + 15$ D) $P(s(a)) = 8a^2 + 8a + 15$

18) An oil well off the Gulf Coast is leaking, with the leak spreading oil over the surface of the gulf as a circle. At any time t, in minutes, after the beginning of the leak, the radius of the oil slick on the surface is $r(t) = 5t$ ft. Find the area A of the oil slick as a function of time.

    A) $A(r(t)) = 25t^2$ B) $A(r(t)) = 25\pi t^2$ C) $A(r(t)) = 5\pi t^2$ D) $A(r(t)) = 25\pi t$

19) An airline charter service charges a fare per person of $450 plus $20 for each unsold seat. The airplane holds 75 passengers. Let x represent the number of unsold seats and write an expression for the total revenue R for a charter flight.

19) _____

    A) $R(x) = (75 - x)(450 + 20x)$ or $33,750 + 1050x - 20x^2$
    B) $R(x) = 75(450 + 20x)$ or $33,750 + 1500x$
    C) $R(x) = x(450 + 20x)$ or $450x + 20x^2$
    D) $R(x) = (75 - x)(450 + 20x)$ or $33,750 + 1500x - 20x^2$

Find the domain of the composite function f ∘ g.
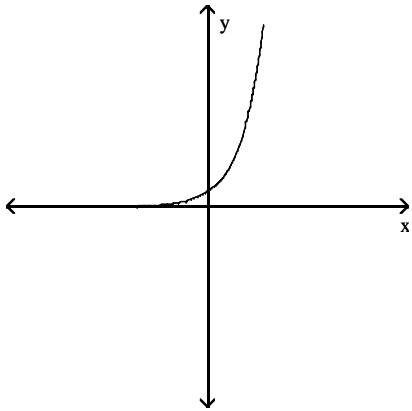
20) $f(x) = 9x + 72$; $g(x) = x + 6$

20) _____

    A) $\{x \mid x \neq -14\}$ B) $\{x \mid x \neq -6, x \neq -8\}$
    C) $\{x \mid x \neq 14\}$ D) $\{x \mid x \text{ is any real number}\}$

21) $f(x) = \dfrac{5}{x + 1}$; $g(x) = x + 10$

21) _____

    A) $\{x \mid x \neq -1\}$ B) $\{x \mid x \text{ is any real number}\}$
    C) $\{x \mid x \neq -11\}$ D) $\{x \mid x \neq -1, x \neq -10\}$

22) $f(x) = \dfrac{x}{x + 1}$; $g(x) = \dfrac{3}{x + 5}$

22) _____

    A) $\{x \mid x \neq -5, x \neq -8\}$ B) $\{x \mid x \text{ is any real number}\}$
    C) $\{x \mid x \neq 0, x \neq -5, x \neq -8\}$ D) $\{x \mid x \neq -5, x \neq -1\}$

23) $f(x) = \sqrt{x - 1}$; $g(x) = \dfrac{1}{x - 9}$

23) _____

    A) $\{x \mid x \neq 9, x \neq 1\}$ B) $\{x \mid 9 < x \leq 10\}$
    C) $\{x \mid x \text{ is any real number}\}$ D) $\{x \mid x \geq 1, x \neq 9\}$

24) $f(x) = \sqrt{2 - x}$; $g(x) = |2x - 1|$

24) _____

    A) $\left\{ x \mid -\dfrac{1}{2} \leq x \leq \dfrac{3}{2} \right\}$ B) $\{x \mid x \leq 2\}$

    C) all real numbers   D) $\{x \mid x \geq 2\}$

Indicate whether the function is one–to–one.

25) $\{(15, -19), (14, 10), (-8, 12)\}$

25) _____

    A) Yes   B) No

26) $\{(11, 9), (-15, 9), (-20, 17)\}$

26) _____

    A) Yes   B) No

27) $\{(-4, 1), (-1, 4), (2, -7), (-2, 7)\}$

27) _____

    A) Yes   B) No

Use the horizontal line test to determine whether the function is one –to–one.

28)

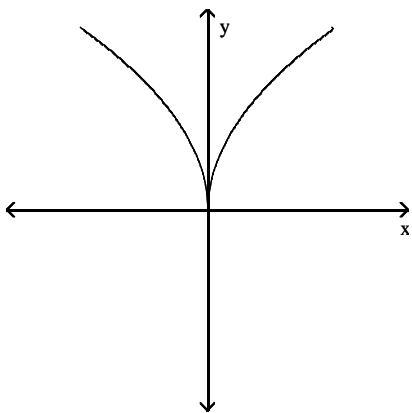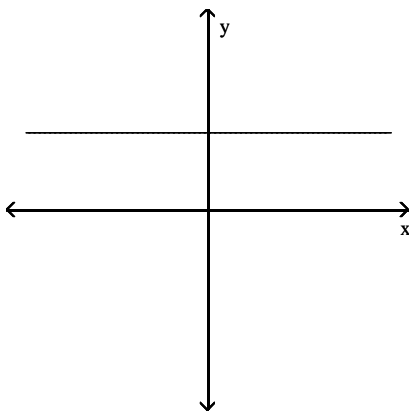A) Yes   B) No

28) _____

29)

A) Yes   B) No

29) _____

30)

A) Yes   B) No

30) _____

4

Find the inverse of the function and state its domain and range .

31) {(14, 3), (12, 4), (10, 5), (8, 6)}   31) _____

    A) {(4, 3), (6, 10), (14, 10), (4, 5)}; D = {4, 6, 14}; R = {3, 10, 5}

    B) {(4, 3), (3, 10), (14, 12), (4, 5)}; D = {(4, 3, 14}; R = {(3, 10 12, 5}

    C) $\left\{\left(14, \frac{1}{3}\right), \left(12, \frac{1}{4}\right), \left(10, \frac{1}{5}\right), \left(8, \frac{1}{6}\right)\right\}$; D = { 14, 12, 10, 8}, R = $\left\{\frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}\right\}$

    D) {(3, 14), (4, 12), (5, 10), (6, 8)}; D = {3, 4, 5, 6 }; R = {14, 12, 10, 8}

32) {(-6, 1), (-1, 6), (-5, -3), (5, 3)}   32) _____

    A) {(3, -5), (-5, -1), (1, -6), (-3, 5)}; D = {3, -5, 1, -3}; R = {-5, -1, -6, 5}

    B) {(3, -5), (6, -1), (1, -1), (-3, 5)}; D = {(3, 6, 1, -3}; R = {-5, -1, 5}

    C) {(1, -6), (6, -1), (-3, -5), (3, 5)} D = {1, 6, -3, 3}; R = {-6, -1, -5, 5}

    D) $\left\{\left(-6, 1\right), \left(-1, \frac{1}{6}\right), \left(-5, -\frac{1}{3}\right), \left(5, \frac{1}{3}\right)\right\}$ D = { -6, -1, -5, 5}, R = $\left\{1, \frac{1}{6}, -\frac{1}{3}, \frac{1}{3}\right\}$

