Solution Manual for College Algebra 7th Edition by Blitzer ISBN 9780134469164

Fullink download

Test Bank :
https://testbankpack.com/p/test-bank-for-college-algebra-7th-edition-by-blitzer-isbn-9780134469164/
Solution Manual :

https://testbankpack.com/p/solution-manual-for-college-algebra-7th-edition-by-blitzer-isbn-9780134469164/

201

Chapter 2
Functions and Graphs

Section 2.1

Check Point Exercises

The domain is the set of all first components: {0, 10, 20, 30, 42}. The range is the set of all second components: {9.1, 6.7, 10.7, 13.2, 21.7}.

a. The relation is not a function since the two ordered pairs (5, 6) and (5, 8) have the same first component but different second components.

b. The relation is a function since no two ordered pairs have the same first component and different second components.

a. $2x + y = 6$

$= 6 - 2x$

For each value of *x*, there is one and only one value for *y*, so the equation defines *y* as a function of *x*.

$x^2 + y^2 = 1$

$y^2 = 1 - x^2$

$y = \pm\sqrt{1 - x^2}$

Since there are values of *x* (all values between – 1 and 1 exclusive) that give more than one value for *y* (for example, if *x* = 0, then

$= \pm\sqrt{1 - 0^2} = \pm 1$), the equation does not define *y* as a function of *x*.

4. a. $f(-5) = (-5)^2 - 2(-5) + 7$

$25 - (-10) + 7$

42

$f(x+4) = (x+4)^2 - 2(x+4) + 7$

$x^2 + 8x + 16 - 2x - 8 + 7$

$x^2 + 6x + 15$

$f(-x) = (-x)^2 - 2(-x) + 7$

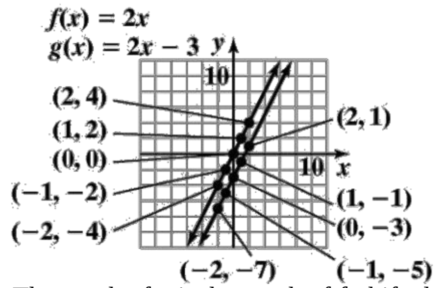
$x^2 - (-2x) + 7$

$x^2 + 2x + 7$

5.

x	$f(x) = 2x$	(x, y)
-2	–4	$(-2, -4)$
-1	–2	$(-1, -2)$
0	0	$(0, 0)$
1	2	$(1, 2)$
2	4	$(2, 4)$

x	$g(x) = 2x - 3$	(x, y)
-2	$g(-2) = 2(-2) - 3 = -7$	$(-2, -7)$
-1	$g(-1) = 2(-1) - 3 = -5$	$(-1, -5)$
0	$g(0) = 2(0) - 3 = -3$	$(0, -3)$
1	$g(1) = 2(1) - 3 = -1$	$(1, -1)$
2	$g(2) = 2(2) - 3 = 1$	$(2, 1)$



The graph of g is the graph of f shifted down 3 units.

203

The graph (a) passes the vertical line test and is therefore is a function.
The graph (b) fails the vertical line test and is therefore not a function.
The graph (c) passes the vertical line test and is therefore is a function.
The graph (d) fails the vertical line test and is therefore not a function.

a. $f(5) = 400$

$x = 9$, $f(9) = 100$

The minimum T cell count in the asymptomatic stage is approximately 425.

8. a. domain: $\{x \mid -2 \le x \le 1\}$ or $[-2,1]$.
range: $\{y \mid 0 \le y \le 3\}$ or $[0,3]$.

b. domain: $\{x \mid -2 < x \le 1\}$ or $(-2,1]$.
range: $\{y \mid -1 \le y < 2\}$ or $[-1,2)$.

c. domain: $\{x \mid -3 \le x < 0\}$ or $[-3,0)$.
range: $\{y \mid y = -3, -2, -1\}$.

Concept and Vocabulary Check 2.1

relation; domain; range

function

f; x

true

false

x; $x + 6$

ordered pairs

more than once; function

[0, 3) ; domain

[1, ∞) ; range

0; 0; zeros

false

Exercise Set 2.1

The relation is a function since no two ordered pairs have the same first component and different second components. The domain is {1, 3, 5} and the range is {2, 4, 5}.

The relation is a function because no two ordered pairs have the same first component and different second components The domain is {4, 6, 8} and the range is {5, 7, 8}.

The relation is not a function since the two ordered pairs (3, 4) and (3, 5) have the same first component but different second components (the same could be said for the ordered pairs (4, 4) and (4, 5)). The domain is {3, 4} and the range is {4, 5}.

The relation is not a function since the two ordered pairs (5, 6) and (5, 7) have the same first component but different second components (the same could be said for the ordered pairs (6, 6) and (6, 7)). The domain is {5, 6} and the range is {6, 7}.

The relation is a function because no two ordered pairs have the same first component and different

second components The domain is {3, 4, 5, 7} and the range is {–2, 1, 9}.

The relation is a function because no two ordered pairs have the same first component and different second components The domain is {–2, –1, 5, 10} and the range is {1, 4, 6}.

The relation is a function since there are no same first components with different second components. The domain is {–3, –2, –1, 0} and the range is {–3, –2, – 1, 0}.

The relation is a function since there are no ordered pairs that have the same first component but different second components. The domain is {–7, –5, –3, 0} and the range is {–7, –5, –3, 0}.

The relation is not a function since there are ordered pairs with the same first component and different second components. The domain is {1} and the range is {4, 5, 6}.

The relation is a function since there are no two ordered pairs that have the same first component and different second components. The domain is {4, 5, 6} and the range is {1}.

$x + y = 16$

$= 16 - x$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$x + y = 25$

$= 25 - x$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$x^2 + y = 16$

$= 16 - x^2$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$x^2 + y = 25$

$= 25 - x^2$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$x^2 + y^2 = 16$

$y^2 = 16 - x^2$

$y = \pm\sqrt{16 - x^2}$

If $x = 0$, $y = \pm 4$.

Since two values, $y = 4$ and $y = -4$, can be obtained for one value of *x*, *y* is not a function of *x*.

$x^2 + y^2 = 25$

$y^2 = 25 - x^2$

$y = \pm\sqrt{25 - x^2}$

If $x = 0$, $y = \pm 5$.

Since two values, $y = 5$ and $y = -5$, can be obtained for one value of *x*, *y* is not a function of *x*.

$x = y^2$

$y = \pm$ [redacted]

If $x = 1$, $y = \pm 1$.

Since two values, $y = 1$ and $y = -1$, can be obtained for $x = 1$, *y* is not a function of *x*.

$4x = y^2$

$y = \pm\sqrt{4x} = \pm 2\sqrt{x}$

If $x = 1$, then $y = \pm 2$.

Since two values, $y = 2$ and $y = -2$, can be obtained for $x = 1$, *y* is not a function of *x*.

19. $y = \sqrt{x + 4}$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

20. $y = -\sqrt{x + 4}$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$x + y^3 = 8$

$y^3 = 8 - x$

$y = \sqrt[3]{8 - x}$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$x + y^3 = 27$

$y^3 = 27 - x$

$y = \sqrt[3]{27 - x}$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$xy + 2y = 1$

$y(x + 2) = 1$

$y = \frac{1}{x + 2}$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$xy - 5y = 1$

$y(x - 5) = 1$

$y = \frac{1}{x - 5}$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$|x| - y = 2$

$-y = -|x| + 2$

$y = |x| - 2$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

$|x| - y = 5$

$-y = -|x| + 5$

$y = |x| - 5$

Since only one value of *y* can be obtained for each value of *x*, *y* is a function of *x*.

a. $f(6) = 4(6) + 5 = 29$

$f(x + 1) = 4(x + 1) + 5 = 4x + 9$

$f(-x) = 4(-x) + 5 = -4x + 5$

a. $f(4) = 3(4) + 7 = 19$

$f(x + 1) = 3(x + 1) + 7 = 3x + 10$

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

a. $g(-1) = (-1)^2 + 2(-1) + 3$

$1 - 2 + 3$

2

$g(x + 5) = (x + 5)^2 + 2(x + 5) + 3$

$x^2 + 10x + 25 + 2x + 10 + 3$

$x^2 + 12x + 38$

$g(-x) = (-x)^2 + 2(-x) + 3$

$x^2 - 2x + 3$

a. $g(-1) = (-1)^2 - 10(-1) - 3$

$1 + 10 - 3$

8

$g(x + 2) = (x + 2)^2 - 10(8 + 2) - 3$

$x^2 + 4x + 4 - 10x - 20 - 3$

$x^2 - 6x - 19$

$g(-x) = (-x)^2 - 10(-x) - 3$

$x^2 + 10x - 3$

a. $h(2) = 2^4 - 2^2 + 1$

$16 - 4 + 1$

13

$h(-1) = (-1)^4 - (-1)^2 + 1$

$1 - 1 + 1$

1

$h(-x) = (-x)^4 - (-x)^2 + 1 = x^4 - x^2 + 1$

$h(3a) = (3a)^4 - (3a)^2 + 1$

$81a^4 - 9a^2 + 1$

a. $h(3) = 3^3 - 3 + 1 = 25$

$h(-2) = (-2)^3 - (-2) + 1$

$-8 + 2 + 1$

-5

$h(-x) = (-x)^3 - (-x) + 1 = -x^3 + x + 1$

$h(3a) = (3a)^3 - (3a) + 1$

$27a^3 - 3a + 1$

33. a. $f(-6) = \sqrt{-6 + 6} + 3 = \sqrt{0} + 3 = 3$

$f(10) = \sqrt{10 + 6} + 3$

$\sqrt{16} + 3$

$4 + 3$

7

c. $f(x - 6) = \sqrt{x - 6 + 6} + 3 = \sqrt{x} + 3$

34. a. $f(16) = \sqrt{25 - 16} - 6 = \sqrt{9} - 6 = 3 - 6 = -3$

$f(-24) = \sqrt{25 - (-24)} - 6$

$\sqrt{49} - 6$

$7 - 6 = 1$

$f(25 - 2x) = \sqrt{25 - (25 - 2x)} - 6$

$\sqrt{2x} - 6$

35. a. $f(2) = \frac{4(2)^2 - 1}{2^2} = \frac{15}{4}$

b. $f(-2) = \frac{4(-2)^2 - 1}{(-2)^2} = \frac{15}{4}$

ʳĀ□Ā□ $f(-x) = \frac{4(-x)^2 - 1}{(-x)^2} = \frac{4x^2 - 1}{x^2}$

36. a. $f(2) = \frac{4(2)^3 + 1}{2^3} = \frac{33}{8}$

$f(-2) = \frac{4(-2)^3 + 1}{(-2)^3} = \frac{-31}{-8} = \frac{31}{8}$

c. $f(-x) = \frac{4(-x)^3 + 1}{(-x)^3} = \frac{-4x^3 + 1}{-x^3}$

or $\frac{4x^3 - 1}{x^3}$

a. $f(6) = \frac{|6|}{6} = 1$

$f(-6) = \frac{|-6|}{-6} = \frac{6}{-6} = -1$

c. $f(r^2) = \frac{|r^2|}{r^2} = \frac{r^2}{r^2} = 1$

38. a. $f(5) = \frac{|5+3|}{5+3} = \frac{|8|}{8} = 1$

b. $f(-5) = \frac{|-5+3|}{-5+3} = \frac{|-2|}{-2} = \frac{2}{-2} = -1$

$f(-9-x) = \frac{|-9-x+3|}{-9-x+3}$

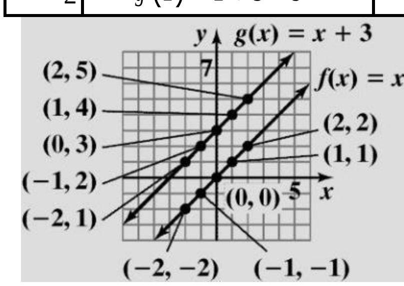
$\frac{-x-6}{}$ 1, if $x < -6$

$-x - = -1$, if $x > -66$

39.

