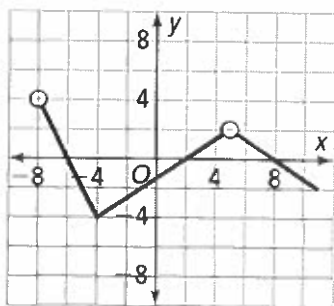




Benchmark Test 1

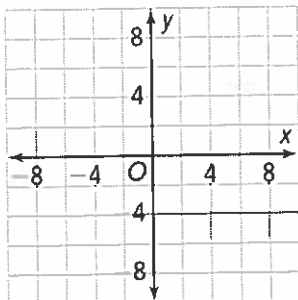
For Items 1–4, find each key feature of the function shown in the graph.



- range
 - domain
 - intervals where the graph is positive
 - What is the average rate of change for the function over the interval $[-6, -4]$?
 - 2
 - 10
 - 1
 - 2
-
- The graph of $y = |x - 3| + 2$ is reflected across the y -axis. What is an equation of the reflected graph?
 - $y = |-x + 3| - 2$
 - $y = |x + 3| - 2$
 - $y = |-x - 3| + 2$
 - $y = -|x + 3| + 2$
-
- Paige is filling a 3.5-L bucket at a rate of 0.25 L per minute. What is the domain of the function that represents the volume of water in the bucket after x minutes if the bucket was empty when Paige arrived?
 - $0 \leq x \leq 0.875$
 - $0 \leq x \leq 7$
 - $0 \leq x \leq 14$
 - $0 \leq x \leq 3.75$
-
- Identify the translations of the parent function $f(x) = x^2$ that result in $g(x) = (x + 2)^2 + 6$.
 - down 2 units, right 6 units
 - up 2 units, right 2 units
 - up 6 units, left 2 units
 - up 2 units, left 6 units

8. Graph the function.

$$f(x) = \begin{cases} -x - 3 & \text{if } -5 \leq x < 0 \\ -3 & \text{if } 0 < x < 4 \\ -x + 1 & \text{if } 4 < x \leq 8 \end{cases}$$



9. Which of the following sequences are arithmetic? Select all that apply.

- (A) $\frac{1}{3}, \frac{1}{6}, \frac{1}{12}, \frac{1}{24}, \dots$
- (B) $\frac{1}{2}, 1, 2, 4, \dots$
- (C) $12, 7, 2, -3, \dots$
- (D) $3, 11, 19, 27, \dots$

10. Write the first 4 terms of the sequence defined below.

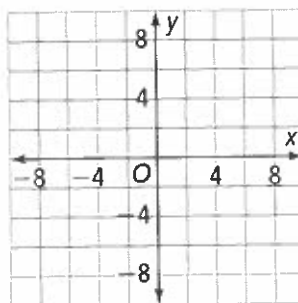
$$a_n = \begin{cases} -6, & \text{if } n = 1 \\ a_{n-1} + 5, & \text{if } n > 1 \end{cases}$$

- (A) $-6, -1, 5, 10$
- (B) $-6, -30, -150, -750$
- (C) $-6, -11, -16, -21$
- (D) $-6, -1, 4, 9$

11. In a concert hall, there are 16 chairs in the first row, and each row has 4 more chairs than the previous row. There are 14 rows altogether. How many chairs are there in the concert hall?

- (A) 68
- (B) 588
- (C) 616
- (D) 1,176

12. Use a graph to solve $-|x - 2| + 4 \leq 0$.



13. Solve the system of equations.

$$\begin{cases} 2x + y = 18 \\ x + 2y = -6 \end{cases}$$

14. Write a matrix that represents the system of equations.

$$\begin{cases} 8x + 16y = -45 \\ -2x + 3y = 7 \end{cases}$$

-
15. What is the reduced row echelon form for the matrix shown?