33) {(-3, 4), (-1, 5), (0, 2), (2, 6), (5, 7)}   33) _____

    A) {(4, -3), (5, -1), (2, 0), (6, 2), (7, 5)} D = {2, 4, 5, 6, 7}; R = {-3, -1, 0, 2, 5}

    B) {(-3, -4), (-1, -5), (0, -2), (2, -6), (5, -7)}; D = {-3, -1, 0, 2, 5}; R = {-7, -6, -5, -4, -2}

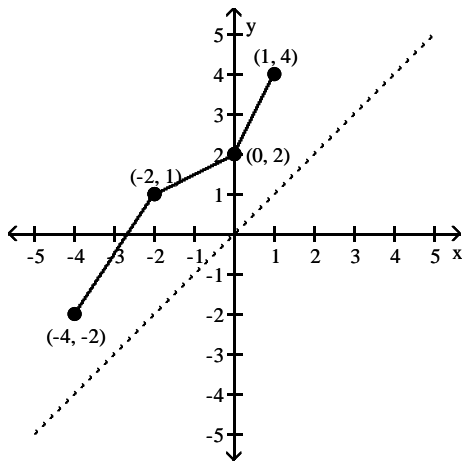   C) {(3, 4), (1, 5), (0, 2), (-2, 6), (-5, 7)}; D = {3, 1, 0, -2, -5}; R = {2, 4, 5, 6, 7}

    D) {(3, -4), (1, -5), (0, -2), (-2, -6), (-5, -7)}; D = {3, 1, 0, -2, -5}; R = {-7, -6, -5, -4, -2}

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the graph of the given one–to–one function to sketch the graph of the inverse function. For convenience, the graph of y = x is also given.

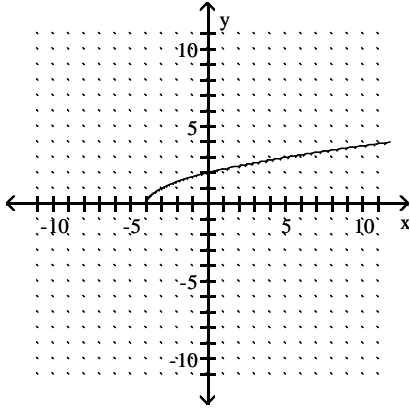34)   34) _____

5

The graph of a one-to-one function f is given. Draw the graph of the inverse function f^{-1} as a dashed line or curve.
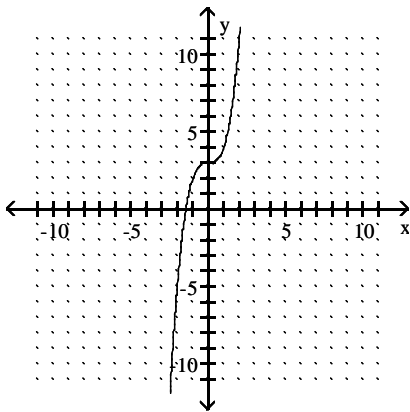
35) $f(x) = \sqrt{x + 4}$

35) _____

36) $f(x) = x^3 + 3$

36) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Decide whether or not the functions are inverses of each other.

37) $f(x) = 3x + 9$, $g(x) = \frac{1}{3}x - 3$

37) _____

A) Yes   B) No

38) $f(x) = 8x^2 + 9$, $g(x) = \sqrt{\dfrac{x - 9}{8}}$

38) _____

A) No   B) Yes; No values need to be excluded.
C) Yes; Exclude the interval $(-\infty, 8)$ D) Yes; Exclude the interval $(-\infty, 9)$

39) $f(x) = (x - 2)^2$, $x \geq 2$; $g(x) = \sqrt{x + 2}$

39) _____

A) Yes   B) No

40) $f(x) = \dfrac{1}{x + 2}$, $g(x) = \dfrac{2x + 1}{x}$

40) _____

A) Yes
B) No
C) Yes; Exclude the value $\{-2\}$

6

The function f is one–to–one. Find its inverse.

41) $f(x) = 3x - 7$

41) _____

  A) $f^{-1}(x) = \dfrac{x}{3} - 7$ B) $f^{-1}(x) = \dfrac{x - 7}{3}$ C) $f^{-1}(x) = \dfrac{x + 7}{3}$ D) $f^{-1}(x) = \dfrac{x}{3} + 7$

42) $f(x) = x^2 + 4, \; x \geq 0$

42) _____

  A) $f^{-1}(x) = \sqrt{x - 4}, \; x \geq 4$ B) $f^{-1}(x) = \sqrt{x} - 4, \; x \geq 0$
  C) $f^{-1}(x) = \sqrt{x + 4}, \; x \geq -4$ D) $f^{-1}(x) = \sqrt{x} - 4, \; x < 0$

43) $f(x) = x^3 - 3$

43) _____

  A) $f^{-1}(x) = \sqrt[3]{x - 3}$ B) $f^{-1}(x) = \sqrt[3]{x} + 3$ C) $f^{-1}(x) = \sqrt[3]{x} - 3$ D) $f^{-1}(x) = \sqrt[3]{x + 3}$

44) $f(x) = \dfrac{4}{7x + 3}$

44) _____

  A) $f^{-1}(x) = \dfrac{7x + 3}{4}$ B) $f^{-1}(x) = \dfrac{3x - 4}{7x}$ C) $f^{-1}(x) = \dfrac{4 - 3x}{7x}$ D) $f^{-1}(x) = \dfrac{4 - 3y}{7y}$

45) $f(x) = \dfrac{7}{x + 7}$

45) _____

  A) $f^{-1}(x) = \dfrac{x}{7 + 7x}$ B) $f^{-1}(x) = \dfrac{7 + 7x}{x}$

  C) $f^{-1}(x) = \dfrac{-7x + 7}{x}$ D) $f^{-1}(x) = \dfrac{7 + 7x^2}{x}$

Find the inverse function of f. State the domain and range of f.

46) $f(x) = \dfrac{3x - 2}{x + 5}$

46) _____

  A) $f^{-1}(x) = \dfrac{5x + 2}{3 - x}$; domain of f: $\{x \mid x \neq -5\}$; range of f: $\{y \mid y \neq 3\}$

  B) $f^{-1}(x) = \dfrac{5x + 2}{3 + x}$; domain of f: $\{x \mid x \neq -5\}$; range of f: $\{y \mid y \neq -3\}$

  C) $f^{-1}(x) = \dfrac{3x + 2}{x - 5}$; domain of f: $\{x \mid x \neq -5\}$; range of f: $\{y \mid y \neq 5\}$

  D) $f^{-1}(x) = \dfrac{x + 5}{3x - 2}$; domain of f: $\{x \mid x \neq -5\}$; range of f: $\{y \mid y \neq \dfrac{2}{3}\}$

Determine i) the domain of the function, ii) the range of the function, iii) the domain of the inverse, and iv) the range of the inverse.

