1. Fill in the blank.

    For a function to have an inverse, it must be _____.

    For a function to have an inverse, it must be (1) _____

    (1) ◯ both increasing and decreasing.
        ◯ one-to-one.

2. Fill in the blanks.

    The domain of f is equal to the _____ of f^{-1}, and the range of f is equal to the _____ of f^{-1}.

    The domain of f is equal to the (1) _____ of f^{-1}, and the range of f is equal to the (2) _____ of f^{-1}.

    (1) ◯ domain   (2) ◯ range
        ◯ range   ◯ domain

3. Select the correct choice that completes the sentence below.

    If the point (a, b) lies on the graph of f, and f has an inverse, then the point (1) _____ lies on the graph of f^{-1}.

    (1) ◯ (b, a)
         ◯ (−a, −b)
         ◯ (−b, −a)

4. Fill in the blank to correctly complete the sentence below.

    If $f(x) = x^3$, then $f^{-1}(x) = $ _____.

5. Fill in the blank to correctly complete the sentence below.

    If a function f has an inverse, then the graph of f^{-1} may be obtained by reflecting the graph of f across the line with the equation _____ . (Type an equation.)

6. Fill in the blank.

    If a function f has an inverse and f(−3) = 6, then $f^{-1}(6) = $ _____.

    If a function f has an inverse and f(−3) = 6, then $f^{-1}(6) = $ _____.

7. Select the correct choices that complete the sentence below.

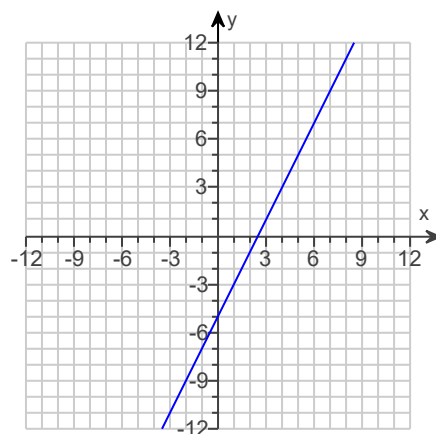   If f(−4) = 16 and f(4) = 16, then f (1) _____ have an inverse because (2) _____

    (1) ◯ does   (2) ◯ it is one-to-one.
        ◯ does not   ◯ it is not one-to-one.

8. Decide whether the function graphed is one-to-one.

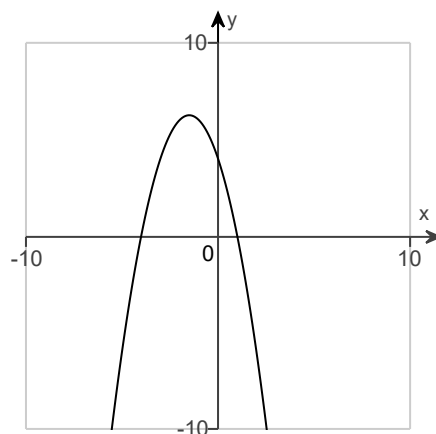Is the function one-to-one?

○ Yes

○ No

9. Determine whether the function graphed is one-to-one.

Is the function graphed one-to-one?

○ **A.** Yes, every horizontal line intersects the graph at exactly one point.

○ **B.** Yes, because each x-value corresponds to only one y-value, and each y-value corresponds to only one x-value.

○ **C.** No, because each x-value corresponds to every y-value, and each y-value corresponds to every x-value.

○ **D.** No, there is a horizontal line that intersects the graph at more than one point.

10. Decide whether the function is one-to-one.

   $y = 8x - 2$

Is the function one-to-one?

○ No

○ Yes

11. Decide whether the function is one-to-one.

   $y = 4(x + 3)^2 - 7$

Is the given function one-to-one?

○ No

○ Yes

12. Explain why a constant function, such as $f(x) = 3$, defined over the set of real numbers, cannot be one-to-one.

Choose the correct answer below.

○ **A.** Every element in the domain of f produce the same y-value, 3.

○ **B.** Every y-value corresponds to no more than one value in the domain.

13. Decide whether the given functions are inverses.

x	f(x)
−6	1
−2	−2
3	7
6	4

x	g(x)
1	−6
−2	−2
7	3
4	6

Are f and g inverses of each other?

○ No
○ Yes

14. Decide whether the given functions are inverses.

$f = \{(3,1),(4,1),(5,1)\}; \quad g = \{(1,3)\}$

Are the given functions inverses?

○ No
○ Yes

15. Use the definition of inverses to determine whether f and g are inverses.

$$f(x) = 3x - 12, \ g(x) = \frac{x}{3} + 4$$

Are the f and g inverses of each other?

○ Yes
○ No

16. Determine whether the functions are inverses of each other.

$f(x) = x^2 - 7,$ domain $[0,\infty)$
$g(x) = \sqrt{x + 7},$ domain $[-7,\infty)$

Are f and g inverses of each other?

○ No
○ Yes

17. If the function defined by the following is one-to-one, find its inverse.

$\{(-2, 6), (3, 1), (4, 8)\}$

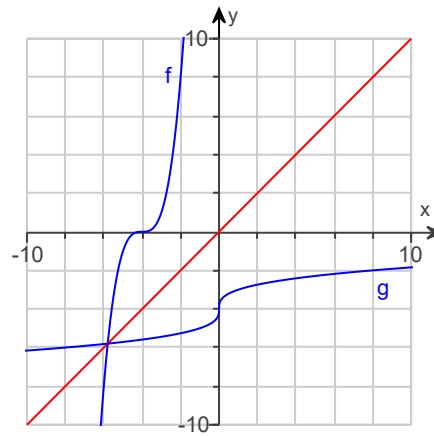Select the correct choice below, and fill in the answer box if necessary.