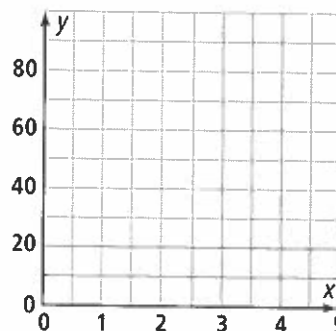
$$\left[\begin{array}{ccc|c} -10 & -5 & -15 & 0 \\ 0 & 5 & 5 & -10 \\ -20 & 0 & -10 & -20 \end{array} \right]$$

-
16. What is the equation in vertex form of a parabola with a vertex of $(4, -2)$ that passes through $(2, -14)$?

-
17. Function g is a transformation of the parent function $f(x) = x^2$. The graph of g is a translation left 6 units and up 5 units of the graph of f . Write the equation for g in the form $y = ax^2 + bx + c$.

- (A) $g(x) = x^2 + 10x + 19$
(B) $g(x) = x^2 - 10x + 19$
(C) $g(x) = x^2 + 12x + 41$
(D) $g(x) = x^2 - 12x + 41$

18. The motion of a projectile launched from a platform 26 ft tall is modeled by the equation $y = -16t^2 + 64t + 26$. Graph the equation. What is the maximum height, in feet, reached by the projectile?



-
19. Use quadratic regression to find a quadratic equation that fits the given points. Round the coefficients to the nearest tenth.

x	0	1	2	3
y	49	50.4	39.5	21

-
20. Solve the equation $-x^2 + 10x = -24$.

- (A) $x = 4$ and $x = 6$
(B) $x = -4$ and $x = -6$
(C) $x = 2$ and $x = -12$
(D) $x = -2$ and $x = 12$

21. Identify the interval(s) on which the function $y = 2x^2 - 8x - 10$ is positive.

- (A) $-1 < x < 5$
- (B) $x < -1$ and $x > 5$
- (C) $-5 < x < 1$
- (D) $x < -5$ and $x > 1$

22. Use square roots to solve the equation $x^2 = -625$ over the complex numbers.

23. Write the product $(6 - i)(6 + i)$ in the form $a + bi$.

- (A) 37
- (B) $36 - i^2$
- (C) 35
- (D) $12 - i^2$

24. Write the quotient $\frac{80}{2 - 6i}$ in the form $a + bi$.

25. Factor the expression $100x^2 - 49$.

- (A) $(10x + 7)(10x - 7)$
- (B) $(10x + 7i)(10x + 7i)$
- (C) $(10x + 7i)(10x - 7i)$
- (D) $(100x + 7i)(x + 7i)$

26. A function is defined by the equation $y = 2x^2 + 12x + 24$. Which statement(s) are true? Select all that apply.

- (A) The equation written in vertex form is $y = 2(x + 3)^2 + 6$.
- (B) The equation written in vertex form is $y = 2(x + 3)^2 + 24$.
- (C) The graph of the function has a minimum of $y = 6$ at $x = -3$.
- (D) The range of the function is $y > -6$.

27. Solve $x^2 + 8x + 5 = 0$ using the Quadratic Formula.

28. Solve $3x^2 + 24x + 90 = 0$ using the Quadratic Formula.

- (A) $x = 4 + i\sqrt{14}$ and $x = 4 - i\sqrt{14}$
- (B) $x = -4 + i\sqrt{14}$ and $x = -4 - i\sqrt{14}$
- (C) $x = 6 + 3i$ and $x = 6 - 3i$
- (D) $x = -6 + 3i$ and $x = -6 - 3i$

29. What value(s) of b will cause $2x^2 + bx + 128 = 0$ to have one real solution?

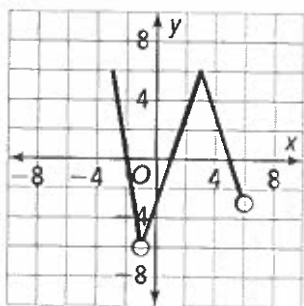
30. Solve $6x^2 - 8x + 1 = x + 4$ to the nearest hundredth by writing a linear-quadratic system using the intersection feature of a graphing calculator. The curve and line intersect at

$x \approx$ _____

and $x \approx$ _____.