47) $f(x) = \dfrac{3}{x+4}$

47) _____

    A) $f(x)$: $D = \left\{ x \mid x \neq \dfrac{3}{4} \right\}$, $R = \{ y \mid y \neq -4 \}$;

    $f^{-1}(x)$: $D = \{ x \mid x \neq -4 \}$, $R = \left\{ y \mid y \neq \dfrac{3}{4} \right\}$

    B) $f(x)$: D is all real numbers, R is all real numbers;

      $f^{-1}(x)$: D is all real numbers, R is all real numbers

    C) $f(x)$: $D = \{ x \mid x \neq -4 \}$, $R = \{ y \neq 0 \}$;

      $f^{-1}(x)$: $D = \{ x \mid x \neq 0 \}$, $R = \{ y \mid y \neq -4 \}$

    D) $f(x)$: D is all real numbers, $R = \left\{ y \mid y \neq \dfrac{3}{4} \right\}$;

    $f^{-1}(x)$: $D = \left\{ x \mid x \neq \dfrac{3}{4} \right\}$, R is all real numbers

48) $f(x) = \sqrt{3 - 5x}$

48) _____

    A) $f(x)$: $D = \{ x \mid x \geq 0 \}$, $R = \{ y \mid y \geq 0 \}$;

    $f^{-1}(x)$: $D = \{ x \mid x \geq 0 \}$, $R = \left\{ y \mid y \geq \dfrac{3}{5} \right\}$

    B) $f(x)$: $D = \left\{ x \mid x \leq \dfrac{3}{5} \right\}$, $R = \{ y \mid y \leq 0 \}$;

    $f^{-1}(x)$: D is all real numbers, $R = \left\{ y \mid y \leq \dfrac{3}{5} \right\}$

    C) $f(x)$: $D = \left\{ x \mid x \leq \dfrac{3}{5} \right\}$, R is all real numbers;

    $f^{-1}(x)$: D is all real numbers, $R = \left\{ y \mid y \leq \dfrac{3}{5} \right\}$

    D) $f(x)$: $D = \left\{ x \mid x \leq \dfrac{3}{5} \right\}$, $R = \{ y \mid y \geq 0 \}$;

    $f^{-1}(x)$: $D = \{ x \mid x \geq 0 \}$, $R = \left\{ y \mid y \leq \dfrac{3}{5} \right\}$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

49) The profit P for selling x items is given by the equation $P(x) = 2x - 500$. Express the sales amount x as a function of the profit P.

49) _____

50) The weight W of a bird's brain (in ounces) is related to the volume V of the bird's skull (in cubic ounces) through the function $W(V) = 3.36 \sqrt[3]{V} + 1.15$.
    (a) Express the skull volume V as a function of brain weight W.
    (b) Predict the skull volume of a bird whose brain weighs 2 oz.

50) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find a formula for the inverse of the function described below.

51) A size 8 dress in Country C is size 34 in Country D. A function that converts dress sizes in Country C to those in Country D is $f(x) = x + 26$.

    A) $f^{-1}(x) = \dfrac{x}{-26}$ B) $f^{-1}(x) = x + 26$ C) $f^{-1}(x) = \dfrac{x}{26}$ D) $f^{-1}(x) = x - 26$

51) _____

52) A size 2 dress in Country C is size 44 in Country D. A function that converts dress sizes in Country C to those in Country D is $f(x) = 2(x + 20)$.

    A) $f^{-1}(x) = \dfrac{x}{2} + 20$ B) $f^{-1}(x) = \dfrac{x}{2} - 20$ C) $f^{-1}(x) = \dfrac{x - 20}{2}$ D) $f^{-1}(x) = x - 20$

52) _____

53) A size 32 dress in Country C is size 8 in Country D. A function that converts dress sizes in Country C to those in Country D is $f(x) = \dfrac{x}{2} - 8$.

    A) $f^{-1}(x) = 2x + 8$ B) $f^{-1}(x) = 2(x + 8)$ C) $f^{-1}(x) = 2(x - 8)$ D) $f^{-1}(x) = x + 8$

53) _____

Solve the problem.

54) The function $D(h) = 8e^{-0.4h}$ can be used to determine the milligrams D of a certain drug in a patient's bloodstream h hours after the drug has been given. How many milligrams (to two decimals) will be present after 12 hours?

    A) 0.07 mg   B) 972.08 mg   C) 0.49 mg   D) 4.76 mg

54) _____

55) The formula $P = 14.7e^{-0.21x}$ gives the average atmospheric pressure, P, in pounds per square inch, at an altitude x, in miles above sea level. Find the average atmospheric pressure for an altitude of 2.3 miles. Round your answer to the nearest tenth.

    A) 7.8 lb/in.^{2} B) 9.1 lb/in.^{2} C) 11.0 lb/in.^{2} D) 8.4 lb/in.^{2}

55) _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.
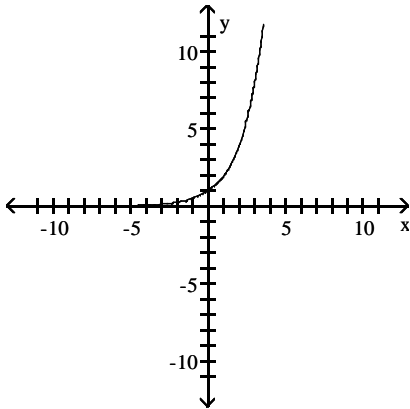
56) A rumor is spread at an elementary school with 1200 students according to the model $N = 1200(1 - e^{-0.16d})$ where N is the number of students who have heard the rumor and d is the number of days that have elapsed since the rumor began. How many students will have heard the rumor after 5 days?

56) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

The graph of an exponential function is given. Match the graph to one of the following functions.
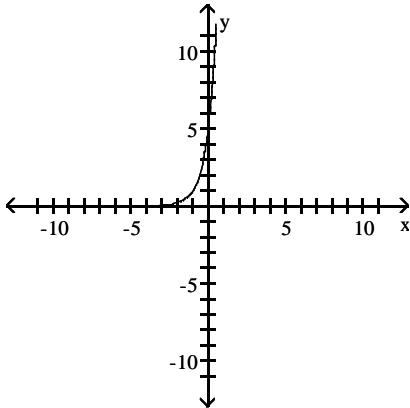
57)

A) $f(x) = 2^{x} + 2$ 　　　　 B) $f(x) = 2^{x} - 2$ 　　　　 C) $f(x) = 2^{x}$ 　　　　 D) $f(x) = 2^{x} + 2$

58)

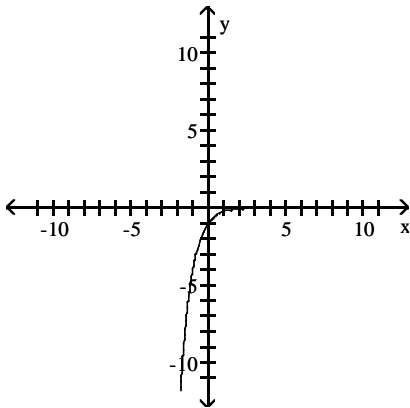A) $f(x) = 5^{x} - 1$ 　　　　 B) $f(x) = 5^{x} + 1$ 　　　　 C) $f(x) = 5^{x} + 1$ 　　　　 D) $f(x) = 5^{x}$

59)

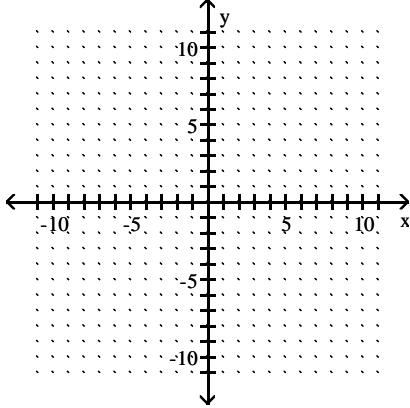A) $f(x) = -4^{x}$ 　　　　 B) $f(x) = 4^{x}$ 　　　　 C) $f(x) = 4^{-x}$ 　　　　 D) $f(x) = -4^{-x}$