x	$f(x) = x$	(x, y)
-2	$f(-2) = -2$	$(-2, -2)$
-1	$f(-1) = -1$	$(-1, -1)$
0	$f(0) = 0$	$(0, 0)$
1	$f(1) = 1$	$(1, 1)$
2	$f(2) = 2$	$(2, 2)$

x	$g(x) = x + 3$	(x, y)
-2	$g(-2) = -2 + 3 = 1$	$(-2, 1)$
-1	$g(-1) = -1 + 3 = 2$	$(-1, 2)$
0	$g(0) = 0 + 3 = 3$	$(0, 3)$
1	$g(1) = 1 + 3 = 4$	$(1, 4)$
2	$g(2) = 2 + 3 = 5$	$(2, 5)$

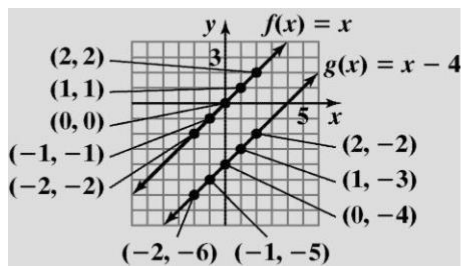


The graph of g is the graph of f shifted up 3 units.

40.

x	$f(x) = x$	(x, y)
-2	$f(-2) = -2$	$(-2, -2)$
-1	$f(-1) = -1$	$(-1, -1)$
0	$f(0) = 0$	$(0, 0)$
1	$f(1) = 1$	$(1, 1)$
2	$f(2) = 2$	$(2, 2)$

x	$g(x) = x - 4$	(x, y)
-2	$g(-2) = -2 - 4 = -6$	$(-2, -6)$
-1	$g(-1) = -1 - 4 = -5$	$(-1, -5)$
0	$g(0) = 0 - 4 = -4$	$(0, -4)$
1	$g(1) = 1 - 4 = -3$	$(1, -3)$
2	$g(2) = 2 - 4 = -2$	$(2, -2)$

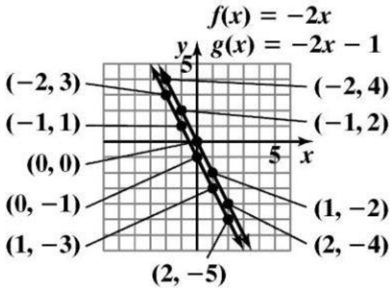


The graph of g is the graph of f shifted down 4 units.

41.

x	$f(x) = -2x$	(x, y)
-2	$f(-2) = -2(-2) = 4$	$(-2, 4)$
-1	$f(-1) = -2(-1) = 2$	$(-1, 2)$
0	$f(0) = -2(0) = 0$	$(0, 0)$
1	$f(1) = -2(1) = -2$	$(1, -2)$
2	$f(2) = -2(2) = -4$	$(2, -4)$

x	$g(x) = -2x - 1$	(x, y)
-2	$g(-2) = -2(-2) - 1 = 3$	$(-2, 3)$
-1	$g(-1) = -2(-1) - 1 = 1$	$(-1, 1)$
0	$g(0) = -2(0) - 1 = -1$	$(0, -1)$
1	$g(1) = -2(1) - 1 = -3$	$(1, -3)$
2	$g(2) = -2(2) - 1 = -5$	$(2, -5)$

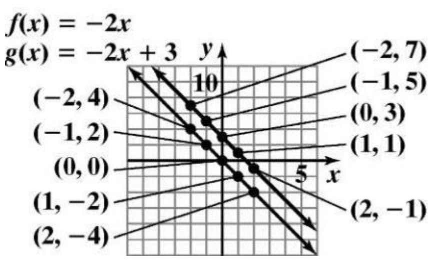


The graph of g is the graph of f shifted down 1 unit.

42.

x	$f(x) = -2x$	(x, y)
−2	$f(-2) = -2(-2) = 4$	$(-2, 4)$
−1	$f(-1) = -2(-1) = 2$	$(-1, 2)$
0	$f(0) = -2(0) = 0$	$(0, 0)$
1	$f(1) = -2(1) = -2$	$(1, -2)$
2	$f(2) = -2(2) = -4$	$(2, -4)$

x	$g(x) = -2x + 3$	(x, y)
−2	$g(-2) = -2(-2) + 3 = 7$	$(-2, 7)$
−1	$g(-1) = -2(-1) + 3 = 5$	$(-1, 5)$
0	$g(0) = -2(0) + 3 = 3$	$(0, 3)$
1	$g(1) = -2(1) + 3 = 1$	$(1, 1)$
2	$g(2) = -2(2) + 3 = -1$	$(2, -1)$

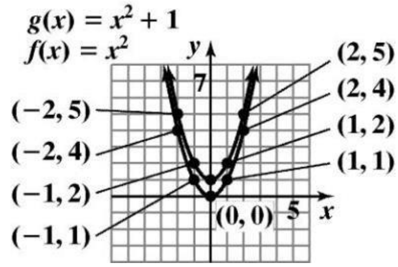


The graph of g is the graph of f shifted up 3 units.

43.

x	$f(x) = x^2$	(x, y)
−2	$f(-2) = (-2)^2 = 4$	$(-2, 4)$
−1	$f(-1) = (-1)^2 = 1$	$(-1, 1)$
0	$f(0) = (0)^2 = 0$	$(0, 0)$
1	$f(1) = (1)^2 = 1$	$(1, 1)$
2	$f(2) = (2)^2 = 4$	$(2, 4)$

x	$g(x) = x^2 + 1$	(x, y)
−2	$g(-2) = (-2)^2 + 1 = 5$	$(-2, 5)$
−1	$g(-1) = (-1)^2 + 1 = 2$	$(-1, 2)$
0	$g(0) = (0)^2 + 1 = 1$	$(0, 1)$
1	$g(1) = (1)^2 + 1 = 2$	$(1, 2)$
2	$g(2) = (2)^2 + 1 = 5$	$(2, 5)$

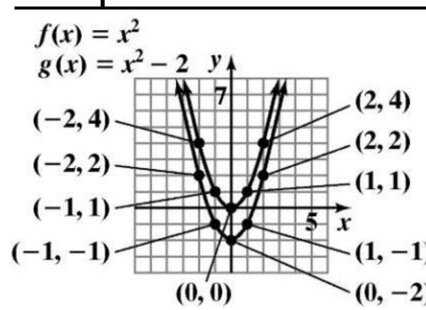


The graph of g is the graph of f shifted up 1 unit.

44.

x	$f(x) = x^2$	(x, y)
	$= (-2)^2$	$(-2, 4)$
		$-1, 1$
1	$f(1) = (1) = 1$	
2	$f(2) = (2)^2 = 4$	$(2, 4)$

x	$g(x) = x^2 - 2$	(x, y)
−2	$g(-2) = (-2)^2 - 2 = 2$	$(-2, 2)$
−1	$g(-1) = (-1)^2 - 2 = -1$	$(-1, -1)$
0	$g(0) = (0)^2 - 2 = -2$	$(0, -2)$
1	$g(1) = (1)^2 - 2 = -1$	$(1, -1)$
2	$g(2) = (2)^2 - 2 = 2$	$(2, 2)$



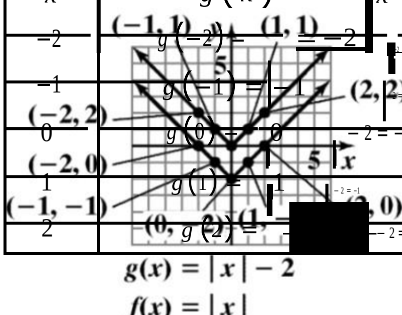
The graph of *g* is the graph of *f* shifted down 2 units.

209

45.

x	$f(x) = \lvert x \rvert$	(x, y)
-2	$f(-2) = \lvert -2 \rvert = 2$	$(-2, 2)$
-1	$f(-1) = \lvert -1 \rvert = 1$	$(-1, 1)$
0	$f(0) = \lvert 0 \rvert = 0$	$(0, 0)$
1	$f(1) = \lvert 1 \rvert = 1$	$(1, 1)$
2	$f(2) = \lvert 2 \rvert = 2$	$(2, 2)$

x	$g(x) = \lvert x \rvert - 2$	(x, y)
-2	$g(-2) = \lvert -2 \rvert - 2 = 0$	$(-2, 0)$
-1	$g(-1) = \lvert -1 \rvert - 2 = -1$	$(-1, -1)$
0	$g(0) = \lvert 0 \rvert - 2 = -2$	$(0, -2)$
1	$g(1) = \lvert 1 \rvert - 2 = -1$	$(1, -1)$
2	$g(2) =$ [redacted] $- 2 = 0$	$(2, 0)$

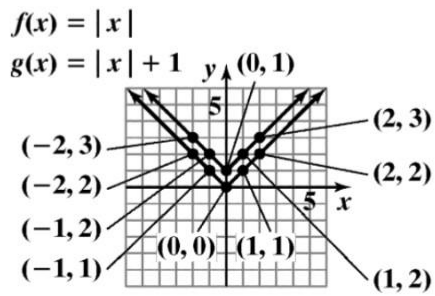


The graph of g is the graph of f shifted down 2 units.