○ **A.** The inverse function is { _____ }.
   (Type ordered pairs. Use a comma to separate answers as needed.)
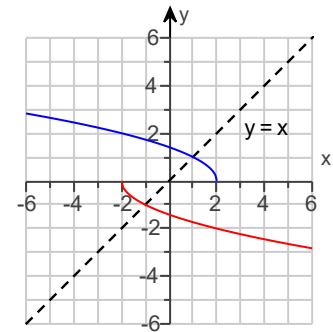○ **B.** The function is not one-to-one.

18. Determine whether the pair of functions f and g are inverses of each other.

Are the functions inverses of each other?

○ No

○ Yes

19. Decide whether the pair of functions graphed to the right are inverses of each other.
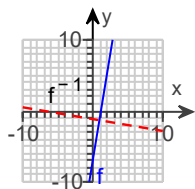

Are the functions inverses of each other?

○ No

○ Yes

20. For the function $f(x) = 6x - 7$, determine whether $f(x)$ is one-to-one. If so, **(a)** write an equation for the inverse function in the form $y = f^{-1}(x)$, **(b)** graph f and f^{-1} on the same axes, and **(c)** give the domain and the range of f and f^{-1}. If the function is not one-to-one, say so.

(a) Write an equation for the inverse function in the form $y = f^{-1}(x)$. Select the correct choice below and, if necessary, fill in any answer boxes to complete your choice.
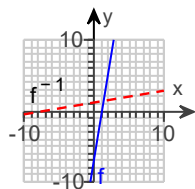
   ◯ **A.** The function $f(x)$ is one-to-one and $f^{-1}(x) =$ _____ .(Simplify your answer.)

   ◯ **B.** The function is not one-to-one.

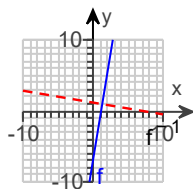**(b)** Choose the correct graph of f and f^{-1} below.

◯ **A.**

◯ **B.**

◯ **C.**

◯ **D.**

The function $f(x)$ is not one-to-one.

(c) Give the domain and range of f and f^{-1}. Begin by finding the domain and range of $f(x)$. Select the correct choice below and, if necessary, fill in any answer boxes to complete your choice.

   ◯ **A.** The domain of f is _____ and the range of f is _____ .
         (Type your answers in interval notation.)

   ◯ **B.** The function is not one-to-one.

Give the domain and the range of f^{-1}. Select the correct choice below and, if necessary, fill in any answer boxes to complete your choice.

   ◯ **A.** The domain of f^{-1} is _____ and the range of f^{-1} is _____ .
         (Type your answers in interval notation.)
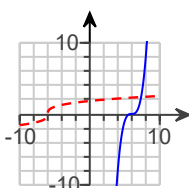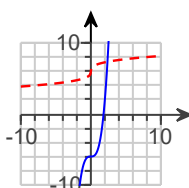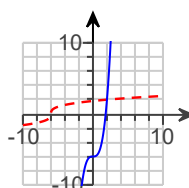
   ◯ **B.** The function is not one-to-one.

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21. Determine whether the function is one-to-one. If so, **(a)** write an equation for the inverse function in the form $y = f^{-1}(x)$, **(b)** graph f and f^{-1} on the same axes, and **(c)** give the domain and the range of f and f^{-1}. If the function is not one-to-one, say so.

$$f(x) = x^3 - 6$$

(a) Write an equation for the inverse function in the form $y = f^{-1}(x)$. Select the correct choice below and, if necessary, fill in any answer boxes to complete your choice.

○ **A.** The function f(x) is one-to-one and $f^{-1}(x) =$ _____ . (Simplify your answer.)

○ **B.** The function is not one-to-one.

(b) Choose the correct graph of f and f^{-1}. The graph of f is a blue, solid curve and f^{-1} is a red, dashed curve.

○ **A.**

○ **B.**

○ **C.**

○ **D.**

The function f(x) is not one-to-one.

(c) Give the domain and range of f and f^{-1}. Begin by finding the domain and range of f(x). Select the correct choice below and, if necessary, fill in any answer boxes to complete your choice.

○ **A.** The domain of f is _____ and the range of f is _____ .
(Type your answers in interval notation.)

○ **B.** The function is not one-to-one.

Give the domain and the range of f^{-1}. Select the correct choice below and, if necessary, fill in any answer boxes to complete your choice.

○ **A.** The domain of f^{-1} is _____ and the range of f^{-1} is _____ .
(Type your answers in interval notation.)
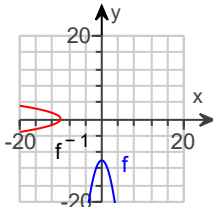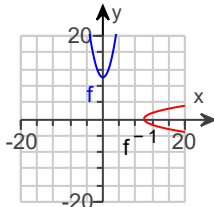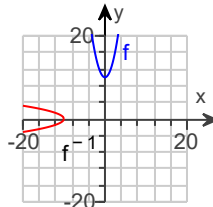
○ **B.** The function f(x) is not one-to-one.

22. Determine whether the function is one-to-one. If so, **(a)** write an equation for the inverse function in the form $y = f^{-1}(x)$, **(b)** graph f and f^{-1} on the same axes, and **(c)** give the domain and range of f and f^{-1}. If the function is not one-to-one, say so.

$$f(x) = x^2 + 10$$

a. What is the equation for the inverse function? Select the correct choice below, and fill in the answer box if necessary.

○ **A.** The function $f(x)$ is one-to-one and $f^{-1}(x) = $ _____ .
(Simplify your answer.)

○ **B.** The function is not one-to-one.

b. If the function is one-to-one, graph f and f^{-1} on the same axes. Choose the correct graph below.

○ **A.**

○ **B.**

○ **C.**

○ **D.** The function is not one-to-one. Thus, the inverse does not exist.

c. Give the domain and range of f. Select the correct choice below, and fill in the answer boxes if necessary.

○ **A.** The domain of f is _____ and the range of f is _____ .
(Type your answers in interval notation.)

○ **B.** The domain and the range of the function are undefined.