10

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use transformations to graph the function. Determine the domain, range, and horizontal asymptote of the function.
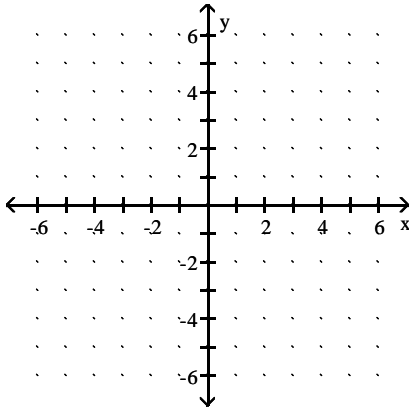
60) $f(x) = -2^{x+3} + 4$

60) _____

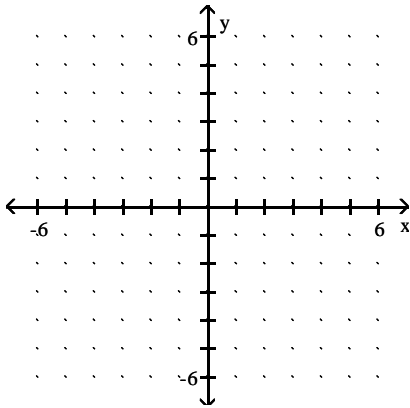**Graph the function.**

61) $f(x) = 3^{(x+3)} + 1$.

61) _____

Use transformations to graph the function. Determine the domain, range, and horizontal asymptote of the function.
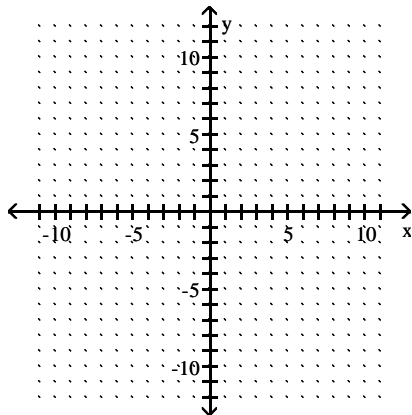
62) $f(x) = 5^{(x-2)}$

62) _____

Graph the function.

63) $f(x) = -1 + e^x$

63) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the equation.

64) $2^{1 + 2x} = 32$

64) _____

    A) {-2}   B) {2}   C) {16}   D) {4}

65) $4^{-x} = \dfrac{1}{64}$

65) _____

    A) {-3}   B) $\left\{\dfrac{1}{16}\right\}$ C) $\left\{\dfrac{1}{3}\right\}$ D) {3}

66) $3^x = \dfrac{1}{27}$

66) _____

    A) $\left\{\dfrac{1}{9}\right\}$ B) {-3}   C) {3}   D) $\left\{\dfrac{1}{3}\right\}$

67) $4^{(3x - 5)} = 256$

67) _____

    A) $\left\{\dfrac{1}{64}\right\}$ B) {-3}   C) {3}   D) {128}

68) $2^{x^2 - 3} = 64$

68) _____

    A) {6}   B) {3}   C) $\{\sqrt{35}, -\sqrt{35}\}$ D) {3, -3}

69) $9^{2x} \cdot 27^{(3 - x)} = \dfrac{1}{9}$

69) _____

    A) $\left\{\dfrac{9 + \sqrt{87}}{6}, \dfrac{9 - \sqrt{87}}{6}\right\}$ B) {10}

    C) {-11}   D) {-8}

70) $3^{(11 - 4x)} = 27$

70) _____

    A) {3}   B) {1}   C) {-2}   D) {2}

12

71) $16^{x-4} = 64^{3x}$ 71) _____

    A) $\{-2\}$ B) $\left\{-\dfrac{2}{7}\right\}$ C) $\left\{-\dfrac{16}{5}\right\}$ D) $\left\{-\dfrac{8}{7}\right\}$

72) $\left(\dfrac{64}{27}\right)^{x+1} = \left(\dfrac{3}{4}\right)^{x-1}$ 72) _____

    A) $\{-1\}$ B) $\left\{\dfrac{1}{2}\right\}$ C) $\left\{-\dfrac{1}{4}\right\}$ D) $\left\{-\dfrac{1}{2}\right\}$

73) $e^{x-5} = \left(\dfrac{1}{e^2}\right)^{x+2}$ 73) _____

    A) $\{-9\}$ B) $\left\{\dfrac{7}{3}\right\}$ C) $\{-7\}$ D) $\left\{\dfrac{1}{3}\right\}$

Solve the problem.

74) The rabbit population in a forest area grows at the rate of 4% monthly. If there are 220 rabbits in April, find how many rabbits (rounded to the nearest whole number) should be expected by next April. Use $y = 220(2.7)^{0.04t}$ 74) _____

    A) 354   B) 285   C) 341   D) 367

75) The bacteria in a 8-liter container double every 4 minutes. After 57 minutes the container is full. How long did it take to fill a quarter of the container?   75) _____

    A) 49 min   B) 42.8 min   C) 14.3 min   D) 28.5 min

76) A city is growing at the rate of 0.6% annually. If there were 4,770,000 residents in the city in 1995, find how many (to the nearest ten-thousand) were living in that city in 2000. Use $y = 4,770,000(2.7)^{0.006t}$ 76) _____

    A) 12,880,000   B) 390,000   C) 4,910,000   D) 4,940,000

77) Find the amount in a savings account at the end of 10 years if the amount originally deposited is $3000 and the interest rate is 5.5% compounded semiannually.   77) _____

Use: $A = P\left(1 + \dfrac{r}{n}\right)^{nt}$ where:

A = final amount
P = \$3000 (the initial deposit)
r = 5.5% = 0.055 (the annual rate of interest)
n = 2 (the number of times interest is compounded each year)
t = 10 (the duration of the deposit in years)

    A) $3934.95   B) $5161.29   C) $61,650.00   D) $5677.41

78) Letitia borrows $3750 at a rate of 10.5% compounded monthly. Find how much Letitia owes at the end of 4 years.

Use: $A = P\left(1 + \dfrac{r}{n}\right)^{nt}$ where:

A = final amount
P = $3750 (the amount borrowed)
r = 10.5% = 0.105 (the annual rate of interest)
n = 12 (the number of times interest is compounded each year)
t = 4 (the duration of the loan in years)

A) $5696.94   B) $6266.63   C) $3882.98   D) $181,575.00

78) _____

Change the exponential expression to an equivalent expression involving a logarithm.

79) $5^3 = 125$

A) $\log_5 3 = 125$ B) $\log_3 125 = 5$ C) $\log_{125} 5 = 3$ D) $\log_5 125 = 3$

79) _____

80) $6^2 = x$

A) $\log_2 x = 6$ B) $\log_6 x = 2$ C) $\log_x 6 = 2$ D) $\log_6 2 = x$

80) _____

81) $10^x = 1000$

A) $\log_{10} 1000 = x$ B) $\log_x 1000 = 10$ C) $\log_{1000} x = 10$ D) $\log_{1000} 10 = x$

81) _____

Change the logarithmic expression to an equivalent expression involving an exponent.