Benchmark Test 2

1. Find the x -intercepts of the function graphed below, and the average rate of change over the interval $(-1, 4)$.



x -intercepts: _____

average rate of change: _____

2. Over what interval is the graph of $y = |x + 6|$ decreasing?

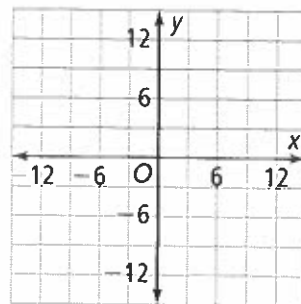
- (A) $(-\infty, -6)$
 (B) $(-\infty, 6)$
 (C) $(-6, \infty)$
 (D) $(6, \infty)$

3. Find the sum of the finite arithmetic sequence

6, 14, 22, 30, ... 62.

- (A) 134
 (B) 172
 (C) 218
 (D) 272

4. Use a graph to solve $|x - 9| = x^2 + 3$.



5. Emaan used row operations on an augmented matrix representing a system of equations and obtained the following result.

$$\left[\begin{array}{cc|c} 1 & -2 & 7 \\ 5 & -10 & 35 \end{array} \right]$$

How many solutions does Emaan's system of equations have?

- (A) 0
 (B) 1
 (C) 2
 (D) infinitely many

6. What is the vertex of the graph of $f(x) = x^2 - 2x - 3$?

- (A) (1, 2)
 (B) (1, 4)
 (C) (1, -4)
 (D) (2, 1)

7. A teacher uses a strong slingshot to release an object from the top of a school high into the air. The function $a(t) = -16t^2 + 128t + 50$ gives the approximate altitude, in feet, of the object t seconds after it is released. How long will it be before the object hits the ground? Round to the nearest second.

8. Solve $0 = x^2 + 16x + 128$ by completing the square.

- (A) $x = 8 + 8i$ and $x = 8 - 8i$
- (B) $x = -8 + 8i$ and $x = -8 - 8i$
- (C) $x = -8 + i\sqrt{2}$ and $x = -8 - i\sqrt{2}$
- (D) $x = -16 + i\sqrt{2}$ and $x = -16 - i\sqrt{2}$

9. A soccer ball is kicked in the air off a 22.0-meter-high hill. The equation $h(t) = -5t^2 + 10t + 22$ gives the approximate height h , in meters, of the ball t seconds after it is kicked. What equation can be used to tell if the ball reaches a height of 35 m? Does the ball reach a height of 35 m?

Equation: _____

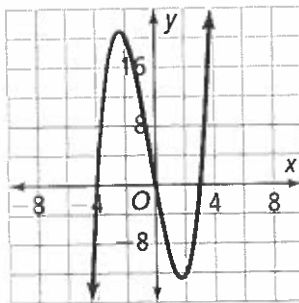
Answer: _____

10. Determine the number of real solutions of the system

$$\begin{cases} y = 2x^2 + 1 \\ y = -x \end{cases}$$

- (A) more than 2
- (B) 2
- (C) 1
- (D) 0

11. The graph of function f is shown. Use the zeros and the turning points of the graph to find the rule for f .



12. Simplify

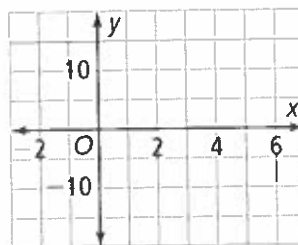
$$(24x^3 - 16x^2) - (6x^3 + 18x^2 - 14)$$

13. Sketch a graph of the polynomial function $f(x) = x^3 - 6x^2 + 3x + 10$. Use it to complete the following:

f is _____ on the intervals $(-\infty, 0.27)$ and $(3.73, \infty)$.

f is _____ on the intervals $(-1, 2)$ and $(5, \infty)$.

f is _____ on the intervals $(-\infty, -1)$ and $(2, 5)$.

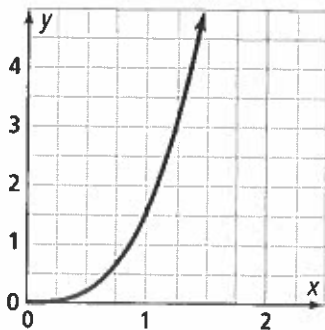


14. An artist cuts 4 squares with side length x ft from the corners of a 12 ft-by-18 ft rectangular piece of sheet metal. She bends up the sides and welds the corners to form a rectangular garden fountain that is x ft high. Write and simplify a function for the volume V of the fountain in terms of x .