46.

x	$f(x) = x$	(x, y)
-2	$f(-2) = -2 = 2$	$(-2, 2)$
-1	$f(-1) = -1 = 1$	$(-1, 1)$
0	$f(0) = 0 = 0$	$(0, 0)$
1	$f(1) = 1 = 1$	$(1, 1)$
2	$f(2) = 2 = 2$	$(2, 2)$

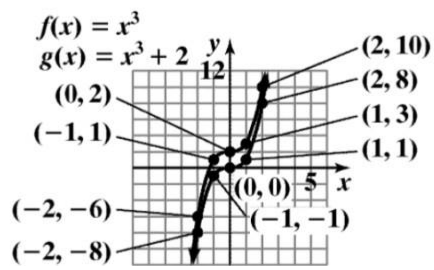
x	$g(x) = \lvert x \rvert + 1$	(x, y)
-2	$g(-2) = \lvert -2 \rvert$	$(-2, 3)$
-1	$g(-1) = \lvert -1 \rvert + 1 = 2$	$(-1, 2)$
0	$g(0) = \lvert 0 \rvert + 1 = 1$	$(0, 1)$
1	$g(1) = 1 + 1 = 2$	$(1, 2)$
2	$g(2) = 2 + 1 = 3$	$(2, 3)$



The graph of g is the graph of f shifted up 1 unit.

47.

x	$f(x) = x^3$	(x, y)	$g(x) = x^3 + 2$	(x, y)
-2			$g(-2) = (-2)^3 + 2 = -6$	$(-2, -6)$
-1	$f(-1) = (-1)^3 = -1$	$(-1, -1)$		$(-1, 1)$
0	$f(0) = (0)^3 = 0$	$(0, 0)$	$g(0) = (0)^3 + 2 = 2$	$(0, 2)$
1	$f(1) = (1)^3 = 1$	$(1, 1)$	$g(1) = (1)^3 + 2 = 3$	$(1, 3)$
2	$f(2) = (2)^3 = 8$	$(2, 8)$	$g(2) = (2)^3 + 2 = 10$	$(2, 10)$



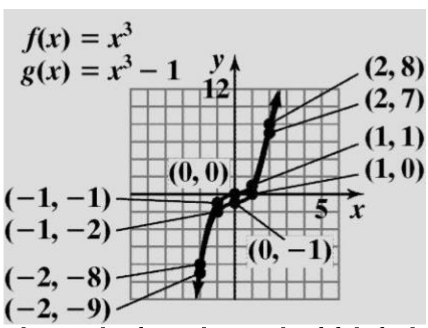
The graph of g is the graph of f shifted up 2 units.

210

48.

x	$f(x) = x^3$	(x, y)
-2	$f(-2) = (-2)^3 = -8$	$(-2, -8)$
	3	$-1, -1$
0	$f(0) = (0)^3 = 0$	$(0, 0)$
	3	$1, 1$
2	$f(2) = (2)^3 = 8$	$(2, 8)$

x	$g(x) = x^3 - 1$	(x, y)
-2	$g(-2) = (-2)^3 - 1 = -9$	$(-2, -9)$
-1	$g(-1) = (-1)^3 - 1 = -2$	$(-1, -2)$
0	$g(0) = (0) - 1 = -1$	$(0, -1)$
1	$g(1) = (1)^3 - 1 = 0$	$(1, 0)$
2	$g(2) = (2)^3 - 1 = 7$	$(2, 7)$

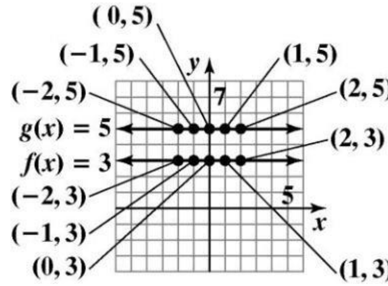


The graph of g is the graph of f shifted down 1 unit.

49.

x	$f(x) = 3$	(x, y)
-2	$f(-2) = 3$	$(-2, 3)$
-1	$f(-1) = 3$	$(-1, 3)$
0	$f(0) = 3$	$(0, 3)$
1	$f(1) = 3$	$(1, 3)$
2	$f(2) = 3$	$(2, 3)$

x	$g(x) = 5$	(x, y)
-2	$g(-2) = 5$	$(-2, 5)$
-1	$g(-1) = 5$	$(-1, 5)$
0	$g(0) = 5$	$(0, 5)$
1	$g(1) = 5$	$(1, 5)$
2	$g(2) = 5$	$(2, 5)$

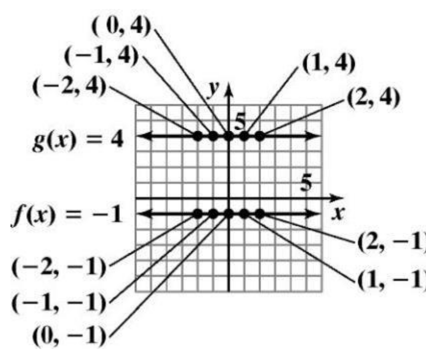


The graph of g is the graph of *f* shifted up 2 units.

50.

x	$f(x) = -1$	(x, y)
-2	$f(-2) = -1$	$(-2, -1)$
-1	$f(-1) = -1$	$(-1, -1)$
0	$f(0) = -1$	$(0, -1)$
1	$f(1) = -1$	$(1, -1)$
2	$f(2) = -1$	$(2, -1)$

x	$g(x) = 4$	(x, y)
-2	$g(-2) = 4$	$(-2, 4)$
-1	$g(-1) = 4$	$(-1, 4)$
0	$g(0) = 4$	$(0, 4)$
1	$g(1) = 4$	$(1, 4)$
2	$g(2) = 4$	$(2, 4)$

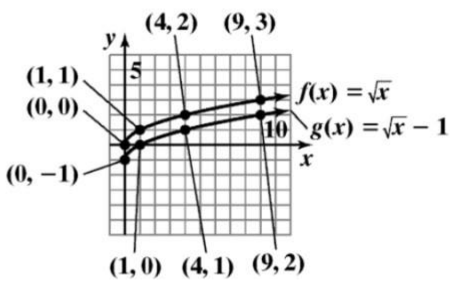


The graph of g is the graph of *f* shifted up 5 units.

51.

x	$f(x) = \sqrt{x}$	(x, y)
0	$f(0) = \sqrt{0} = 0$	$(0, 0)$
1	$f(1) = \sqrt{1} = 1$	$(1, 1)$
4	$f(4) = \sqrt{4} = 2$	$(4, 2)$
9	$f(9) = \sqrt{9} = 3$	$(9, 3)$

x	$g(x) = \sqrt{x} - 1$	(x, y)
0	$g(0) = \sqrt{0} - 1 = -1$	$(0, -1)$
1	$g(1) = \sqrt{1} - 1 = 0$	$(1, 0)$
4	$g(4) = \sqrt{4} - 1 = 1$	$(4, 1)$
9	$g(9) = \sqrt{9} - 1 = 2$	$(9, 2)$

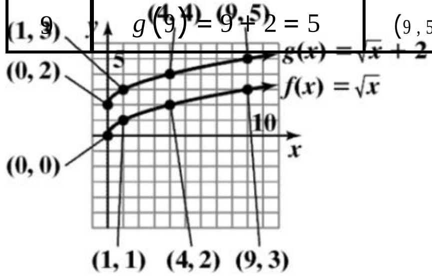


The graph of g is the graph of *f* shifted down 1 unit.

52.

x	$f(x) = \sqrt{x}$	(x, y)
0	$f(0) = \sqrt{0} = 0$	$(0, 0)$
1	$f(1) = \sqrt{1} = 1$	$(1, 1)$
4	$f(4) = \sqrt{4} = 2$	$(4, 2)$
9	$f(9) = \sqrt{9} = 3$	$(9, 3)$

x	$g(x) = \sqrt{x} + 2$	(x, y)
0	$g(0) = \sqrt{0} + 2 = 2$	$(0, 2)$
1	$g(1) = \sqrt{1} + 2 = 3$	$(1, 3)$
4	$g(4) = \sqrt{4} + 2 = 4$	$(4, 4)$
9	$g(9) = \sqrt{9} + 2 = 5$	$(9, 5)$

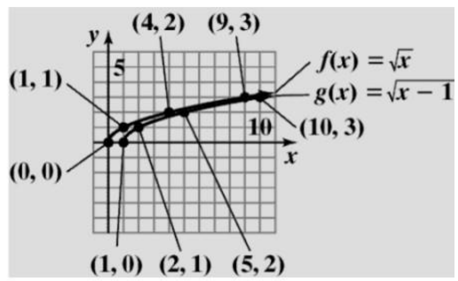


The graph of g is the graph of *f* shifted up 2 units.

53.

x	$f(x) = \sqrt{x}$	(x, y)
0	$f(0) = \sqrt{0} = 0$	$(0, 0)$
1	$f(1) = \sqrt{1} = 1$	$(1, 1)$
4	$f(4) = \sqrt{4} = 2$	$(4, 2)$
9	$f(9) = \sqrt{9} = 3$	$(9, 3)$

x	$g(x) = \sqrt{x - 1}$	(x, y)
1	$g(1) = \sqrt{1 - 1} = 0$	$(1, 0)$
2	$g(2) = \sqrt{2 - 1} = 1$	$(2, 1)$
5	$g(5) = \sqrt{5 - 1} = 2$	$(5, 2)$
10	$g(10) = \sqrt{10 - 1} = 3$	$(10, 3)$

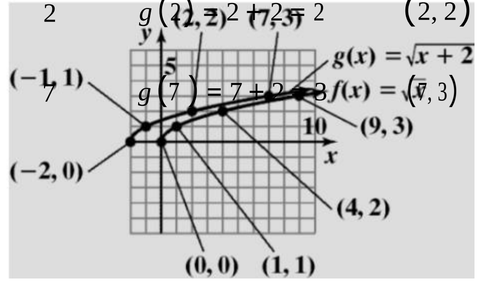


The graph of g is the graph of *f* shifted right 1 unit.

54.

x	$f(x) = \sqrt{x}$	(x, y)
0	$f(0) = \sqrt{0} = 0$	$(0, 0)$
1	$f(1) = \sqrt{1} = 1$	$(1, 1)$
4	$f(4) = \sqrt{4} = 2$	$(4, 2)$
9	$f(9) = \sqrt{9} = 3$	$(9, 3)$

x	$g(x) = \sqrt{x + 2}$	(x, y)
−2	$g(-2) = \sqrt{-2 + 2} = 0$	$(-2, 0)$
−1	$g(-1) = \sqrt{-1 + 2} = 1$	$(-1, 1)$
2	$g(2) = \sqrt{2 + 2} = 2$	$(2, 2)$
7	$g(7) = \sqrt{7 + 2} = 3$	$(7, 3)$



The graph of g is the graph of *f* shifted left 2 units.