82) $\log_{1/4} 16 = -2$

A) $(-2)^{1/4} = 16$ B) $\left(\dfrac{1}{4}\right)^{-2} = 16$ C) $\left(\dfrac{1}{4}\right)^2 = 16$ D) $16^{1/4} = 2$

82) _____

83) $\log_4 64 = 3$

A) $4^{64} = 3$ B) $4^3 = 64$ C) $3^4 = 64$ D) $64^3 = 4$

83) _____

84) $\log_b 64 = 3$

A) $b^3 = 64$ B) $64^b = 3$ C) $64^3 = b$ D) $3^b = 64$

84) _____

85) $\ln x = 4$

A) $e^4 = x$ B) $4^e = x$ C) $e^x = 4$ D) $x^4 = e$

85) _____

Find the exact value of the logarithmic expression.

86) $\log_4 64$

A) 64   B) 3   C) 12   D) 4

86) _____

87) $\log_7 \dfrac{1}{343}$

A) 3   B) 49   C) –49   D) –3

87) _____

14

88) $\log_4 1$ 88) _____

    A) 4   B) 1   C) $\dfrac{1}{4}$ D) 0

89) $\ln 1$ 89) _____

    A) –1   B) 0   C) e   D) 1

90) $\ln e^8$ 90) _____

    A) $\dfrac{1}{8}$ B) 1   C) e   D) 8

Find the domain of the function.

91) $f(x) = \log(x + 9)$ 91) _____

    A) $(9, \infty)$ B) $(-9, \infty)$ C) $(0, \infty)$ D) $(1, \infty)$

92) $f(x) = \ln(-1 - x)$ 92) _____

    A) $(-1, \infty)$ B) $(-\infty, 1)$ C) $(1, \infty)$ D) $(-\infty, -1)$

93) $f(x) = \log_5(25 - x^2)$ 93) _____

    A) $(-25, 25)$ B) $[-5, 5]$ C) $(-\infty, -5) \cup (5, \infty)$ D) $(-5, 5)$

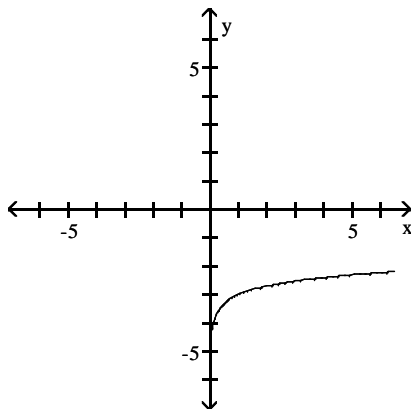94) $f(x) = \ln\left(\dfrac{1}{x + 6}\right)$ 94) _____

    A) $(1, \infty)$ B) $(6, \infty)$ C) $(0, \infty)$ D) $(-6, \infty)$

95) $f(x) = 2 - \ln(6x)$ 95) _____

    A) $(6, \infty)$ B) $(-\infty, 2) \cup (6, \infty)$ C) $(0, \infty)$ D) $(-2, 6)$

96) $f(x) = \ln \sqrt{x}$ 96) _____

    A) $(-\infty, 0)$ B) $(1, \infty)$ C) $(-\infty, 1)$ D) $(0, \infty)$

The graph of a logarithmic function is shown. Select the function which matches the graph.
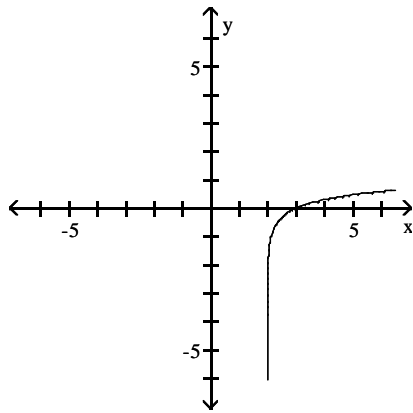
97)   97) _____

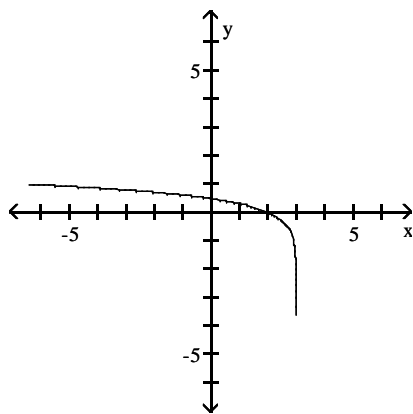   A) $y = \log(x - 3)$ B) $y = \log(3 - x)$ C) $y = 3 - \log x$ D) $y = \log x - 3$

98)

A) y = 2 – log x   B) y = log(2 – x)   C) y = log(x – 2)   D) y = log x – 2

99)

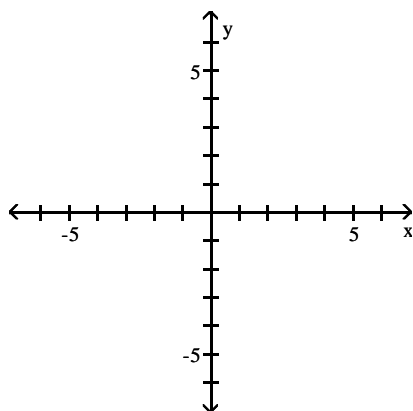A) y = log x – 3   B) y = log(x – 3)   C) y = 3 – log x   D) y = log(3 – x)

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.
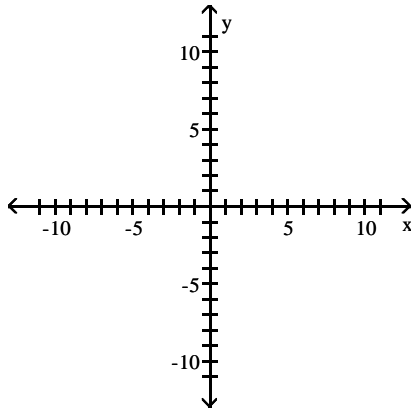
Graph the function.

100) f(x) = 4 – ln x

100) _____

101) $f(x) = 2 - \ln(x + 4)$

101) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the equation.

102) $\log_5 25 = x$

102) _____

    A) {2}   B) {30}   C) {125}   D) {5}

103) $\log_5 (x - 3) = 1$

103) _____

    A) {8}   B) {2}   C) {-2}   D) {4}

104) $4 + 7 \ln x = 6$

104) _____

    A) $\left\{\dfrac{e^2}{7}\right\}$ B) $\{e^{2/7}\}$ C) $\left\{\ln\left(\dfrac{2}{7}\right)\right\}$ D) $\left\{\dfrac{2}{7 \ln 1}\right\}$

105) $e^{3x} = 7$

105) _____

    A) $\left\{\dfrac{7}{3}e\right\}$ B) $\{3 \ln 7\}$ C) $\left\{\dfrac{\ln 3}{7}\right\}$ D) $\left\{\dfrac{\ln 7}{3}\right\}$

106) $e^{x + 4} = 7$

106) _____

    A) $\{e^7 + 4\}$ B) $\{\ln 7 - 4\}$ C) $\{e^{28}\}$ D) $\{\ln 11\}$

The loudness L(x), measured in decibels, of a sound of intensity x, measured in watts per square meter, is defined as

$L(x) = 10\log \left(\dfrac{x}{I_0}\right)$, **where** $I_0 = 10^{-12}$ **watt per square meter is the least intense sound that a human ear can detect.**

Determine the loudness, in decibels, of the sound.

107) A particular Boeing 747 jetliner produces noise at a loudness level of 113 decibels. Find the intensity level (round to the nearest hundredth) in watt per square meter for this noise.