15. Use polynomial identities to factor $64x^9 - 125y^6$.
- (A) $(4x^2 + 5y)(16x^4 + 20x^2y + 25y^2)$
 (B) $(4x^2 - 5y)(16x^4 - 20x^2y + 25y^2)$
 (C) $(4x^3 + 5y^2)(16x^6 - 20x^3y^2 + 25y^4)$
 (D) $(4x^3 - 5y^2)(16x^6 + 20x^3y^2 + 25y^4)$

16. Use the Binomial Theorem to expand $(2a + 2b)^6$.

17. The volume of a cube with side length x is $V(x) = x^3$. The volume of a cylinder with radius x and height $0.5x$ is shown in the graph. When $x = 1$, which volume is greater?



18. Use synthetic division to divide $6x^3 - 10x^2 + 20$ by $x + 1$.

quotient: _____

remainder: _____

19. Find the zeros of the function $f(x) = x^3 - 8x^2 + 9x + 18$, and describe the behavior of the graph at each zero.

- (A) The graph crosses the x -axis at $-1, 3$, and 6 .
 (B) The graph touches the x -axis at -1 and crosses the x -axis at -3 and 6 .
 (C) The graph crosses the x -axis at $-1, 3$, and 9 .
 (D) The graph touches the x -axis at -3 and -1 and crosses the x -axis at 6 .

20. What are all the real and complex solutions of $x^3 + 2x^2 + 36x = -72$? Round to the nearest tenth if necessary.

- (A) $2.8, 8.4i, -8.4i$
 (B) $-2, 6i, -6i$
 (C) $1.7, 1.7i, -5.1i$
 (D) $2, -6i$

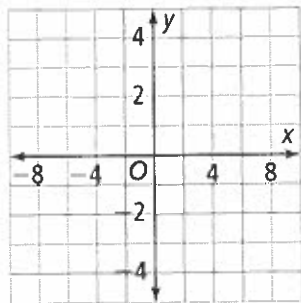
21. P varies inversely with x . If $P = 14$ when $x = 16$, find the value of P when $x = 21$.

- (A) 224
 (B) $\frac{21}{16}$
 (C) $\frac{32}{3}$
 (D) 4,704

22. What is the domain of the function

$$f(x) = \frac{2x^2 - 2x - 4}{x^2 + 2x - 24}$$

23. Sketch the graphs of $y = \frac{3}{x}$ and $y = \frac{x-3}{x+6}$ to demonstrate that there are two points of intersection.



24. It takes 24 h to fill a large basin with two hoses, where the water in one hose flows four times as fast as the other hose. How long will it take the slower hose to fill the basin if the faster hose is not functioning?

- (A) 60 h (C) 72 h
(B) 96 h (D) 120 h

25. What is the remainder when $6x + 12$ is divided by $2x - 8$?

26. Solve $2x + \frac{12}{x-3} = \frac{4x}{x-3}$.

- (A) 2
(B) 2, 3
(C) 2, -3
(D) $\frac{1}{2}$

27. What are the horizontal and vertical asymptotes of the graph of $y = \frac{x-10}{x^3-125}$?

- (A) $y = 10$; $x = 125$
(B) $y = 10$; $x = 5$
(C) $y = 0$; $x = 5$
(D) $y = 0$; $x = 10$

28. The graph of $xy = 12$ is translated down 6 units and to the left 4 units. Which are possible equations for the translated graph? Select all that apply.