212

function

function

function

not a function

not a function

not a function

function

not a function

function

function

$f(-2) = -4$

$f(2) = -4$

$f(4) = 4$

$f(-4) = 4$

$f(-3) = 0$

$f(-1) = 0$

$g(-4) = 2$

$g(2) = -2$

$g(-10) = 2$

$g(10) = -2$

75. When $x = -2$, $g(x) = 1$.

76. When $x = 1$, $g(x) = -1$.

a. domain: $(-\infty, \infty)$

range: $[-4, \infty)$

x-intercepts: –3 and 1

y-intercept: –3

e. $f(-2) = -3$ and $f(2) = 5$

a. domain: (–∞, ∞)

range: (–∞, 4]

x-intercepts: –3 and 1

y-intercept: 3

e. $f(-2) = 3$ and $f(2) = -5$

a. domain: $(-\infty, \infty)$

range: $[1, \infty)$

x-intercept: none

y-intercept: 1

e. $f(-1) = 2$ and $f(3) = 4$

a. domain: (–∞, ∞)

range: [0, ∞)

x-intercept: –1

y-intercept: 1

f(–4) = 3 and *f*(3) = 4

a. domain: [0, 5)

range: [–1, 5)

x-intercept: 2

y-intercept: –1

f(3) = 1

a. domain: (–6, 0]

range: [–3, 4)

x-intercept: –3.75

y-intercept: –3 *f*(–
5) = 2

a. domain: [0, ∞)

range: [1, ∞)

c. *x*-intercept: none

y-intercept: 1

f(4) = 3

a. domain: $[-1, \infty)$

range: $[0, \infty)$

x-intercept: –1

y-intercept: 1

$f(3) = 2$

a. domain: $[-2, 6]$

range: $[-2, 6]$

x-intercept: 4

y-intercept: 4

$f(-1) = 5$

a. domain: $[-3, 2]$

range: $[-5, 5]$

c. x-intercept: $-\frac{1}{2}$

y-intercept: 1

$f(-2) = -3$

a. domain: $(-\infty, \infty)$

range: $(-\infty, -2]$

x-intercept: none

y-intercept: –2

$f(-4) = -5$ and $f(4) = -2$

a. domain: $(-\infty, \infty)$

range: $[0, \infty)$

x-intercept: $\{x \mid x \le 0\}$

y-intercept: 0

$f(-2) = 0$ and $f(2) = 4$

a. domain: $(-\infty, \infty)$

range: $(0, \infty)$

x-intercept: none

y-intercept: 1.5

90. a. domain: $(-\infty, 1) \cup (1, \infty)$

b. range: $(-\infty, 0) \cup (0, \infty)$

x-intercept: none

y-intercept: -1

$f(2) = 1$

a. domain: $\{-5, -2, 0, 1, 3\}$

range: $\{2\}$

x-intercept: none

y-intercept: 2

$f(-5) + f(3) = 2 + 2 = 4$

a. domain: $\{-5, -2, 0, 1, 4\}$

range: $\{-2\}$

x-intercept: none

y-intercept: –2

$f(-5) + f(4) = -2 + (-2) = -4$

$g(1) = 3(1) - 5 = 3 - 5 = -2$

$(g(1)) = f(-2) = (-2)^2 - (-2) + 4$

$4 + 2 + 4 = 10$

$g(-1) = 3(-1) - 5 = -3 - 5 = -8$

$(g(-1)) = f(-8) = (-8)^2 - (-8) + 4$

$64 + 8 + 4 = 76$

$\sqrt{3 - (-1)} - (-6)^2 + 6 \div (-6) \cdot 4$

$\sqrt{3 + 1} - 36 + 6 \div (-6) \cdot 4$

$\sqrt{4} - 36 + -1 \cdot 4$

$2 - 36 + -4$

$-34 + -4$

-38

$|-4 - (-1)| - (-3)^2 + -3 \div 3 \cdot -6$

6

$f(4) =$

$= \quad 5 - (x^3 + x - 5)$

$-4 \quad = -x^3 - x - 5 - x^3 - x + 5 = -2x^3 - 2x$

1

− 9

97.

−3

÷ 3

·

−6

= | |

−3

9

+

1

·

6

= 3

9

+ 6

=

−6

+ 6

=

0

f

(−

)

−

(

)

=

(−

$)^3$

+

(−

)

$f(-x) - f(x)$
$(-x)^2 - 3(-x) + 7 - (x^2 - 3x + 7)$
$x^2 + 3x + 7 - x^2 + 3x - 7$
$6x$

a. {(Iceland, 9.7), (Finland, 9.6), (New Zealand, 9.6), (Denmark, 9.5)}

Yes, the relation is a function because each country in the domain corresponds to exactly one corruption rating in the range.

{(9.7, Iceland), (9.6, Finland), (9.6, New Zealand), (9.5, Denmark)}

No, the relation is not a function because 9.6 in the domain corresponds to two countries in the range, Finland and New Zealand.

a. {(Bangladesh, 1.7), (Chad, 1.7), (Haiti, 1.8), (Myanmar, 1.8)}

Yes, the relation is a function because each country in the domain corresponds to exactly one corruption rating in the range.

{(1.7, Bangladesh), (1.7, Chad), (1.8, Haiti), (1.8, Myanmar)}

No, the relation is not a function because 1.7 in the domain corresponds to two countries in the range, Bangladesh and Chad.

a. $f(70) = 83$ which means the chance that a 60-year old will survive to age 70 is 83%.

$g(70) = 76$ which means the chance that a 60-year old will survive to age 70 is 76%.

Function f is the better model.

102. **a.** $f(90) = 25$ which means the chance that a 60-year old will survive to age 90 is 25%.

$g(90) = 10$ which means the chance that a 60-year old will survive to age 90 is 10%.

Function f is the better model.

a. $G(30) = -0.01(30)2 + (30) + 60 = 81$
In 2010, the wage gap was 81%. This is represented as (30, 81) on the graph.

$G(30)$ underestimates the actual data shown by the bar graph by 2%.

104. a. $G(10) = -0.01(10)2 + (10) + 60 = 69$
In 1990, the wage gap was 69%. This is represented as (10, 69) on the graph.

$G(10)$ underestimates the actual data shown by the bar graph by 2%.

$C(x) = 100,000 + 100x$
$C(90) = 100,000 + 100(90) = \$109,000$
It will cost $109,000 to produce 90 bicycles.

$V(x) = 22,500 - 3200x$
$V(3) = 22,500 - 3200(3) = \$12,900$
After 3 years, the car will be worth $12,900.

$T(x) = \frac{40}{x} + \frac{40}{x + 30}$

$$T(30) = \frac{40}{30} + \frac{40}{30+30} = \frac{80}{60} + \frac{40}{60} = \frac{120}{60} = 2$$

If you travel 30 mph going and 60 mph returning, your total trip will take 2 hours.

$S(x) = 0.10x + 0.60(50 - x)$
$S(30) = 0.10(30) + 0.60(50 - 30) = 15$
When 30 mL of the 10% mixture is mixed with 20 mL of the 60% mixture, there will be 15 mL of sodium-iodine in the vaccine.

– 117. Answers will vary.

makes sense

does not make sense; Explanations will vary. Sample explanation: The parentheses used in function notation, such as $f(x)$, do not imply multiplication.

does not make sense; Explanations will vary. Sample explanation: The domain is the number

does not make sense; Explanations will vary. Sample explanation: This would not be a function because some elements in the domain would correspond to more than one age in the range.

false; Changes to make the statement true will vary. A sample change is: The domain is $[-4, 4]$.

false; Changes to make the statement true will vary. A sample change is: The range is $[-2, 2)$.

true

false; Changes to make the statement true will vary. A sample change is: $f(0) = 0.8$

$f(a + h) = 3(a + h) + 7 = 3a + 3h + 7$

$f(a) = 3a + 7$

$$\frac{f(a+h) - f(a)}{h}$$

$$= \frac{(3a + 3h + 7) - (3a + 7)}{h}$$

$$\frac{3a + 3h + 7 - 3a - 7}{h} = \frac{3h}{h} = 3$$

Answers will vary.
An example is {(1,1),(2,1)}

It is given that $f(x + y) = f(x) + f(y)$ and $f(1) = 3$. To find $f(2)$, rewrite 2 as 1 + 1.

$f(2) = f(1 + 1) = f(1) + f(1)$

$3 + 3 = 6$

Similarly:

$f(3) = f(2 + 1) = f(2) + f(1)$

$6 + 3 = 9$

$f(4) = f(3 + 1) = f(3) + f(1)$

$9 + 3 = 12$

While $f(x + y) = f(x) + f(y)$ is true for this function, it is not true for all functions. It is not true for $f(x) = x^2$, for example.

$$-1 + 3(x - 4) = 2x$$
$$-1 + 3x - 12 = 2x$$
$$3x - 13 = 2x$$
$$-13 = -x$$
$$13 = x$$

The solution set is {13}.

$$\frac{x-3}{5} - \frac{x-4}{2} = 5$$
$$10\left(\frac{x-3}{5}\right) - 10\left(\frac{x-4}{2}\right) = 10(5)$$
$$2x - 6 - 5x + 20 = 50$$
$$-3x + 14 = 50$$
$$-3x = 36$$
$$x = -12$$

The solution set is {–12}.

Let x = the number of deaths by snakes, in thousands, in 2014
Let x + 661 = the number of deaths by mosquitoes, in thousands, in 2014
Let x + 106 = the number of deaths by snails, in thousands, in 2014

$$x + (x + 661) + (x + 106) = 1049$$
$$x + x + 661 + x + 106 = 1049$$
$$3x + 767 = 1049$$
$$3x = 282$$
$$x = 94$$

$x = 94$, thousand deaths by snakes

$x + 661 = 755$, thousand deaths by mosquitoes

$x + 106 = 200$, thousand deaths by snails

ÀĀĀĀĀ□Ā $C(t) = 20 + 0.40(t - 60)$

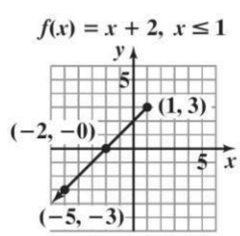
$C(100) = 20 + 0.40(100 - 60)$

. $20 + 0.40(40)$

. $20 + 16$

. 36

For 100 calling minutes, the monthly cost is $36.