107) _____

    A) 0.40 watt per square meter   B) 0.20 watt per square meter

    C) 0.80 watt per square meter   D) 0.10 watt per square meter

The Richter scale converts seismographic readings into numbers for measuring the magnitude of an earthquake according to this function $M(x) = \log\left(\dfrac{x}{x_0}\right)$, **where** $x_0 = 10^{-3}$.

108) What is the magnitude of an earthquake whose seismographic reading is 0.94 millimeters at a distance of 100 kilometers from its epicenter? Round the answer to four decimal places.

    A) –3.0269   B) 2.9731   C) 0.9731   D) –0.0269

108) _____

Solve the problem.

109) The formula $D = 6e^{-0.04h}$ can be used to find the number of milligrams D of a certain drug in a patient's bloodstream h hours after the drug has been given. When the number of milligrams reaches 2, the drug is to be given again. What is the time between injections?

    A) 17.33 hr   B) 30.29 hr   C) 27.47 hr   D) 44.79 hr

109) _____

Use the properties of logarithms to find the exact value of the expression. Do not use a calculator.

110) $\log_5 5^4$

    A) 1   B) 4   C) 5   D) 20

110) _____

111) $\ln e^{\sqrt{3}}$

    A) 9   B) e   C) $\sqrt{3}$ D) 3

111) _____

112) $\log_4 24 - \log_4 6$

    A) 1   B) 6   C) 4   D) 24

112) _____

113) $e^{\ln 9}$

    A) ln 9   B) 9   C) e^9 D) 8

113) _____

Write as the sum and/or difference of logarithms. Express powers as factors.

114) $\log_5 \dfrac{8}{19}$

    A) $\log_5 8 + \log_5 8$ B) $\log_5 8 - \log_5 19$

    C) $\log_5 8 \div \log_5 19$ D) $\log_5 19 - \log_5 8$

114) _____

115) $\log_{19} \dfrac{14\sqrt{m}}{n}$

    A) $\log_{19}(14\sqrt{m}) - \log_{19} n$ B) $\log_{19} 14 + \dfrac{1}{2}\log_{19} m - \log_{19} n$

    C) $\log_{19} n - \log_{19} 14 - \dfrac{1}{2}\log_{19} m$ D) $\log_{19} 14 \cdot \dfrac{1}{2}\log_{19} m \div \log_{19} n$

115) _____

116) $\log_5\left(\dfrac{x^5}{y^8}\right)$

    A) $8\log_5 y - 5\log_5 x$ B) $5\log_5 x + 8\log_5 y$

    C) $\dfrac{5}{8}\log_5\left(\dfrac{x}{y}\right)$ D) $5\log_5 x - 8\log_5 y$

116) _____

117) $\log_4\left(\dfrac{x+1}{x^2}\right)$ 117) _____

    A) $\log_4(x+1) - \log_4 x$ B) $2\log_4 x - \log_4(x+1)$

    C) $\log_4(x+1) - 2\log_4 x$ D) $\log_4(x+1) + 2\log_4 x$

118) $\log_w\left(\dfrac{9x}{4}\right)$ 118) _____

    A) $\log_w 5x$ B) $\log_w 9 + \log_w x + \log_w 4$

    C) $\log_w 9 + \log_w x - \log_w 4$ D) $\log_w 9x - \log_w 4$

119) $\log_3 \sqrt{6x}$ 119) _____

    A) $\dfrac{1}{2}\log_3 6x$ B) $\log_3 6 + \dfrac{1}{2}\log_3 x$

    C) $\log_3 \sqrt{6} + \log_3 \sqrt{x}$ D) $\dfrac{1}{2}\log_3 6 + \dfrac{1}{2}\log_3 x$

120) $\log_2\left(\dfrac{\sqrt{x}}{8}\right)$ 120) _____

    A) $\log_2 x - 3$ B) $\dfrac{1}{2}\log_2 x - 3$ C) $-3\log_2 x$ D) $6 - \dfrac{1}{2}\log_2 x$

121) $\log_3 \dfrac{\sqrt[2]{p}\,\sqrt[7]{q}}{t^2}$ 121) _____

    A) $\dfrac{1}{2}\log_3 p + \dfrac{1}{7}\log_3 q - 2\log_3 t$ B) $2\log_3 p + 7\log_3 q - 2\log_3 t$

    C) $\dfrac{2}{3}\log_3 p + \dfrac{7}{3}\log_3 q - \dfrac{2}{3}\log_3 t$ D) $\dfrac{1}{2}\log_3 p \cdot \dfrac{1}{7}\log_3 q \div 2\log_3 t$

122) $\log\left(1 - \dfrac{1}{x^3}\right)$ 122) _____

    A) $\log 1 - 3\log 1 - 3\log x$ B) $\log(x-1) + \log(x^2+1) - 3\log x$

    C) $\log x^3 - \log 1 - 3\log x$ D) $\log(x-1) + \log(x^2 + x + 1) - 3\log x$

123) $\ln\left(\dfrac{(x+5)(x-8)}{(x-2)^3}\right)^{5/2}, \quad x > 8$ 123) _____

    A) $\ln(x+5) + \ln(x-8) + \ln 5 - 15\ln(x-2) - \ln 2$

    B) $5\ln(x+5) - 2\ln(x-8) - \dfrac{15}{2}\ln(x-2)$

    C) $\dfrac{5}{2}\ln(x^2 + 13x - 40) - \dfrac{15}{2}\ln(x-2)$

    D) $\dfrac{5}{2}\ln(x+5) + \dfrac{5}{2}\ln(x-8) - \dfrac{15}{2}\ln(x-2)$

124) $\ln \dfrac{(5x)\sqrt[9]{1 + 2x}}{(x - 8)^7}$, $x > 8$ 124) _____

    A) $5\ln x + \dfrac{2}{9}\ln (1 + 2x) - 7\ln (x - 8)$ B) $\ln 5 + \ln x - 9\ln (1 + 2x) - 7\ln (x - 8)$

    C) $\ln 5 + \ln x + \dfrac{1}{9}\ln (1 + 2x) - 7\ln (x - 8)$ D) $\ln 5 + \ln x + \dfrac{1}{9}\ln (1 + 2x) - \ln 7 - \ln (x - 8)$

Express as a single logarithm.

125) $\log_c m + \log_c n$ 125) _____

    A) $\log_c (mn)$ B) $\log_c \dfrac{m}{n}$

    C) $\log_c m \cdot \log_c n$ D) $\log_c mn$

126) $5\log_a 10 + 3\log_a 3$ 126) _____

    A) $\log_a (50 + 9)$ B) $\log_a 10^5 \cdot \log_a 3^3$

    C) $\log_a \dfrac{10^5}{3^3}$ D) $\log_a 10^5 3^3$

127) $5\log_a x - \dfrac{5}{6}\log_a y + \dfrac{1}{4}\log_a w - 4\log_a z$ 127) _____

    A) $\log_a \dfrac{x^5 \, w^{1/4}}{y^{5/6} \, z^4}$ B) $\log_a \left(5x - \dfrac{5}{6}y + \dfrac{1}{4}w - 4z\right)$

    C) $\log_a \dfrac{x^5 \, y^{5/6}}{w^{1/4} \, z^4}$ D) $\log_a \dfrac{x^5 z^4}{w^{1/4} \, y^{5/6}}$