- (A) $y = 6 + \frac{12}{x-4}$
(B) $y = -6 + \frac{12}{x+4}$
(C) $y = \frac{-6-12x}{x+4}$
(D) $y = \frac{-6x-12}{x+4}$

29. If $b = \frac{3}{x} + \frac{3}{y}$, what is the value of $\frac{1}{b}$?

- (A) $\frac{x+y}{3y+3x}$ (C) $\frac{xy}{3y+3x}$
(B) $\frac{3xy}{y+x}$ (D) $\frac{xy}{3y+x}$

30. Which graph(s) have a horizontal asymptote at $y = -3$? Select all that apply.

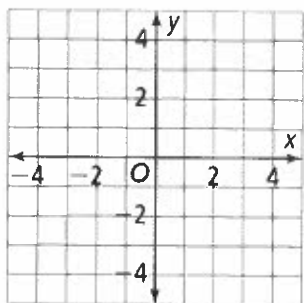
- (A) $y = \frac{1}{x} - 3$ (C) $y = \frac{3}{x+3}$
(B) $y = \frac{-3x}{x-3}$ (D) $y = \frac{3x}{x+3}$



Mid-Year Assessment

1. Graph the function.

$$y = \begin{cases} -4, & x < 1 \\ 5x - 9, & 1 < x \leq 2 \\ 1, & x > 2 \end{cases}$$



2. What are the domain and range of the function in Item 1?

domain: _____

range: _____

3. What is the average rate of change over the interval
- $[\frac{1}{2}, \frac{2}{3}]$
- for the function in Item 1?

- (A) $-\frac{17}{2}$
 (B) $-\frac{13}{2}$
 (C) 0
 (D) 5

4. Write the first four terms of the sequence defined by

$$a_n = \begin{cases} 5, & n = 1 \\ a_{n-1} + 3, & n > 1 \end{cases}$$

- (A) 5, 2, -1, -4, ...
 (B) 5, 15, 45, 135, ...
 (C) 5, 8, 11, 14, ...
 (D) 5, 4, 3, 2, ...

5. Solve the system of equations.

$$2x + 5y = -4$$

$$-x - 3y = 1$$

6. What is the equation in vertex form of a parabola with a vertex of
- $(-3, 4)$
- that passes through the point
- $(1, -4)$
- ?

- (A) $y = \frac{1}{2}(x + 3)^2 - 4$
 (B) $y = -\frac{1}{2}(x - 3)^2 - 4$
 (C) $y = -\frac{1}{2}(x + 3)^2 + 4$
 (D) $y = -2(x + 3)^2 - 4$

7. Solve the equation
- $x^2 - x = 30$
- .

- (A) $x = 5$ and $x = -6$
 (B) $x = -5$ and $x = 6$
 (C) $x = 3$ and $x = -10$
 (D) $x = -3$ and $x = -10$

8. A stone is tossed from the top of a cliff. The function
- $h(t) = -16t^2 - 48t + 160$
- gives the height, in feet, of the stone
- t
- seconds after it is tossed. How long will it be before the stone hits the ground?

9. Write the product
- $(7 + 3i)(7 - 3i)$
- in the form
- $a + bi$
- .

- (A) $49 - 9i$
 (B) $49 - 9i^2$
 (C) 40
 (D) 58

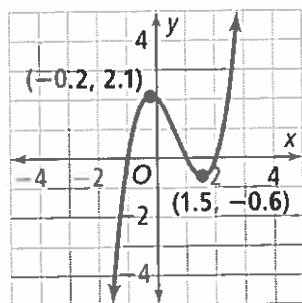
10. Solve $x^2 - 2x + 9 = 0$ using the Quadratic Formula.

- (A) $x = 1 + 2i\sqrt{2}$ and $x = 1 - 2i\sqrt{2}$
- (B) $x = 1 + 2\sqrt{10}$ and $x = 1 - 2\sqrt{10}$
- (C) $x = 1$ and $x = 9$
- (D) $x = \frac{1}{2} + 2i$ and $x = \frac{1}{2} - 2i$

11. For the polynomial $x^5 - 2x^6 + 3$, which of these statement(s) is true? Select all that apply.

- (A) The polynomial is a trinomial.
- (B) The degree of the polynomial is 6.
- (C) The leading coefficient is 1.
- (D) Written in standard form, the polynomial is $-2x^6 + x^5 + 3$.