133.

$$2(x + h)^2 + 3(x + h) + 5 - (2x^2 + 3x + 5)$$
$$2(x^2 + 2xh + h^2) + 3x + 3h + 5 - 2x^2 - 3x - 5$$
$$2x^2 + 4xh + 2h^2 + 3x + 3h + 5 - 2x^2 - 3x - 5$$
$$2x^2 - 2x^2 + 4xh + 2h^2 + 3x - 3x + 3h + 5 - 5$$
$$4xh + 2h^2 + 3h$$

217

Section 2.2

Check Point Exercises

The function is increasing on the interval $(-\infty, -1)$, decreasing on the interval $(-1,1)$, and increasing on the interval $(1, \infty)$.

Test for symmetry with respect to the *y*-axis.

$= x^2 - 1$

$= (-x)^2 - 1$

$= x^2 - 1$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$= x^2 - 1$

$y = x^2 - 1$

$= -x^2 + 1$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$= x^2 - 1$

$y = (-x)^2 - 1$

$y = x^2 - 1$

$= -x^2 + 1$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis. $y^5 = x^3$

$y^5 = (-x)^3$

$y^5 = -x^3$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$y^5 = x^3$

$(-y)^5 = x^3$

$y^5 = x^3$

$y^5 = -x^3$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$y^5 = x^3$

$(-y)^5 = (-x)^3$

$y^5 = -x^3$

$y^5 = x^3$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the origin.

a. The graph passes the vertical line test and is therefore the graph of a function. The graph is symmetric with respect to the *y*-axis. Therefore, the graph is that of an even function.

The graph passes the vertical line test and is therefore the graph of a function. The graph is neither symmetric with respect to the *y*-axis nor the origin. Therefore, the graph is that of a function which is neither even nor odd.

The graph passes the vertical line test and is therefore the graph of a function. The graph is symmetric with respect to the origin. Therefore, the graph is that of an odd function.

a. $f(-x) = (-x)^2 + 6 = x^2 + 6 = f(x)$

The function is even. The graph is symmetric with respect to the *y*-axis.

$g(-x) = 7(-x)^3 - (-x) = -7x^3 + x = -f(x)$

The function is odd. The graph is symmetric with respect to the origin.

$h(-x) = (-x)^5 + 1 = -x^5 + 1$

The function is neither even nor odd. The graph is neither symmetric to the *y*-axis nor the origin.

6. $C(t) = \begin{cases} 20 & \text{if } 0 \le t \le 60 \\ 20 + 0.40(t-60) & \text{if } t > 60 \end{cases}$

Since $0 \le 40 \le 60$, $C(40) = 20$

With 40 calling minutes,(the cost) is $20.

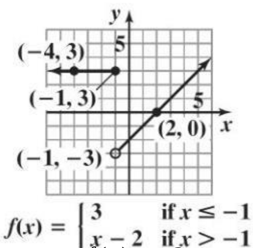
This is represented by $(40, 20)$.

Since $80 > 60$,

$C(80) = 20 + 0.40(80 - 60) = 28$

With 80 calling minutes,(the cost) is $28.

This is represented by $(80, 28)$.

7. 

8. a. $f(x) = -2x^2 + x + 5$

$(x+h) = -2(x+h)^2 + (x+h) + 5$

$-2(x^2 + 2xh + h^2) + x + h + 5$

$-2x^2 - 4xh - 2h^2 + x + h + 5$

b. $\frac{f(x+h) - f(x)}{h}$

$= \frac{-2x^2 - 4xh - 2h^2 + x + h + 5 - (-2x^2 + x + 5)}{h}$

$= \frac{-2x^2 - 4xh - 2h^2 + x + h + 5 + 2x^2 - x - 5}{h}$

$= \frac{-4xh - 2h^2 + h}{h}$

$= \frac{h(-4x - 2h + 1)}{h}$

$= -4x - 2h + 1, \quad h \neq 0$

Concept and Vocabulary Check 2.2

$< f(x_2)$; $> f(x_2)$; $= f(x_2)$

maximum; minimum

y-axis

x-axis

origin

$f(x)$; y-axis

$-f(x)$; origin

piecewise

9. less than or equal to x; 2; -3; 0

10. difference quotient; $x + h$; $f(x)$; h; h

false

false

Exercise Set 2.2

a. increasing: $(-1, \infty)$
decreasing: $(-\infty, -1)$
constant: none

a. increasing: $(-\infty, -1)$
decreasing: $(-1, \infty)$
constant: none

a. increasing: $(0, \infty)$
decreasing: none
constant: none

a. increasing: $(-1, \infty)$
decreasing: none
constant: none

a. increasing: none
decreasing: $(-2, 6)$
constant: none

a. increasing: $(-3, 2)$
decreasing: none
constant: none

a. increasing: $(-\infty, -1)$
decreasing: none
constant: $(-1, \infty)$

a. increasing: $(0, \infty)$
decreasing: none
constant: $(-\infty, 0)$

a. increasing: $(-\infty, 0)$ or $(1.5, 3)$
decreasing: $(0, 1.5)$ or $(3, \infty)$
constant: none

a. increasing: $(-5, -4)$ or $(-2, 0)$ or $(2, 4)$

decreasing: $(-4, -2)$ or $(0, 2)$ or $(4, 5)$

constant: none

a. increasing: (–2, 4)

decreasing: none

constant: $(-\infty, -2)$ or $(4, \infty)$

a. increasing: none

decreasing: (–4, 2)

constant: $(-\infty, -4)$ or $(2, \infty)$

a. $x = 0$, relative maximum = 4

$x = -3, 3$, relative minimum = 0

a. $x = 0$, relative maximum = 2

$x = -3, 3$, relative minimum = –1

a. $x = -2$, relative maximum = 21

$x = 1$, relative minimum = -6

a. $x = 1$, relative maximum = 30

$x = 4$, relative minimum = 3

Test for symmetry with respect to the *y*-axis. $y = x^2 + 6$

$= (-x)^2 +$

6 $y = x^2 + 6$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$= x^2 + 6$

$y = x^2 + 6$

$= -x^2 - 6$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$= x^2 + 6$

$y = (-x)^2 + 6$

$y = x^2 + 6$

$= -x^2 - 6$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis. $y = x^2 - 2$

$= (-x)^2 - 2$

$= x^2 - 2$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$= x^2 - 2$

$y = x^2 - 2$

$= -x^2 + 2$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$= x^2 - 2$

$y = (-x)^2 - 2$

$y = x^2 - 2$

$= -x^2 + 2$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis.

$= y^2 + 6$

$x = y^2 + 6$

$= -y^2 - 6$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$x = y^2 + 6$

$= (-y)^2 + 6$

$= y^2 + 6$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$x = y^2 + 6$

$x = (-y)^2 + 6$

$x = y^2 + 6$

$= -y^2 - 6$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis.

$= y^2 - 2$

$x = y^2 - 2$

$= -y^2 + 2$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$x = y^2 - 2$

$= (-y)^2 - 2$

$x = y^2 - 2$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$x = y^2 - 2$

$x = (-y)^2 - 2$

$x = y^2 - 2$

$= -y^2 + 2$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis. $y^2 = x^2 + 6$

$y^2 = (-x)^2 + 6$

$y^2 = x^2 + 6$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$y^2 = x^2 + 6$

$(-y)^2 = x^2 + 6$

$y^2 = x^2 + 6$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$y^2 = x^2 + 6$

$(-y)^2 = (-x)^2 + 6$

$= x^2 + 6$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis. $y^2 = x^2 - 2$

$y^2 = (-x)^2 - 2$

$y^2 = x^2 - 2$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$y^2 = x^2 - 2$

$(-y)^2 = x^2 - 2$

$y^2 = x^2 - 2$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$y^2 = x^2 - 2$

$(-y)^2 = (-x)^2 - 2$

$= x^2 - 2$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis. $y = 2x + 3$

$= 2(-x) +$

$3\ y = -2x + 3$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$= 2x + 3$

$y = 2x + 3\ y$

$= -2x - 3$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$= 2x + 3$

$y = 2(-x) + 3$

$= 2x - 3$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the y-axis. $y = 2x + 5$

$= 2(-x) + 5$

$= -2x + 5$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the y-axis.

Test for symmetry with respect to the x-axis.

$= 2x + 5$

$y = 2x + 5$

$= -2x - 5$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the x-axis.

Test for symmetry with respect to the origin.

$= 2x + 5$

$y = 2(-x) + 5$

$= 2x - 5$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the y-axis.

$^2 - y^3 = 2$

$(-x)^2 - y^3 = 2$

$x^2 - y^3 = 2$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the y-axis.

Test for symmetry with respect to the x-axis.

$x^2 - y^3 = 2$

$x^2 - (-y)^3 = 2$

$x^2 + y^3 = 2$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the x-axis.

Test for symmetry with respect to the origin.

$x^2 - y^3 = 2$

$(-x)^2 - (-y)^3 = 2$

$x^2 + y^3 = 2$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the y-axis. $x^3 - y^2 = 5$

$(-x)^3 - y^2 = 5$

$x^3 - y^2 = 5$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the y-axis.

Test for symmetry with respect to the x-axis.

$x^3 - y^2 = 5$

$x^3 - (-y)^2 = 5$

$x^3 - y^2 = 5$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the x-axis.

Test for symmetry with respect to the origin.

$x^3 - y^2 = 5$

$(-x)^3 - (-y)^2 = 5$

$x^3 - y^2 = 5$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the y-axis.

$^2 + y^2 = 100$

$(-x)^2 + y^2 = 100$

$x^2 + y^2 = 100$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the y-axis.

Test for symmetry with respect to the x-axis.

$x^2 + y^2 = 100$

$x^2 + (-y)^2 = 100$

$x^2 + y^2 = 100$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the x-axis.

Test for symmetry with respect to the origin.

$$x^2 + y^2 = 100$$
$$(-x)^2 + (-y)^2 = 100$$
$$x^2 + y^2 = 100$$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis.

$$^2 + y^2 = 49$$
$$(-x)^2 + y^2 = 49$$
$$x^2 + y^2 = 49$$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$$x^2 + y^2 = 49$$
$$x^2 + (-y)^2 = 49$$
$$x^2 + y^2 = 49$$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$$x^2 + y^2 = 49$$
$$(-x)^2 + (-y)^2 = 49$$
$$x^2 + y^2 = 49$$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis.

$$^2 y^2 + 3xy = 1$$
$$(-x)^2 y^2 + 3(-x)y = 1$$
$$x^2 y^2 - 3xy = 1$$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$$x^2 y^2 + 3xy = 1$$
$$x^2(-y)^2 + 3x(-y) = 1$$
$$x^2 y^2 - 3xy = 1$$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$$x^2 y^2 + 3xy = 1$$
$$(-x)^2(-y)^2 + 3(-x)(-y) = 1$$
$$x^2 y^2 + 3xy = 1$$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis.

$$^2 y^2 + 5xy = 2$$
$$(-x)^2 y^2 + 5(-x)y = 2$$
$$x^2 y^2 - 5xy = 2$$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$$x^2 y^2 + 5xy = 2$$
$$x^2(-y)^2 + 5x(-y) = 2$$
$$x^2 y^2 - 5xy = 2$$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$$x^2 y^2 + 5xy = 2$$
$$(-x)^2(-y)^2 + 5(-x)(-y) = 2$$
$$x^2 y^2 + 5xy = 2$$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the origin.