Give the domain and range of f^{-1}, if possible. Select the correct choice below, and fill in the answer boxes if necessary.

○ **A.** The domain of f^{-1} is _____ and the range of f^{-1} is _____ .
(Type your answers in interval notation.)
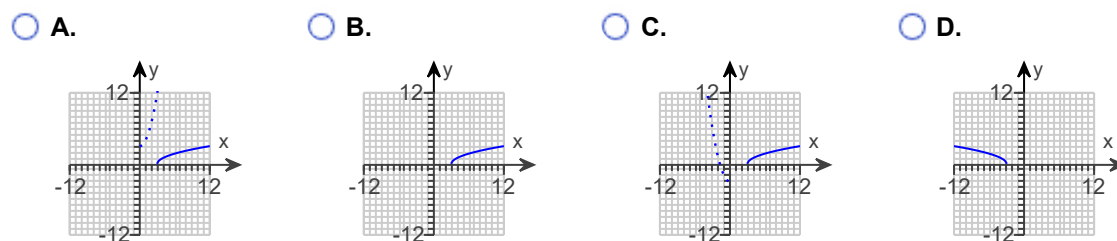
○ **B.** The function is not one-to-one.

23. For the following function defined that is one-to-one, write an equation for the inverse function in the form $y = f^{-1}(x)$, and then graph f and f^{-1} on the same axes. Give the domain and range of f and f^{-1}. If the function is not one-to-one, say so.

$$f(x) = \sqrt{-3 + x}, \ x \geq 3$$

Find the equation of the inverse function. Select the correct choice below, and fill in the answer box if necessary.

- **A.** $f^{-1}(x) = $ _____ , $x \leq 0$
- **B.** $f^{-1}(x) = $ _____ , $x \geq 0$
- **C.** The function is not one-to-one.

If the function is one-to-one, graph f and f^{-1}. If the function is not one-to-one, just graph f. Choose the correct graph below. The solid curve shows the graph of f and the dotted curve shows the graph of f^{-1}, if applicable.

- **A.**
- **B.**
- **C.**
- **D.**

The domain of f is _____ .
(Type your answer in interval notation.)

The range of f is _____ .
(Type your answer in interval notation.)

If the function is one-to-one, find the domain of f^{-1}. Select the correct choice below, and fill in the answer box if necessary.
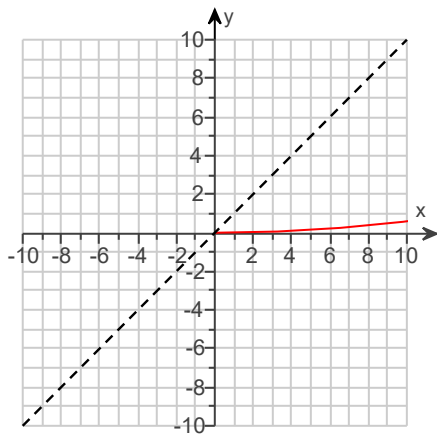
- **A.** The domain of f^{-1} is _____ . (Type your answer in interval notation.)
- **B.** The function is not one-to-one.

If the function is one-to-one, find the range of f^{-1}. Select the correct choice below, and fill in the answer box if necessary.

- **A.** The range of f^{-1} is _____ . (Type your answer in interval notation.)
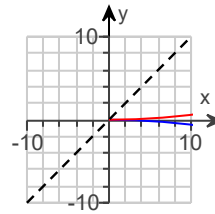- **B.** The function is not one-to-one.

24. Graph the inverse of the given one-to-one function.

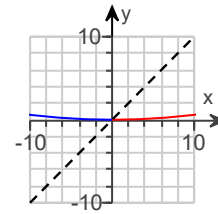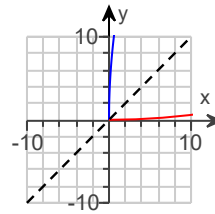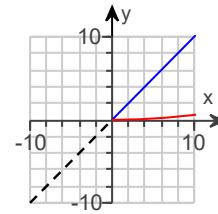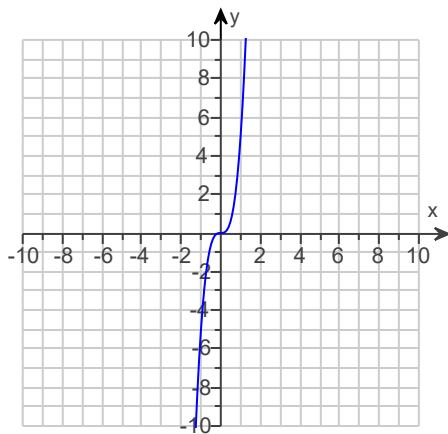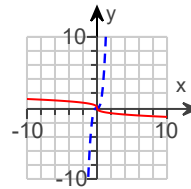Choose the correct graph below.

○ A.

○ B.

○ C.

○ D.

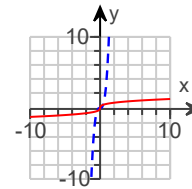25. Graph the inverse of the one-to-one function.

Choose the correct graph of the function and its inverse below. The graph of the function is dashed, and the graph of the inverse is solid.
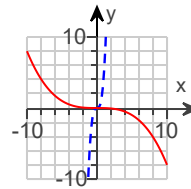
○ A.

○ B.

○ C.

○ D.

The function does not have an inverse.

26. Graph the inverse of the one-to-one function f.

Choose the correct graph on the right that shows the inverse as a dashed line.

Choose the correct graph.

○ **A.**
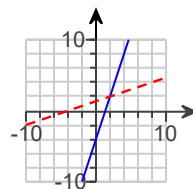
○ **B.**
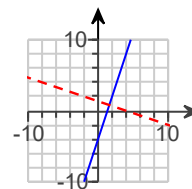
○ **C.**
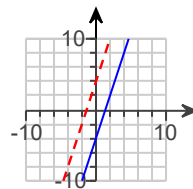
○ **D.**
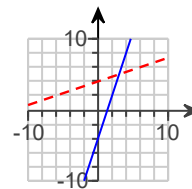
27. The graph of a function f is shown.
Use the graph to find $f^{-1}(-5)$.