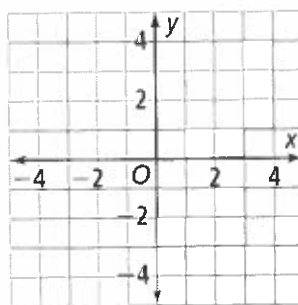
12. The graph of function f is shown. Use the zeros to find the rule for f .



- (A) $f(x) = x^3 - 2x^2 - x + 2$
- (B) $f(x) = x^3 + 2x^2 - x - 2$
- (C) $f(x) = -x^3 + 2x^2 + x - 2$
- (D) $f(x) = x^3 - 2$

13. Is $x + 2$ a factor of $P(x) = x^3 + 5x^2 + 11x + 10$? If it is, write $P(x)$ as a product of the two factors.

14. Sketch a graph of the polynomial function $f(x) = x^3 - x^2 - 2x$. Use the graph complete the statements below, where values are rounded to the nearest tenth.



f is _____ on the intervals $(-\infty, -1)$ and $(0, 2)$.

f is _____ on the intervals $(-1, 0)$ and $(2, \infty)$.

f is _____ on the intervals $(-\infty, -0.5)$ and $(1.2, \infty)$.

f is _____ on the interval $(-0.5, 1.2)$.

15. What are all the real and complex solutions of $x^3 - 2x^2 + 9x - 8 = 10$?

- (A) $3i, -3i, 2$
- (B) $3i, -2, 2$
- (C) $3i, -3i, -2$
- (D) $3, -3, 2i$

16. Add $\frac{12}{a-4} + \frac{3a}{4-a}$. State the sum and any restrictions on the variables.
-

17. R varies inversely with x . If $R = -2$ when $x = 6$, what is the value of R when $x = -3$?

(A) -1
(B) 4
(C) -4
(D) 1

18. Identify the horizontal and vertical asymptotes of the graph of

$$y = \frac{x^2 - x - 6}{14 - 9x + x^2}$$

19. Describe the transformations needed to translate the graph of $y = \frac{1}{x}$ to the graph of $y = \frac{1}{x+1} - 3$.

(A) to the right 1 and down 3
(B) to the right 1 and up 3
(C) to the left 1 and down 3
(D) to the left 1 and up 3

20. If $a = \frac{1}{x} - \frac{1}{y}$, what is the value of $\frac{1}{a}$?

(A) $\frac{xy}{y-x}$
(B) $\frac{1}{x-y}$
(C) $\frac{xy}{x-y}$
(D) $x-y$

21. Simplify $\sqrt[4]{16a^4b^{20}}$

(A) $4a^2b^{10}$
(B) $4a^2|b^5|$
(C) $2b^{16}$
(D) $2|a| \cdot |b^5|$

22. Which of the following is equivalent to $\frac{14}{3-\sqrt{2}}$?

(A) $\frac{42 - 14\sqrt{2}}{11}$
(B) $6 + 2\sqrt{2}$
(C) $6 - 2\sqrt{2}$
(D) $4\sqrt{2}$

23. The graph of $y = \sqrt{x}$ has been translated to the right 1 unit and up 4 units. What is the equation of the translated graph?

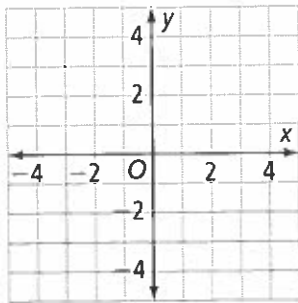
- (A) $y = 1 + \sqrt{x + 4}$
- (B) $y = 4 - \sqrt{x - 1}$
- (C) $y = 4 + \sqrt{x - 1}$
- (D) $y = 3 + \sqrt{x}$

24. The function g has domain $x \geq 0$ and range $y \geq 3$. What are the domain and range of g^{-1} ?

domain: _____

range: _____

25. Graph the function $f(x) = -2 + \sqrt{x}$.



26. Given $f(x) = 4x^2 - 4x + 1$ and $g(x) = 2x - 1$, which of the following are expression(s) for $f \cdot g$? Select all that apply.