Test for symmetry with respect to the *y*-axis. $y^4 = x^3 + 6$

$$y^4 = (-x)^3 + 6$$
$$y^4 = -x^3 + 6$$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the *y*-axis.

Test for symmetry with respect to the *x*-axis.

$$y^4 = x^3 + 6$$
$$(-y)^4 = x^3 + 6$$
$$y^4 = x^3 + 6$$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the *x*-axis.

Test for symmetry with respect to the origin.

$y^4 = x^3 + 6$

$(-y)^4 = (-x)^3 + 6$

$y^4 = -x^3 + 6$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the y-axis. $y^5 = x^4 + 2$

$y^5 = (-x)^4 + 2$

$y^5 = x^4 + 2$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the y-axis.

Test for symmetry with respect to the x-axis.

$y^5 = x^4 + 2$

$(-y)^5 = x^4 + 2$

$y^5 = x^4 + 2$

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

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the x-axis.

Test for symmetry with respect to the origin.

$y^4 = x^3 + 6$

$(-y)^4 = (-x)^3 + 6$

$y^4 = -x^3 + 6$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

The graph is symmetric with respect to the y-axis. The function is even.

The graph is symmetric with respect to the origin. The function is odd.

The graph is symmetric with respect to the origin. The function is odd.

The graph is not symmetric with respect to the y-axis or the origin. The function is neither even nor odd.

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

$(-x) = (-x)^3 + (-x)$

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

$f(-x) = -f(x)$, odd function

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

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

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

$(-x) = -f(x)$, odd function

$g(x) = x^2 + x$

$g(-x) = (-x)^2 + (-x)$

$g(-x) = x^2 - x$, neither

$g(x) = x^2 - x$

$g(-x) = (-x)^2 - (-x)$

$g(-x) = x^2 + x$, neither

$h(x) = x^2 - x^4$

$h(-x) = (-x)^2 - (-x)^4$

$h(-x) = x^2 - x^4$

$h(-x) = h(x)$, even function

$h(x) = 2x^2 + x^4$

$h(-x) = 2(-x)^2 + (-x)^4$

$h(-x) = 2x^2 + x^4$

$h(-x) = h(x)$, even function

$f(x) = x^2 - x^4 + 1$

$(-x) = (-x)^2 - (-x)^4 + 1$

$(-x) = x^2 - x^4 + 1$

$f(-x) = f(x)$, even function

$f(x) = 2x^2 + x^4 + 1$

$(-x) = 2(-x)^2 + (-x)^4 + 1$

$(-x) = 2x^2 + x^4 + 1$

$(-x) = f(x)$, even function

$f(x) = \frac{1}{5}x^6 - 3x^2$

$(-x) = \frac{1}{5}(-x)^6 - 3(-x)^2$

$(-x) = \frac{1}{5}x^6 - 3x^2$

$f(-x) = f(x)$, even function

$f(x) = 2x^3 - 6x^5$

$(-x) = 2(-x)^3 - 6(-x)^5$

$(-x) = -2x^3 + 6x^5$

$(-x) = -(2x^3 - 6x^5)$

$(-x) = -f(x)$, odd function

$f(x) = x\sqrt{1-x^2}$

$(-x) = -x\sqrt{1-(-x)^2}$

$(-x) = -x\sqrt{1-x^2}$

$= -\left(x\sqrt{1-x^2}\right)$

$f(-x) = -f(x)$, odd function

48. $f(x) = x^2\sqrt{1-x^2}$

$(-x) = (-x)^2\sqrt{1-(-x)^2}$

$f(-x) = x^2\sqrt{1-x^2}$

$f(-x) = f(x)$, even function

a. domain: $(-\infty, \infty)$

range: $[-4, \infty)$

x-intercepts: 1, 7

y-intercept: 4

$(4, \infty)$

$(0, 4)$

$(-\infty, 0)$

$x = 4$

$y = -4$

$f(-3) = 4$

$f(2) = -2$ and $f(6) = -2$

neither ; $f(-x) \neq x$, $f(-x) \neq -x$

a. domain: $(-\infty, \infty)$

range: $(-\infty, 4]$

x-intercepts: –4, 4

y-intercept: 1

$(-\infty, -2)$ or $(0, 3)$

$(-2, 0)$ or $(3, \infty)$

$(-\infty, -4]$ or $[4, \infty)$

$x = -2$ and $x = 3$

$f(-2) = 4$ and $f(3) = 2$

$f(-2) = 4$

$x = -4$ and $x = 4$

neither ; $f(-x) \neq x$, $f(-x) \neq -x$

a. domain: $(-\infty, 3]$

range: $(-\infty, 4]$

x-intercepts: –3, 3

$f(0) = 3$

$(-\infty, 1)$

$(1, 3)$

$(-\infty, -3]$

$f(1) = 4$

$x = 1$

positive; $f(-1) = +2$

a. domain: $(-\infty, 6]$

range: $(-\infty, 1]$

zeros of f: –3, 3

$f(0) = 1$

$(-\infty, -2)$

$(2, 6)$

$(-2, 2)$

h. $(-3, 3)$

i. $x = -5$ and $x = 5$

j. negative; $f(4) = -1$

k. neither

l. no; f(2) is not greater than the function values to the immediate left.

53. a. $f(-2) = 3(-2) + 5 = -1$

b. $f(0) = 4(0) + 7 = 7$

c. $f(3) = 4(3) + 7 = 19$

54. a. $f(-3) = 6(-3) - 1 = -19$

b. $f(0) = 7(0) + 3 = 3$

c. $f(4) = 7(4) + 3 = 31$

55. a. $g(0) = 0 + 3 = 3$

b. $g(-6) = -(-6 + 3) = -(-3) = 3$

c. $g(-3) = -3 + 3 = 0$

56. a. $g(0) = 0 + 5 = 5$

b. $g(-6) = -(-6 + 5) = -(-1) = 1$

c. $g(-5) = -5 + 5 = 0$

57. a. $h(5) = \frac{5^2 - 9}{5 - 3} = \frac{25 - 9}{2} = \frac{16}{2} = 8$

$h(0) = \frac{0^2 - 9}{0 - 3} = \frac{-9}{-3} = 3$

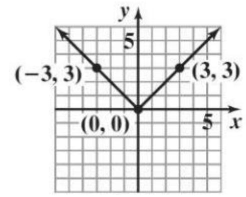
$h(3) = 6$

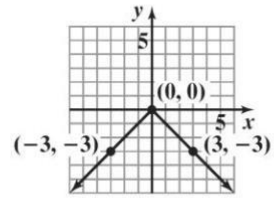
58. a. $h(7) = \frac{7^2 - 25}{7 - 5} = \frac{49 - 25}{2} = \frac{24}{2} = 12$

$h(0) = \frac{0^2 - 25}{0 - 5} = \frac{-25}{-5} = 5$

$h(5) = 10$

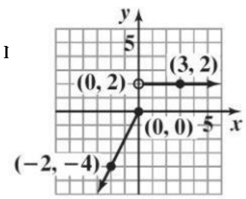
a.





a. $f(x) = \begin{cases} x & \text{if } x < 0 \\ -x & \text{if } x \ge 0 \end{cases}$

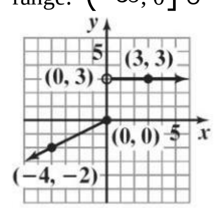
b.



a. $f(x) = \begin{cases} 2x & \text{if } x \le 0 \\ 2 & \text{if } x > 0 \end{cases}$

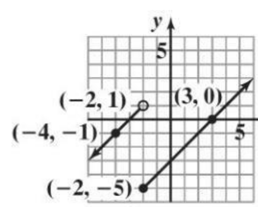
b. range: $(-\infty, 0] \cup \{2\}$

a.



$f(x) = \begin{cases} \frac{1}{2}x & \text{if } x \le 0 \\ 3 & \text{if } x > 0 \end{cases}$

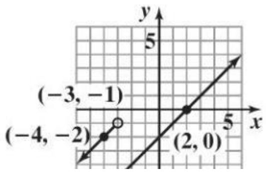
range: $(-\infty, 0] \cup \{3\}$



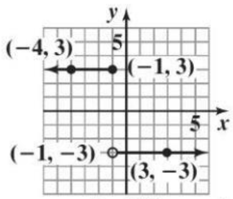
a. $f(x) = \begin{cases} x + 3 & \text{if } x < -2 \\ x - 3 & \text{if } x \ge -2 \end{cases}$

range: $(-\infty, \infty)$

a.



b

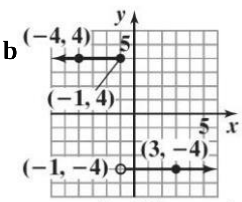


3
3

$$f(x) = \begin{cases} 3 & \text{if } x \le -1 \\ -3 & \text{if } x > -1 \end{cases}$$

a.

b

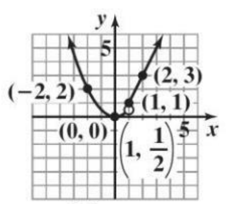


$$f(x) = \begin{cases} 4 & \text{if } x \le -1 \\ -4 & \text{if } x > -1 \end{cases}$$

a.

b. range: $\{-4, 4\}$

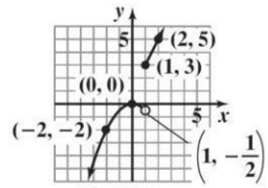
a.