$f^{-1}(-5) = $ _____
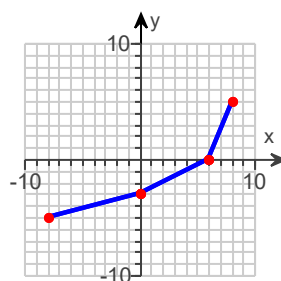
28. The graph of a function f is shown.
Use the graph to find $f^{-1}(6)$.

$f^{-1}(6) = $ _____
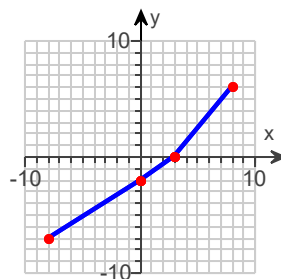
29. The graph of a function f is shown.
Use the graph to find $f^{-1}(-4)$.

$f^{-1}(-4) = $ _____
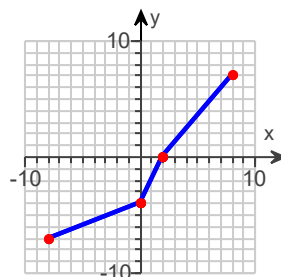
30. If $f(x) = 2^x$, find $f(5)$ and $f(-5)$.

$f(5) =$ _____
(Simplify your answer. Type an integer or a fraction.)

$f(-5) =$ _____
(Simplify your answer. Type an integer or a fraction.)

---

31. Select the correct choice that completes the sentence below.

If $a > 1$, then the graph of $f(x) = a^x$ (1) _____ from left to right.

(1) ○ rises
     ○ falls

---

32. Select the correct choice that completes the sentence below.

If $0 < a < 1$, then the graph of $f(x) = a^x$ (1) _____ from left to right.

(1) ○ falls
     ○ rises

---

33. Complete the sentence below.

The domain of $f(x) = 8^x$ is _____ and the range is _____ .
(Type your answers in interval notation.)

---

34. Complete the sentence below.

The graph of $f(y) = 22^y$ passes through the points $\left(-1, \underline{\hspace{1.5cm}}\right)$, $\left(0, \underline{\hspace{1.5cm}}\right)$, and $\left(1, \underline{\hspace{1.5cm}}\right)$.
(Simplify your answers.)

---

35. Complete the sentence below.

The graph of $f(y) = -\left(\dfrac{1}{4}\right)^{y+6} - 3$ is that of $f(y) = \left(\dfrac{1}{4}\right)^y$ reflected across the (1) _____ -axis, translated

_____ units to the left and _____ units down.

(1) ○ x
     ○ y

---

36. If $f(x) = 4^x$, find $f(5)$.

$f(5) =$ _____
(Simplify your answer. Type an integer or a fraction.)

---

37. If $f(x) = 2^x$, find $f(-1)$.

$f(-1) =$ _____
(Simplify your answer. Type an integer or a fraction.)

38. Graph the equation.

$$y = 8^x$$

Choose the correct graph on the right.
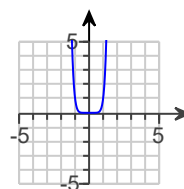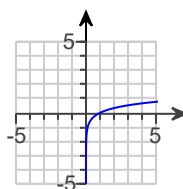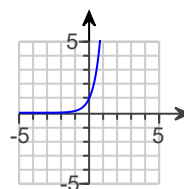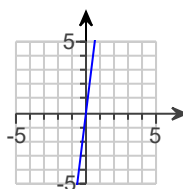
39. Graph the equation on paper, and then choose the correct graph on the right.

$$y = \left(\frac{1}{3}\right)^x$$

Choose the correct graph.

A.
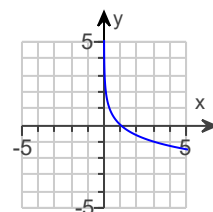
B.
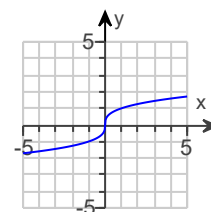
C.
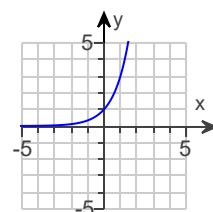
D.
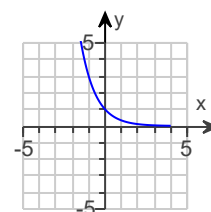
40. Graph the function $f(x) = 5^x + 4$. Give the domain and range.

Use the graphing tool to graph the function.

The domain of the function $f(x) = 5^x + 4$ is _____ .
(Type your answer in interval notation.)

The range of the function $f(x) = 5^x + 4$ is _____ .
(Type your answer in interval notation.)
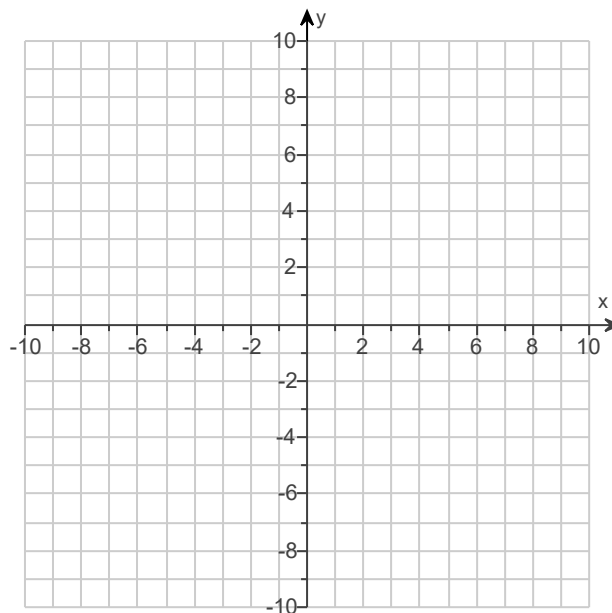
41. Graph the function $f(x) = 4^{x+2}$. Give the domain and range.