128) $3 \log_a (2x + 1) - 2 \log_a (2x - 1) + 2$ 128) _____

    A) $\log_a 2(x + 1)$ B) $\log_a \dfrac{a^2(2x + 1)^3}{(2x - 1)^2}$

    C) $\log_a (2x + 3)$ D) $\log_a (2x + 1) + 2$

129) $\ln \dfrac{x^2 - 7x - 18}{x - 7} - \ln \dfrac{x^2 - 5x - 14}{x + 1} + \ln (x^2 - 18x + 81)$, $x > 0$ 129) _____

    A) $\ln \dfrac{(x - 9)^3(x + 1)}{(x - 7)^2}$ B) $\ln \dfrac{3(x - 9)}{2(x - 7)(x + 1)}$

    C) $\ln \dfrac{3(x - 9)(x + 1)}{2(x - 7)}$ D) $\ln \dfrac{(x - 9)^3}{(x - 7)^2(x + 1)}$

130) $56 \log_8 \sqrt[8]{x} + \log_8(56x^4) - \log_8 56$ 130) _____

    A) $\log_8 x^{12/7}$ B) $\log_8 x^{11/8}$ C) $\log_8 x^{11}$ D) $\log_8 x^{15/4}$

Use the Change–of–Base Formula and a calculator to evaluate the logarithm. Round your answer to three decimal places.

131) $\log_4 80.26$ 131) _____

    A) 3.163   B) 0.316   C) 1.904   D) 20.065

132) $\log_3 0.485$ 132) _____

    A) 6.186   B) –0.659   C) –0.314   D) –1.518

133) $\log_{4.7} 2.1$ 133) _____

    A) 0.479   B) 2.086   C) 0.447   D) 0.322

Use the Change–of–Base Formula and a calculator to evaluate the logarithm. Round your answer to two decimal places.

134) $\log_{3.6} 2.2$ 134) _____

    A) 0.34   B) 1.62   C) 0.62   D) 0.61

135) $\log_{\sqrt{2}} 117.1$ 135) _____

    A) 0.07   B) 13.74   C) 6.87   D) 0.15

Solve the equation.

136) $\log_3 x = 5$ 136) _____

    A) {125}   B) {15}   C) {1.46}   D) {243}

137) $\log(x + 4) = \log(4x + 1)$ 137) _____

    A) $\left\{ \dfrac{5}{3} \right\}$ B) {1}   C) $\left\{ \dfrac{3}{5} \right\}$ D) {– 1}

138) $\log(5 + x) - \log(x - 3) = \log 5$ 138) _____

    A) $\left\{ \dfrac{3}{2} \right\}$ B) {5}   C) {–5}   D) $\varnothing$

139) $\log(5x) = \log 4 + \log(x - 1)$ 139) _____

    A) $\left\{ -\dfrac{4}{9} \right\}$ B) {4}   C) {– 4}   D) $\left\{ \dfrac{3}{4} \right\}$

140) $\log_9(2x + 4) = \log_9(2x + 7)$ 140) _____

    A) {3}   B) {0}   C) $\left\{ \dfrac{11}{3} \right\}$ D) $\varnothing$

141) $\log_3 x + \log_3(x - 24) = 4$ 141) _____

    A) {–3, 27}   B) {53}   C) {27}   D) $\varnothing$

142) $\log_2(3x - 2) - \log_2(x - 5) = 4$

    A) {6}   B) $\left\{\dfrac{38}{5}\right\}$ C) $\left\{\dfrac{3}{13}\right\}$ D) {18}

142) _____

143) $\log_3(x - 2) + \log_3(x - 8) = 3$

    A) {-1}   B) {12}   C) {11, -1}   D) {11}

143) _____

144) $2 + \log_3(2x + 5) - \log_3 x = 4$

    A) $\left\{\dfrac{1 + \sqrt{46}}{9}\right\}$ B) $\left\{\dfrac{5}{4}\right\}$ C) $\left\{\dfrac{5}{7}\right\}$ D) $\left\{\dfrac{1 \pm \sqrt{46}}{9}\right\}$

144) _____

Solve the problem.

145) $f(x) = \log_2(x + 6)$ and $g(x) = \log_2(x - 2)$.

    Solve $f(x) = 3$. What point is on the graph of f?

    A) {3}, (3, 3)   B) {9}, (3, 3)   C) {9}, (3, 9)   D) {3}, (3, 15)

145) _____

146) $f(x) = \log_3(x + 1)$ and $g(x) = \log_3(x - 3)$.

    Solve $f(x) = g(x)$. Do the graphs of f and g intersect? If so, where?

    A) {4}, (4, $\log_3(4)$)   B) {4}, (4, $\log_3(1)$)

    C) {4}, (4, $\log_3(5)$)   D) No solution. No intersection.

146) _____

Solve the equation.

147) $2^{(1 + 2x)} = 32$

    A) {2}   B) {4}   C) {-2}   D) {16}

147) _____

148) $3^{(6 + 3x)} = \dfrac{1}{27}$

    A) {3}   B) $\left\{\dfrac{1}{9}\right\}$ C) {9}   D) {-3}

148) _____

149) $3 \cdot 5^{2t - 1} = 75$

    A) $\left\{\dfrac{13}{10}\right\}$ B) $\left\{\dfrac{1}{2}\right\}$ C) $\left\{\dfrac{3}{2}\right\}$ D) {3}

149) _____

Solve the problem.

150) $f(x) = 2^x$ and $g(x) = 15$.

    Find the point of intersection of the graphs of f and g by solving $f(x) = g(x)$.

    A) ($\log_2 15$, 15)   B) ($\log_2 15$, 2)   C) ($\log_2 15$, 0)   D) (15, 15)

150) _____

151) The formula $A = 118e^{0.041t}$ models the population of a particular city, in thousands, t years after 1998. When will the population of the city reach 201 thousand?

    A) 2014   B) 2011   C) 2012   D) 2013

151) _____

Provide an appropriate response.

152) Find t to four decimal places.   152) _____

$e^{-t} = 0.06$

    A) 2.8134   B) 2.9134   C) −2.8134   D) 2.6134

153) Find t to four decimal places.   153) _____

$e^{-0.07t} = 0.05$

    A) 44.321   B) −70.1312   C) 42.7962   D) −66.4815

Find the amount that results from the investment.

154) $1,000 invested at 12% compounded annually after a period of 3 years   154) _____

    A) $1404.93   B) $1573.52   C) $404.93   D) $1254.40

155) $12,000 invested at 4% compounded quarterly after a period of 5 years   155) _____

    A) $2642.28   B) $14,599.83   C) $14,642.28   D) $14,497.31

Solve the problem.

156) Find the amount owed at the end of 8 years if $5000 is loaned at a rate of 5% compounded   156) _____
    monthly.

    A) $7452.93   B) $9093.60   C) $8060.16   D) $12,911.25

Find the present value. Round to the nearest cent.

157) To get $5600 after 3 years at 12% compounded annually   157) _____

    A) $7117.8   B) $3985.97   C) $1614.03   D) $4464.29

158) To get $2000 after 3 years at 7% compounded semiannually   158) _____

    A) $1627.00   B) $1632.60   C) $373   D) $1683.95

159) To get $10,000 after 2 years at 18% compounded monthly   159) _____

    A) $6995.44   B) $5000.00   C) $11,956.18   D) $8363.87

Solve the problem.