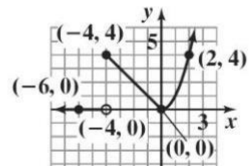
$$f(x) = \begin{cases} \frac{1}{2}x^2 & \text{if } x < 1 \\ 2x - 1 & \text{if } x \ge 1 \end{cases}$$

b. range: $[0, \infty)$

a.



$$f(x) = \begin{cases} -\frac{1}{2}x^2 & \text{if } x < 1 \end{cases}$$



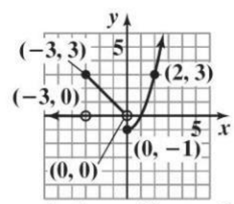
$3, \infty)$

$$f(x) = \begin{cases} 0 & \text{if } x < -4 \\ -x & \text{if } -4 \le x < 0 \\ x^2 & \text{if } x \ge 0 \end{cases}$$

a.

b. range: $[0, \infty)$

a.



$$f(x) = \begin{cases} 0 & \text{if } x < -3 \\ -x & \text{if } -3 \le x < 0 \\ x^2 - 1 & \text{if } x \ge 0 \end{cases}$$

range: $[-1, \infty)$

71. $\dfrac{f(x+h) - f(x)}{h}$

$\dfrac{4(x+h) - 4x}{h}$

$\dfrac{4x + 4h - 4x}{h}$

$\dfrac{4h}{h}$

4

72. $\frac{f(x+h)-f(x)}{h}$

$=\frac{7(x+h)-7x}{h}$

$=\frac{7x+7h-7x}{h}$

$=\frac{7h}{h}$

$=7$

73. $\frac{f(x+h)-f(x)}{h}$

$=\frac{3(x+h)+7-(3x+7)}{h}$

$=\frac{3x+3h+7-3x-7}{h}$

$=\frac{3h}{h}$

$=3$

74. $\frac{f(x+h)-f(x)}{h}$

$=\frac{6(x+h)+1-(6x+1)}{h}$

$=\frac{6x+6h+1-6x-1}{h}$

$=\frac{6h}{h}$

$=6$

$\frac{f(x+h)-f(x)}{h}$

$=\frac{(x+h)^2-x^2}{h}$

$=\frac{x^2+2xh+h^2-x^2}{h}$

$=\frac{2xh+h^2}{h}$

$=\frac{h(2x+h)}{h}$

$=2x+h$

76. $\frac{f(x+h)-f(x)}{h}$

$=\frac{2(x+h)^2-2x^2}{h}$

$=\frac{2(x^2+2xh+h^2)-2x^2}{h}$

$=\frac{2x^2+4xh+2h^2-2x^2}{h}$

$=\frac{4xh+2h^2}{h}$

$=\frac{h(4x+2h)}{h}$

$=4x+2h$

77. $\frac{f(x+h)-f(x)}{h}$

$=\frac{(x+h)^2-4(x+h)+3-(x^2-4x+3)}{h}$

$=\frac{x^2+2xh+h^2-4x-4h+3-x^2+4x-3}{h}$

$=\frac{2xh+h^2-4h}{h}$

$=\frac{h(2x+h-4)}{h}$

$=2x+h-4$

78. $\frac{f(x+h)-f(x)}{h}$

$=\frac{(x+h)^2-5(x+h)+8-(x^2-5x+8)}{h}$

$=\frac{x^2+2xh+h^2-5x-5h+8-x^2+5x-8}{h}$

$=\frac{2xh+h^2-5h}{h}$

$=\frac{h(2x+h-5)}{h}$

$=2x+h-5$

79. $\dfrac{f(x+h)-f(x)}{h}$

$=\dfrac{2(x+h)^2+(x+h)-1-(2x^2+x-1)}{h}$

$=\dfrac{2x^2+4xh+2h^2+x+h-1-2x^2-x+1}{h}$

$=\dfrac{4xh+2h^2+h}{h}$

$=\dfrac{h(4x+2h+1)}{h}$

$=4x+2h+1$

80. $\dfrac{f(x+h)-f(x)}{h}$

$=\dfrac{3(x+h)^2+(x+h)+5-(3x^2+x+5)}{h}$

$=\dfrac{3x^2+6xh+3h^2+x+h+5-3x^2-x-5}{h}$

$=\dfrac{6xh+3h^2+h}{h}$

$=\dfrac{h(6x+3h+1)}{h}$

$=6x+3h+1$

81. $\dfrac{f(x+h)-f(x)}{h}$

$=\dfrac{-(x+h)^2+2(x+h)+4-(-x^2+2x+4)}{h}$

$=\dfrac{-x^2-2xh-h^2+2x+2h+4+x^2-2x-4}{h}$

$=\dfrac{-2xh-h^2+2h}{h}$

$=\dfrac{h(-2x-h+2)}{h}$

$=-2x-h+2$

82. $\dfrac{f(x+h)-f(x)}{h}$

$=\dfrac{-(x+h)^2-3(x+h)+1-(-x^2-3x+1)}{h}$

$=\dfrac{-x^2-2xh-h^2-3x-3h+1+x^2+3x-1}{h}$

$=\dfrac{-2xh-h^2-3h}{h}$

$=\dfrac{h(-2x-h-3)}{h}$

$=-2x-h-3$

83. $\dfrac{f(x+h)-f(x)}{h}$

$=\dfrac{-2(x+h)^2+5(x+h)+7-(-2x^2+5x+7)}{h}$

$=\dfrac{-2x^2-4xh-2h^2+5x+5h+7+2x^2-5x-7}{h}$

$=\dfrac{-4xh-2h^2+5h}{h}$

$=\dfrac{h(-4x-2h+5)}{h}$

$=-4x-2h+5$

84. $\dfrac{f(x+h)-f(x)}{h}$

$=\dfrac{-3(x+h)^2+2(x+h)-1-(-3x^2+2x-1)}{h}$

$=\dfrac{-3x^2-6xh-3h^2+2x+2h-1+3x^2-2x+1}{h}$

$=\dfrac{-6xh-3h^2+2h}{h}$

$=\dfrac{h(-6x-3h+2)}{h}$

$=-6x-3h+2$

85. $\frac{f(x+h)-f(x)}{h}$

$= \frac{-2(x+h)^2-(x+h)+3-(-2x^2-x+3)}{h}$

$= \frac{-2x^2-4xh-2h^2-x-h+3+2x^2+x-3}{h}$

$= \frac{-4xh-2h^2-h}{h}$

$= \frac{h(-4x-2h-1)}{h}$

$= -4x-2h-1$

86. $\frac{f(x+h)-f(x)}{h}$

$= \frac{-3(x+h)^2+(x+h)-1-(-3x^2+x-1)}{h}$

$= \frac{-3x^2-6xh-3h^2+x+h-1+3x^2-x+1}{h}$

$= \frac{-6xh-3h^2+h}{h}$

$= \frac{h(-6x-3h+1)}{h}$

$= -6x-3h+1$

87. $\frac{f(x+h)-f(x)}{h} = \frac{6-6}{h} = \frac{0}{h} = 0$

$\frac{f(x+h)-f(x)}{h} = \frac{7-7}{h} = \frac{0}{h} = 0$

89. $\frac{f(x+h)-f(x)}{h}$

$= \frac{\frac{1}{x+h}-\frac{1}{x}}{h}$

$= \frac{\frac{x}{x(x+h)}+\frac{-(x+h)}{x(x+h)}}{h}$

$= \frac{\frac{x-x-h}{x(x+h)}}{h}$

$= \frac{-h}{x(x+h)h}$

90. $\frac{f(x+h)-f(x)}{h}$

$= \frac{\frac{1}{2(x+h)}-\frac{1}{2x}}{h}$

$= \frac{\frac{x}{2x(x+h)}-\frac{x+h}{2x(x+h)}}{h}$

$= \frac{-h}{2x(x+h)h}$

$= \frac{-h}{2x(x+h)} \cdot \frac{1}{h}$

$= \frac{-1}{2x(x+h)}$

91. $\frac{f(x+h)-f(x)}{h}$

$= \frac{\sqrt{x+h}-\sqrt{x}}{h}$

$= \frac{\sqrt{x+h}-\sqrt{x}}{h} \cdot \frac{\sqrt{x+h}+\sqrt{x}}{\sqrt{x+h}+\sqrt{x}}$

$= \frac{x+h-x}{h\left(\sqrt{x+h}+\sqrt{x}\right)}$

$= \frac{h}{h\left(\sqrt{x+h}+\sqrt{x}\right)}$

$= \frac{1}{\sqrt{x+h}+\sqrt{x}}$

$\frac{f(x+h)-f(x)}{h}$

$= \frac{\sqrt{x+h-1}-\sqrt{x-1}}{h}$

$= \frac{\sqrt{x+h-1}-\sqrt{x-1}}{h} \cdot \frac{\sqrt{x+h-1}+\sqrt{x-1}}{\sqrt{x+h-1}+\sqrt{x-1}}$

$= \frac{x+h-1-(x-1)}{h\left(\sqrt{x+h-1}+\sqrt{x-1}\right)}$

$x + h - 1 - x$

$+1$

h

$\overline{x(\, x - + h \ h)} \cdot h\underline{1}$

$\frac{-1}{x(\,x + h)}$

$(\qquad)$

$\overline{h \ \sqrt{x + h - 1} + \sqrt{x - 1}}$

h

$= h\left(\sqrt{x + h - 1} + \sqrt{x - 1}\right)$

$= \frac{1}{\sqrt{x + h - 1} + \sqrt{x - 1}}$

$\sqrt{f(-1.5)+f(-0.9)} - [f(\pi)]^2 + f(-3) \div f(1) \cdot f(-\pi)$

$\sqrt{1+0} - [-4]^2 + 2 \div (-2) \cdot 3$

$\sqrt{1} - 16 + (-1) \cdot 3$

$1 - 16 - 3$

-18

94. $\sqrt{f(-2.5) - f(1.9)} - [f(-\pi)]^2 + f(-3) \div f(1) \cdot f(\pi)$

$\sqrt{f(-2.5) - f(1.9)} - [f(-\pi)]^2 + f(-3) \div f(1) \cdot f(\pi)$

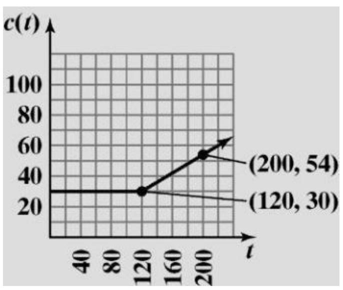
$\sqrt{2-(-2)} - [3]^2 + 2 \div (-2) \cdot (-4)$

$\sqrt{4} - 9 + (-1)(-4)$

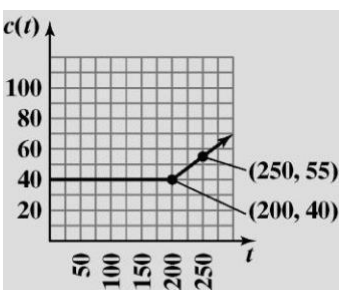
$2 - 9 + 4$

-3

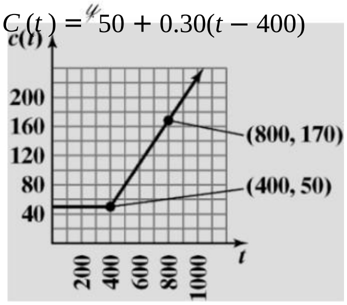
$30 + 0.30(t - 120) = 30 + 0.3t - 36 = 0.3t - 6$



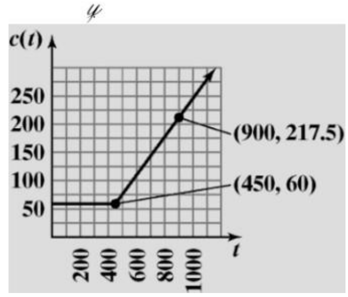
$40 + 0.30(t - 200) = 40 + 0.3t - 60 = 0.3t - 20$



97. $C(t) = \begin{cases} 50 & \text{if } 0 \le t \le 400 \\ 50 + 0.30(t - 400) & \text{if } t > 400 \end{cases}$



98. ($\quad$ if $0 \le t \le 450$; if $t > 450$



increasing: (25, 55); decreasing: (55, 75)

increasing: (25, 65); decreasing: (65, 75)

The percent body fat in women reaches a maximum at age 55. This maximum is 38%.