Use the graphing tool to graph the function.

The domain of the function $f(x) = 4^{x+2}$ is _____ .
(Type your answer in interval notation.)

The range of the function $f(x) = 4^{x+2}$ is _____ .
(Type your answer in interval notation.)
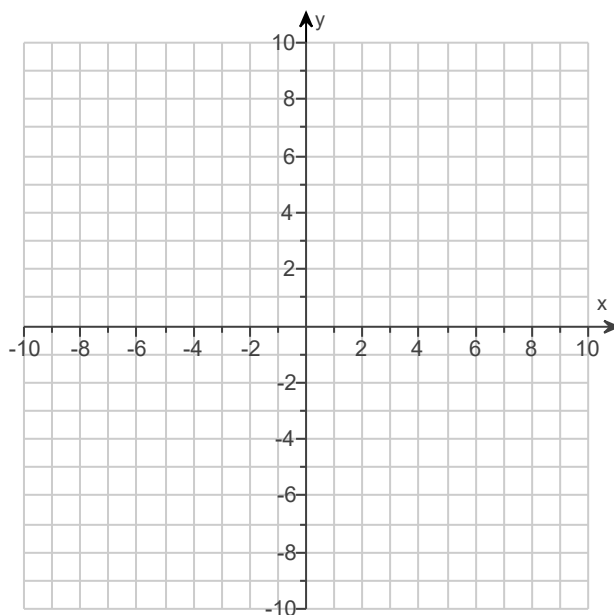
42. Graph the function $f(x) = 10^{-x}$. Give the domain and range.

Use the graphing tool to graph the function.

The domain of the function $f(x) = 10^{-x}$ is _____ .
(Type your answer in interval notation.)

The range of the function $f(x) = 10^{-x}$ is _____ .
(Type your answer in interval notation.)
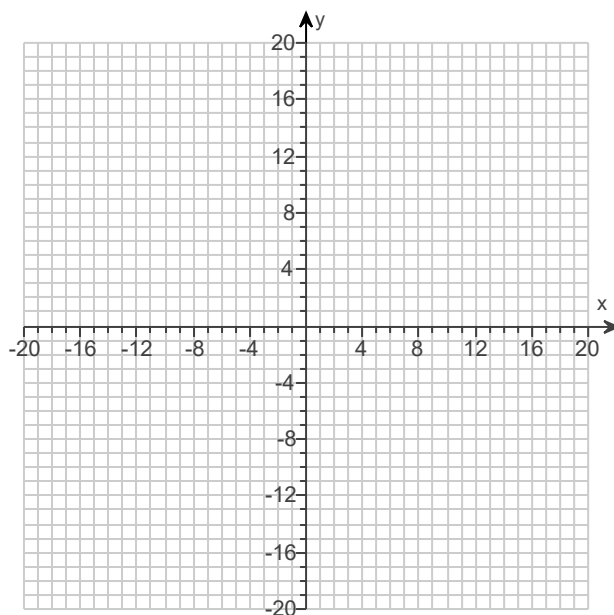
43. Graph the function $f(x) = 3^{x+1} - 2$. Give the domain and range.

Use the graphing tool to graph the function.

The domain of the function $f(x) = 3^{x+1} - 2$ is

_____.

(Type your answer in interval notation.)

The range of the function $f(x) = 3^{x+1} - 2$ is _____.

(Type your answer in interval notation.)

---
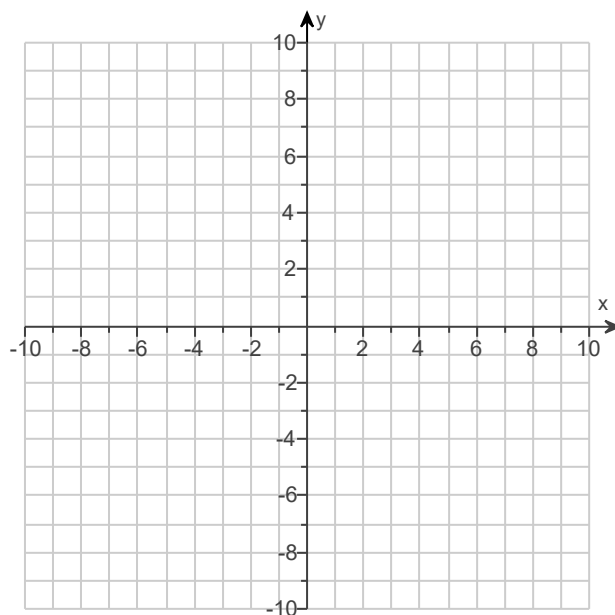
44. Solve the equation.

$$36^x = 6$$

The solution set is { _____ }.

(Type an integer or a simplified fraction.)

---

45. Solve the equation.

$$64^{3x} = 16^{x+3}$$

The solution set is { _____ }.

(Simplify your answer. Type an integer or a fraction.)

---

46. Solve the equation.

$$16^{3x-6} = 64^{x+3}$$

The solution set is { _____ }.

---

47. Solve the following equation.

$$x^{\frac{3}{2}} = 27$$

The solution set is { _____ }.

(Use a comma to separate answers as needed.)

---

48. Find the future value and interest earned if $8706.54 is invested for 8 years at 4% compounded **(a)** semiannually and **(b)** continuously.

    (a) The future value when interest is compounded semiannually is approximately $ _____ .
    (Type an integer or decimal rounded to the nearest hundredth as needed.)

    The interest earned is approximately $ _____ .
    (Type an integer or decimal rounded to the nearest hundredth as needed.)

    (b) The future value when interest is compounded continuously is approximately $ _____ .
    (Type an integer or decimal rounded to the nearest hundredth as needed.)