160) What principal invested at 8% compounded continuously for 4 years will yield $1190? Round the   160) _____
    answer to two decimal places.

    A) $864.12   B) $627.48   C) $1188.62   D) $1638.78

Solve the problem. Round your answer to three decimals.

161) What annual rate of interest is required to triple an investment in 7 years?   161) _____

    A) 8.497%   B) 10.409%   C) 16.993%   D) 15.694%

Solve the problem.

162) How long does it take $1125 to triple if it is invested at 7% interest, compounded quarterly? Round   162) _____
    your answer to the nearest tenth.

    A) 15.8 months   B) 18.1 months   C) 18.1 years   D) 15.8 years

163) If Emery has $1600 to invest at 5% per year compounded monthly, how long will it be before he   163) _____
has $2300? If the compounding is continuous, how long will it be? (Round your answers to three
decimal places.)
   A) 0.62 yrs, 0.605 yrs   B) 7.273 yrs, 7.258 yrs
   C) 122.642 yrs, 7.658 yrs   D) 0.087 yrs, 0.726 yrs

164) Larry has $2900 to invest and needs $3300 in 18 years. What annual rate of return will he need to   164) _____
get in order to accomplish his goal? (Round your answer to two decimals.)
   A) 0.72%   B) 3.3%   C) 2.3%   D) 1.3%

165) The size P of a small herbivore population at time t (in years) obeys the function $P(t) = 700e^{0.12t}$ if   165) _____
they have enough food and the predator population stays constant. After how many years will the
population reach 1400?
   A) 14.11 yrs   B) 54.59 yrs   C) 16.22 yrs   D) 5.78 yrs

166) The half–life of silicon–32 is 710 years. If 100 grams is present now, how much will be present in   166) _____
600 years? (Round your answer to three decimal places.)
   A) 55.668   B) 0.286   C) 94.311   D) 0

167) The half–life of a radioactive element is 130 days, but your sample will not be useful to you after   167) _____
80% of the radioactive nuclei originally present have disintegrated. About how many days can you
use the sample?
   A) 287   B) 312   C) 302   D) 297

168) During 1991, 200,000 people visited Rave Amusement Park. During 1997, the number had grown   168) _____
to 834,000. If the number of visitors to the park obeys the law of uninhibited growth, find the
exponential growth function that models this data.
   A) $f(t) = 634,000e^{0.248t}$ B) $f(t) = 200,000e^{0.238t}$
   C) $f(t) = 634,000e^{0.238t}$ D) $f(t) = 200,000e^{0.248t}$

169) A fossilized leaf contains 19% of its normal amount of carbon 14. How old is the fossil (to the   169) _____
nearest year)? Use 5600 years as the half–life of carbon 14.
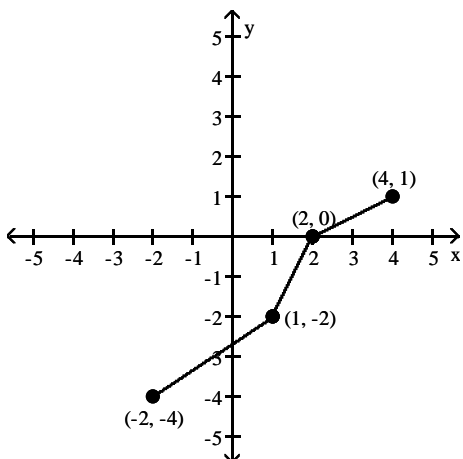   A) 13,393   B) 35,439   C) 23,745   D) 1699

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

170) How long does it take $1700 to double if it is invested at 5% interest, compounded   170) _____
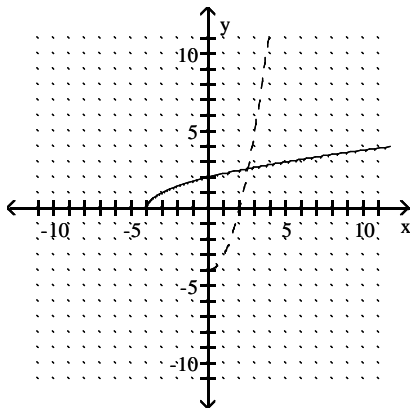monthly? Round your answer to the nearest tenth.

1) A
2) B
3) A
4) D
5) C
6) A
7) C
8) D
9) D
10) D
11) B
12) C
13) B
14) B
15) B
16) B
17) C
18) B
19) A
20) D
21) C
22) A
23) B
24) A
25) A
26) B
27) A
28) A
29) B
30) B
31) D
32) C
33) A
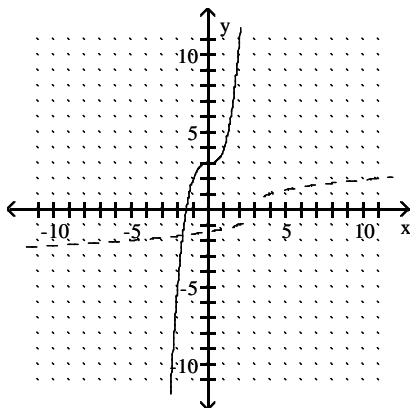34)

35)

36)

37) A
38) D
39) B
40) B
41) C
42) A
43) D
44) C
45) C
46) A
47) C
48) D

49) $x(P) = \dfrac{1}{2} P + 250$

50) (a) $V(W) = (\dfrac{W - 1.15}{3.36})^3$

(b) 0.02

51) D
52) B
53) B
54) A
55) B
56) 661 students

57) C
58) B
59) D
60) domain of f: $(-\infty, \infty)$; range of f: $(-\infty, 4)$;
   horizontal asymptote: $y = 4$

61)

62) domain of f: $(-\infty, \infty)$; range of f: $(0, \infty)$
   horizontal asymptote: $y = 0$

63)

64) B
65) D
66) B
67) C
68) D
69) C
70) D
71) D
72) D
73) D
74) A
75) A
76) C
77) B
78) A
79) D
80) B
81) A
82) B
83) B
84) A
85) A
86) B
87) D
88) D
89) B
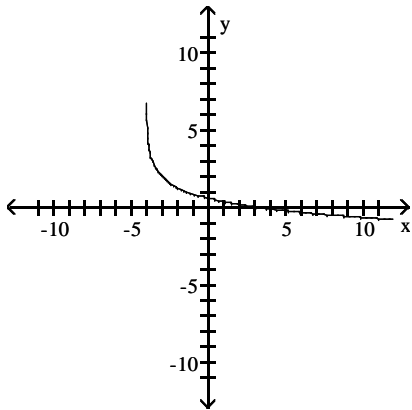90) D
91) B
92) D
93) D
94) D
95) C
96) D
97) D
98) C
99) D

100)

101)

102) A
103) A
104) B
105) D
106) B
107) B
108) B
109) C
110) B
111) C
112) A
113) B
114) B
115) B
116) D
117) C
118) C
119) D
120) B
121) A
122) D
123) D
124) C
125) D

126) D
127) A
128) B
129) A
130) C
131) A
132) B
133) A
134) C
135) B
136) D
137) B
138) B
139) C
140) D
141) C
142) A
143) D
144) C
145) A
146) D
147) A
148) D
149) C
150) A
151) B
152) A
153) C
154) A
155) C
156) A
157) B
158) A
159) A
160) A
161) D
162) D
163) B
164) A
165) D
166) A
167) C
168) B
169) A
170) 13.9 years