- (A) $6x^3 + 6x^2 - 6x + 1$
- (B) $(2x - 1)^3$
- (C) $8x^3 - 12x^2 + 6x - 1$
- (D) $4x^2 - 2x$

27. Let $f(x) = \sqrt{x - 2}$ and $g(x) = 3x$. Write an expression for $f \circ g$. What is the domain of $f \circ g$?

expression for $f \circ g$: _____

domain of $f \circ g$: _____

28. If $h(x) = 4x - 3$, what is an equation for $h^{-1}(x)$?

- (A) $h^{-1}(x) = 3x + 4$
- (B) $h^{-1}(x) = 3x - 4$
- (C) $h^{-1}(x) = \frac{x + 3}{4}$
- (D) $h^{-1}(x) = \frac{x - 3}{4}$

29. If $f(x) = \sqrt{x - 3}$, which of the following are true? Select all that apply.

- (A) $f^{-1}(0) = 3$
- (B) $f^{-1}(-1) = 4$
- (C) $f \circ f^{-1}(7) = 7$
- (D) $f^{-1}(12) = 3$

30. Solve $\sqrt{x + 7} - 1 = \sqrt{3x + 10}$

- (A) -3
- (B) 0
- (C) 2
- (D) 9

31. Which function represents the exponential function $f(x) = 5^x$ after a horizontal stretch by a factor of 2 and a reflection across the x -axis?

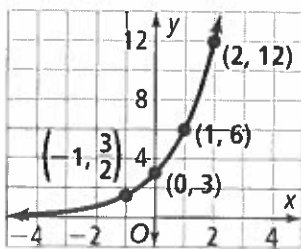
- Ⓐ $g(x) = \left(-\frac{1}{2}\right)5^x$
 Ⓑ $g(x) = -5^{\frac{x}{2}}$
 Ⓒ $g(x) = -2 \cdot 5^x$
 Ⓓ $g(x) = -5^{2x}$

32. For the function $f(x) = \frac{1}{3} \cdot 6^x$, identify the y -intercept and the asymptote.

y -intercept: _____

asymptote: _____

33. Which of the following functions has a greater average rate of change on the interval $(0, 2)$ than the function shown in the graph?



- Ⓐ $f(x) = 5 \cdot 2^x$
 Ⓑ $f(x) = 2^x$
 Ⓒ $f(x) = \left(\frac{1}{2}\right)^x$
 Ⓓ $f(x) = \frac{1}{3} \cdot 2^x$

34. A colony of spiders has a population of 350. The population is decreasing at a rate of 3% per year. Write an exponential decay function for the quarterly decay rate. What does the y -intercept of its graph mean in this context? Round values to the nearest thousandth.

function: _____

The y -intercept is the _____

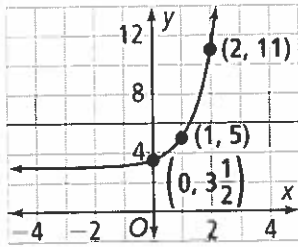
at time _____.

35. Which function is the inverse of the exponential function $y = \left(\frac{3}{2}\right)^x$?

- Ⓐ $y = \left(\frac{2}{3}\right)^x$
 Ⓑ $y = x^{\frac{3}{2}}$
 Ⓒ $y = \log_{\frac{3}{2}} x$
 Ⓓ $y = \log_x \left(\frac{2}{3}\right)$

36. What is the solution to the equation $\log_2(5x - 2) = -2$?

37. The graph shows the function $f(x) = \frac{1}{2} \cdot 4^x + 3$. What is the value of the inverse function f^{-1} at $x = 5$?



- (A) 5
 (B) $3\frac{1}{2}$
 (C) 1
 (D) 2

38. Find the equation of the inverse of the function $f(x) = \log_5(2x)$.

39. Which of the following is equivalent to the expression $\log \frac{m^2}{np^4}$?

- (A) $2 \log m - \log n - 4 \log p$
 (B) $\frac{\log m^2}{4 \log np}$
 (C) $2 \log m - \log n + 4 \log p$
 (D) $8 \frac{\log m}{\log np}$

40. Write a recursive and an explicit definition for the geometric sequence 2, 6, 18, 54, ... What is the sum of the first 5 terms in the sequence?

recursive: _____

explicit: _____

sum: _____