    The interest earned is approximately $ _____ .
    (Type an integer or decimal rounded to the nearest hundredth as needed.)

49. Find the present value that will grow to $22,000 if interest is 2% compounded quarterly for 15 quarters.

    The present value is $ _____ . (Round to the nearest cent as needed.)

50. Find the required annual interest rate to the nearest tenth of a percent for $1300 to grow to $1800 if interest is compounded quarterly for 7 yr.

    The required annual interest rate is _____ %. (Round to the nearest tenth as needed.)

51. Bank A is lending money at 5.6% interest compounded monthly. The rate at Bank B is 5.65% compounded quarterly, and the rate at Bank C is 5.7% compounded annually. Which bank will you pay the least interest?

    Choose the correct answer.

    ○   Bank C
    ○   Bank B
    ○   Bank A

52. Evaluate the logarithmic expression without using a calculator. Remember that $\log_a x$ is the exponent to which a must be raised in order to obtain x.

(a) $\log_2 16$ (d) $\log_2 \sqrt{2}$

(b) $\log_3 1$ (e) $\log_e \left(\dfrac{1}{e^2} \right)$

(c) $\log_{10} 0.1$ (f) $\log_{1/2} 8$

(a) $\log_2 16 = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(b) $\log_3 1 = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(c) $\log_{10} 0.1 = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(d) $\log_2 \sqrt{2} = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(e) $\log_e \left(\dfrac{1}{e^2} \right) = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(f) $\log_{1/2} 8 = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

53. Evaluate the logarithmic expression without using a calculator. Remember that $\log_a x$ is the exponent to which a must be raised in order to obtain x.

(a) $\log_3 81$

(d) $\log_6 \sqrt{6}$

(b) $\log_3 \dfrac{1}{3}$

(e) $\log_e 1$

(c) $\log_{10} 0.01$

(f) $\log_3 27^{3/2}$

(a) $\log_3 81 = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(b) $\log_3 \dfrac{1}{3} = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(c) $\log_{10} 0.01 = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(d) $\log_6 \sqrt{6} = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(e) $\log_e 1 \quad = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

(f) $\log_3 27^{3/2} = $ _____

(Simplify your answer. Type an integer or a simplified fraction.)

---

54. Convert to an exponential equation.	Complete the equivalent exponential equation.
$\log_5 125 = 3$	_____ $= 125$ (Type your answer using exponential notation. Do not simplify.)

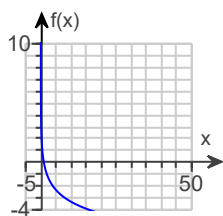| 55. Write in logarithmic form.	What is the equivalent logarithmic form?
$3^5 = 243$	$\log_3$ _____ $= $ _____ (Simplify your answers. Type integers or fractions.)

56. Sketch the graph of the function. Give the domain and range.

$$f(x) = \log_2 x$$

Choose the correct graph.
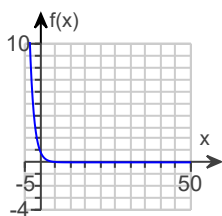
     ○ **A.**   ○ **B.**   ○ **C.**   ○ **D.**

The domain is _____ .
(Type your answer in interval notation.)

The range is _____ .
(Type your answer in interval notation.)

---

57. Write in logarithmic form.

$$3^5 = 243$$

What is the equivalent logarithmic form?

$\log_3$ _____ = _____
(Simplify your answers. Type integers or fractions.)

---

58. Convert to an exponential equation.

$$\log_4 256 = 4$$

Complete the equivalent exponential equation.

_____ = 256
(Type your answer using exponential notation. Do not simplify.)

---

59. Solve the logarithmic equation.

$$x = \log_3 \frac{1}{27}$$

The solution set is { _____ }.

---

60. Solve the given logarithmic equation.

$$\log_x \frac{1}{16} = 2$$

The solution set is { _____ }.
(Simplify your answer.)

---

61. Solve the given logarithmic equation.

$$\log_4 x = 3$$

The solution set is { _____ }.
(Simplify your answer. Type an integer or a fraction.)

---

62. Use the graph of f(x) = **log** $_2$x to graph the function
    f(x) = $\left(\textbf{log}_2 x\right)$ + 8. Then give the domain and range.

    Use the graphing tool to graph the function.
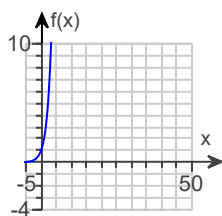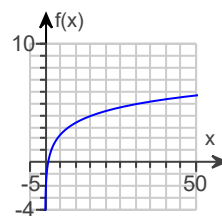
    The domain is _____ .
    (Type your answer in interval notation.)

    The range is _____ .
    (Type your answer in interval notation.)

63. Graph.

    f(x) = **log** $_2$x
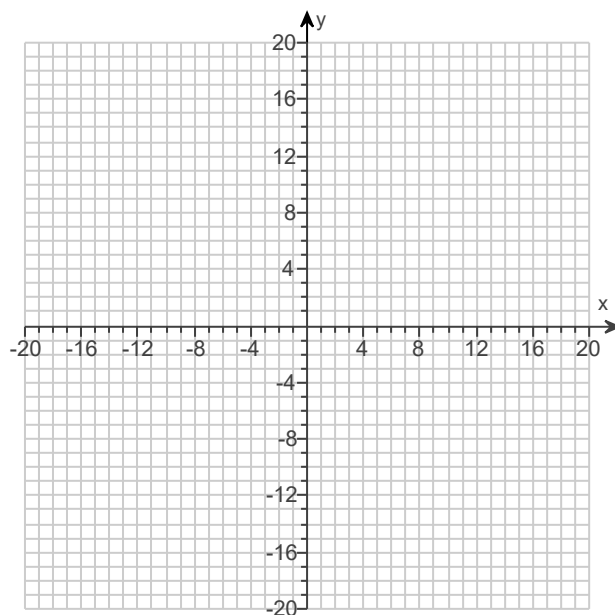
    Choose the correct graph.

    ○ **A.**
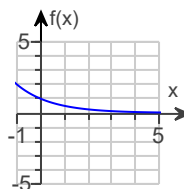
    ○ **B.**
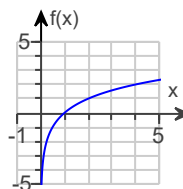
    ○ **C.**

    ○ **D.**

64. Graph the function $y = \log_3(x - 2)$ from the graph of
    $y = \log_3 x$.

    Choose the correct graph of $y = \log_3(x - 2)$ below.

    ○ **A.**
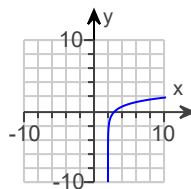
    ○ **B.**
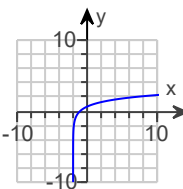
    ○ **C.**
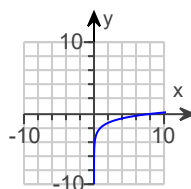
    ○ **D.**
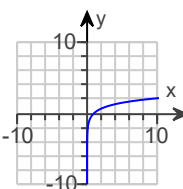
65. Use the properties of logarithms to rewrite the expression. Simplify the result if possible. Assume all variables represent positive real numbers.

$$\log_3\left(\frac{6y}{z}\right)$$

Choose the correct answer.

- A. $\log_3 6 + \log_3 y - \log_3 z$
- B. This cannot be simplified.
- C. $\log_3 6 + \log_3 y \div \log_3 z$
- D. $\log_3 6 \cdot \log_3 y \div \log_3 z$

66. Use the properties of logarithms to rewrite the expression. Simplify the result if possible. Assume all variables represent positive real numbers.
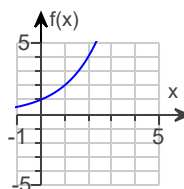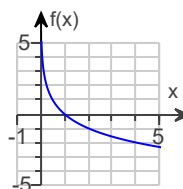
$$\log_4\left(\frac{8\sqrt{7}}{5}\right)$$

Choose the correct answer.

- A. This cannot be simplified.
- B. $\log_4 8 + \log_4 7^2 - \log_4 5$
- C. $\log_4 8 + \dfrac{1}{2}\log_4 7 - \log_4 5$
- D. $\log_4 8 + \log_4 \sqrt{7} - \log_4 5$

67. Use the properties of logarithms to rewrite the following expression. Simplify the result if possible. Assume all variables represent positive real numbers.

$$\log_5(3x + 2y)$$

Choose the correct answer.

- A. $\log_5 3x - \log_5 2y$
- B. This cannot be simplified.
- C. $\log_5 3x + \log_5 2y$
- D. $\log_5 6xy$

68. Use the properties of logarithms to rewrite the expression. Simplify the result as much as possible. Assume all variables represent positive real numbers.

$$\log_2\sqrt{\frac{7r^5}{z^7}}$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ○ $\log_2\sqrt{\dfrac{7r^5}{z^7}} = $ _____
- ○ The expression cannot be simplified.

69. Expand. Simplify if possible. Assume that all variables represent positive real numbers.

$$\log_4 \left(\frac{ab}{cd} \right)$$

What is the expanded expression?

---

70. Write the expression as a single logarithm with coefficient 1. Assume all variables represent positive real numbers.

$$\log_d x + \log_d y - \log_d m$$

Choose the correct answer.

- A. $\log_d \dfrac{xy}{m}$

- B. $\log_d xym$

- C. $\log_d \dfrac{m}{xy}$

- D. $\log_d \dfrac{xm}{y}$

---

71. Write the expression as a single logarithm with coefficient 1. Assume all variables represent positive real numbers.

$$\log_c m - \log_c n - \log_c f$$

Choose the correct answer.

- A. $\log_c \dfrac{mf}{n}$

- B. $\log_c mnf$

- C. $\log_c \dfrac{fn}{m}$

- D. $\log_c \dfrac{m}{nf}$

---

72. For the exponential function $f(x) = a^x$, where $a > 1$, is the function increasing or decreasing over its entire domain?

Choose the correct answer below.

- A. decreasing
- B. increasing
- C. constant

73. For the logarithmic function $g(x) = \log_a x$, where $a > 1$, is the function increasing or decreasing over its entire domain?

Choose the correct answer below.

- ○ **A.** Increasing, because $a > 1$.
- ○ **B.** Decreasing, because a logarithmic function always decreases.
- ○ **C.** Decreasing, because $a > 1$.
- ○ **D.** Increasing, because a logarithmic function always increases.

74. Answer the following.

A base e logarithm is called a _____ logarithm, and a base 10 logarithm is called a _____ logarithm.

A base e logarithm is called a (1) _____ logarithm, and a base 10 logarithm is called a (2) _____ logarithm.

(1) ○ natural   (2) ○ natural
     ○ common   ○ common

75. How is $\log_5 20$ written in terms of natural logarithms using the change-of-base theorem?

The formula $\log_5 20$ in a natural logarithm can be written as $L(x) = $ _____ .

76. Why is $\log_2 0$ undefined?

Choose the correct answer below.

- ○ **A.** There is no power of 0 that yields a result of 2.
- ○ **B.** A logarithm with base 2 does not exist. Logarithms of only base 10 and base e exist.
- ○ **C.** There is no power of 2 that yields a result of 0.

77. Between what two consecutive integers must $\log_4 13$ lie?

The expression $\log_4 13$ must lie between _____ and _____ . (Use ascending order.)

78. Find the exact value.

$$\log 10^{-7}$$

$\log 10^{-7} = $ _____

79. Find the exact value.

$$\log 0.01$$

$\log 0.01 = $ _____

80. Use a calculator to find the common logarithm.

    log (48)

    The answer is _____ .
    (Round to four decimal places as needed.)

81. Find the common logarithm of 0.0303.

    log 0.0303 = _____
    (Round to four decimal places as needed.)

82. The formula for the pH of a solution of hydronium ions is given by the logarithmic equation pH = − **log** $[H_3O^+]$, where $[H_3O^+]$ is the hydronium ion concentration. Find the pH of a certain agricultural product with the hydronium ion concentration of 5.2×10^{-5}.

    The pH is _____ .
    (Round to the nearest tenth.)

83. The pH of a fruit juice is 5.9. Find the hydronium ion concentration, $\left[H_3O^+\right]$, of the juice. Use the formula pH = − **log** $\left[H_3O^+\right]$.

    The hydronium ion concentration $\left[H_3O^+\right]$ is approximately _____ moles per liter.
    (Use scientific notation. Use the multiplication symbol in the math palette as needed. Round to the nearest tenth as needed.)

84. Evaluate the following expression. Do not use a calculator.

    In $e^{\frac{7}{4}}$

    In $e^{\frac{7}{4}}$ = _____ (Type an integer or a fraction.)

85. Find the value.

    In $\left(\dfrac{1}{e^3}\right)$

    In $\left(\dfrac{1}{e^3}\right)$ = _____

86. Use a calculator to find the natural logarithm, base e.

    In 49

    In 49 = _____
    (Round to four decimal places as needed.)

87. Use a calculator to find the natural logarithm, base e.

$\ln 0.0592$

$\ln 0.0592 =$ _____
(Round to four decimal places as needed.)

88.
(a) Find the decibel rating of a sound, $d = 10 \log \dfrac{I}{I_0}$, having intensity $100,000 I_0$, where I_0 is the initial intensity.

(b) If the intensity of a sound is doubled, by how much is the decibel rating increased?

(a) Find the decibel rating of a sound having intensity $100,000 I_0$, where I_0 is the initial intensity.

The decibel rating of this sound is _____.

(b) If the intensity of a sound is doubled, by how much is the decibel rating increased?

The decibel rating of the sound increases by about _____ decibels.
(Round to the nearest integer as needed.)

89.
The magnitude of an earthquake, measured on the Richter scale, is $\log_{10} \dfrac{I}{I_0}$, where I is the amplitude registered on a seismograph 100 km from the epicenter of the earthquake, and I_0 is the amplitude of a certain (small) size. Find the Richter scale rating for an amplitude of $100,000,000 I_0$.

The magnitude, R (measured on the Richter scale) is _____.

90. Use the change-of-base theorem to find the logarithm.

$\log_3 6$

$\log_3 6 =$ _____
(Simplify your answer. Do not round until the final answer. Then round to four decimal places as needed.)

91. Use the change-of-base theorem to find the logarithm.

$\log_8 0.69$

$\log_8 0.69 =$ _____
(Simplify your answer. Do not round until the final answer. Then round to four decimal places as needed.)

92. Let $u = \ln a$ and $v = \ln b$. Write the expression in terms of u and v without using the logarithm function.

$\ln \left(b^5 \cdot \sqrt[6]{a} \right)$

$\ln \left(b^5 \cdot \sqrt[6]{a} \right) =$ _____
(Simplify your answer.)

93.

Let $u = \ln a$ and $v = \ln b$. Write the expression $\ln \sqrt{\dfrac{a^3}{b^4}}$ in terms of u and v without using the **ln** function.

$\ln \sqrt{\dfrac{a^3}{b^4}} = $ _____

(Use integers or fractions for any numbers in the expression. Simplify your answer.)

94. Which of the following is equivalent to $2 \ln (10x)$ for $x > 0$?

$\ln 100 + \ln x$
$\ln (20x)$
$\ln 20 + \ln x$
$\ln \left(100x^2\right)$

Choose the correct answer below.

- $\bigcirc$ $\ln 100 + \ln x$
- $\bigcirc$ $\ln (20x)$
- $\bigcirc$ $\ln \left(100x^2\right)$
- $\bigcirc$ $\ln 20 + \ln x$

95. Use the properties of logarithms and the terminology of graphs and functions to describe how the graph of the given function compares to the graph of $g(x) = \ln x$.

    $f(x) = \ln \left(e^{11}x\right)$

Select the correct choice below and fill in the answer boxes within your choice.
(Simplify your answer.)

- $\bigcirc$ **A.** The given function can be rewritten using the properties of logarithms as
  $f(x) = $ _____ , so it is the graph of $g(x) = \ln x$ translated _____ units up.
- $\bigcirc$ **B.** The given function can be rewritten using the properties of logarithms as
  $f(x) = $ _____ , so it is the graph of $g(x) = \ln x$ translated _____ units left.
- $\bigcirc$ **C.** The given function can be rewritten using the properties of logarithms as
  $f(x) = $ _____ , so it is the graph of $g(x) = \ln x$ translated _____ units right.
- $\bigcirc$ **D.** The given function can be rewritten using the properties of logarithms as
  $f(x) = $ _____ , so it is the graph of $g(x) = \ln x$ translated _____ units down.

96. Use the properties of logarithms and the terminology of graphs and functions to describe how the graph of the given function compares to the graph of $g(x) = \ln x$.

$$f(x) = \ln\left(\frac{x}{e^{10}}\right)$$

Select the correct choice below and fill in the answer boxes within your choice. (Simplify your answer.)

○ **A.** The given function can be rewritten using the properties of logarithms as $f(x) =$ _____ , so it is the graph of $g(x) = \ln x$ translated _____ units right.

○ **B.** The given function can be rewritten using the properties of logarithms as $f(x) =$ _____ , so it is the graph of $g(x) = \ln x$ translated _____ units down.

○ **C.** The given function can be rewritten using the properties of logarithms as $f(x) =$ _____ , so it is the graph of $g(x) = \ln x$ translated _____ units left.

○ **D.** The given function can be rewritten using the properties of logarithms as $f(x) =$ _____ , so it is the graph of $g(x) = \ln x$ translated _____ units up.