The percent body fat in men reaches a maximum at age 65. This maximum is 26%.

domain: [25, 75]; range: [34, 38]

domain: [25, 75]; range: [23, 26]

This model describes percent body fat in men.

This model describes percent body fat in women.

$T(20,000) = 850 + 0.15(20,000 - 8500)$

2575

A single taxpayer with taxable income of $20,000 owes $2575.

$T(50,000) = 4750 + 0.25(50,000 - 34,500)$

8625

A single taxpayer with taxable income of $50,000 owes $8625.

$42{,}449 + 0.33(x - 174{,}400)$

$f(3) = 0.93$

The cost of mailing a first-class letter weighing 3 ounces is $0.93.

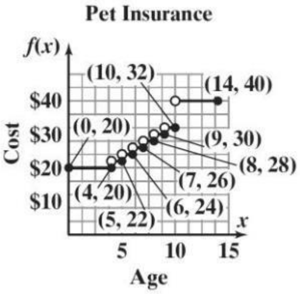
$f(3.5) = 1.05$

The cost of mailing a first-class letter weighing 3.5 ounces is $1.05.

The cost to mail a letter weighing 1.5 ounces is $0.65.

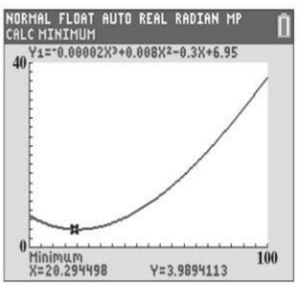
The cost to mail a letter weighing 1.8 ounces is \$0.65.

115.



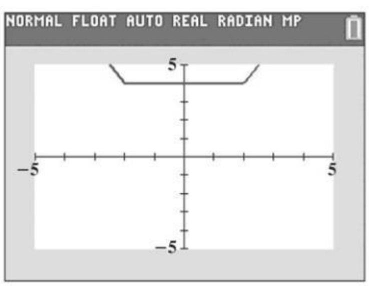
– 124. Answers will vary.

125.



The number of doctor visits decreases during childhood and then increases as you get older.
The minimum is (20.29, 3.99), which means that the minimum number of doctor visits, about 4, occurs at around age 20.

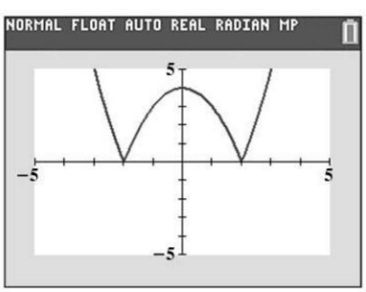
126.



Increasing: $(-\infty, 1)$ or $(3, \infty)$

Decreasing: $(1, 3)$

127.

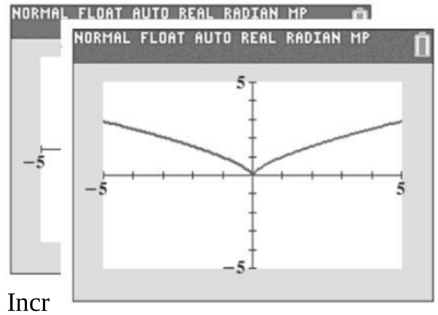


, 2)

ncreasing: (–2, 0) or (2, ∞) Decreasing: (–∞, –2) or (0

∞) Decreasing: (–∞, 1)

128.

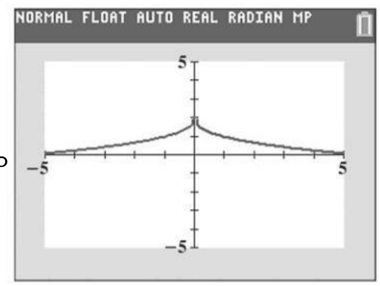


Incr
easi
ng:
(2,
∞)

Increasing: (0, ∞)

Decreasing: (−∞, 0)

129.

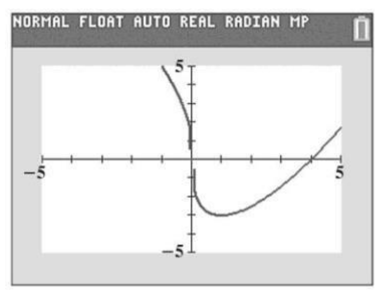


Dec
reas
ing:
(−∞
−
2)
Con
stan
t: (−
2,
2)

Increasing: (–∞, 0)

Decreasing: (0, ∞)

130.



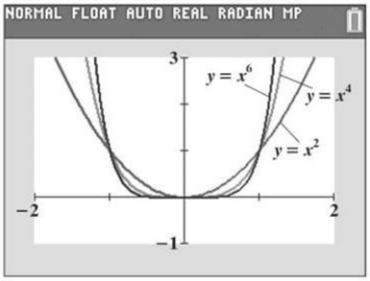
131.

I
n
c
r
e
a
s
i
n
g
:

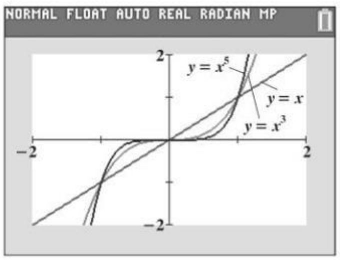
(
1
,

234

132. a.

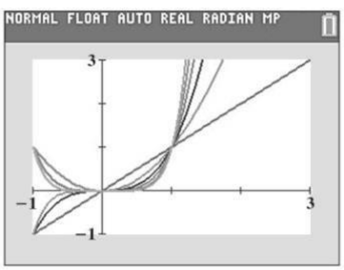


b.



Increasing: $(0, \infty)$
Decreasing: $(-\infty, 0)$

$f(x) = x^n$ is increasing from $(-\infty, \infty)$ when n is odd.



does not make sense; Explanations will vary. Sample explanation: It's possible the graph is not defined at *a*.

makes sense

makes sense

makes sense

answers will vary

answers will vary

a. *h* is even if both *f* and *g* are even or if both *f* and *g* are odd.

f and *g* are both even:

$$h(-x) = \frac{f(-x)}{g(-x)} = \frac{f(x)}{g(x)} = h(x)$$

f and *g* are both odd:

$$h(-x) = \frac{f(-x)}{g(-x)} = \frac{-f(x)}{-g(x)} = \frac{f(x)}{g(x)} = h(x)$$

h is odd if *f* is odd and *g* is even or if *f* is even and *g* is odd.

f is odd and *g* is even:

$$h(-x) = \frac{f(-x)}{g(-x)} = \frac{-f(x)}{g(x)} = -\frac{f(x)}{g(x)} = -h(x)$$

f is even and *g* is odd:

$$h(-x) = \frac{f(-x)}{g(-x)} = \frac{f(x)}{-g(x)} = -\frac{f(x)}{g(x)} = -h(x)$$

Let x = the amount invested at 5%.
Let $80{,}000 - x$ = the amount invested at 7%.

$$0.05x + 0.07(80,000 - x) = 5200$$
$$0.05x + 5600 - 0.07x = 5200$$
$$-0.02x + 5600 = 5200$$
$$-0.02x = -400$$
$$x = 20,000$$
$$80,000 - x = 60,000$$

\$20,000 was invested at 5% and \$60,000 was invested at 7%.

$C = A + Ar$
$C = A + Ar$
$C = A(1 + r)$

$\frac{C}{1 + r} = A$

$5x^2 - 7x + 3 = 0$ a

$= 5,\ b = -7,\ c = 3$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$= \frac{-(-7) \pm \sqrt{(-7)^2 - 4(5)(3)}}{2(5)}$

$x = \frac{7 \pm \sqrt{}}{10}$ [redacted]

$x = \frac{7 \pm \sqrt{}}{10}$ [redacted]

$x = \frac{7 \pm i}{10}$ [redacted]

$\frac{7 \pm 11}{}\sqrt{}$

$10 \quad i\ 10$

The solution set is $\frac{7}{}$ [redacted] $\frac{7}{}$ [redacted]

$10 + i\ 10 \quad 10 - \ 10$.

143. $\frac{y_2 - y_1}{x_2 - x_1} = \frac{4-1}{-2-(-3)} = \frac{3}{1} = 3$

When $y = 0$:

$4x - 3y - 6 = 0$

$4x - 3(0) - 6 = 0$

$4x - 6 = 0$

$4x = 6$

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

The point is $\left(\frac{3}{2}, 0\right)$.

When $x = 0$:

$4x - 3y - 6 = 0$

$4(0) - 3y - 6 = 0$

$-3y - 6 = 0$

$-3y = 6$

$= -2$

The point is $(0, -2)$.

$3x + 2y - 4 = 0$

$2y = -3x + 4$

$= \frac{-3x}{2}$

$\pm \frac{4}{}$ or

$y = -\frac{2}{3}x + 2$

Section 2.3

Check Point Exercises

a. $m = \frac{-4-(-43)}{-2} = \frac{-6}{1} = 6$ **b.**

$m = \frac{5-(-1)}{-2-4} = \frac{-7}{5} = -\frac{7}{5}$

Point-slope form:

$y - y_1 = m(x - x_1)$

$-(-5) = 6(x - 2)$

$y + 5 = 6(x - 2)$

Slope-intercept form:

$y + 5 = 6(x - 2)$

$+ 5 = 6x - 12$

$y = 6x - 17$

$m = \frac{-6-(-1)}{-1-(-2)} = \frac{-5}{1} = -5$,

so the slope is –5.

Using the point (–2, –1), we get the following point-slope equation:

$y - y_1 = m(x - x_1)$

$-(-1) = -5[x - (-2)]$

$+1 = -5(x + 2)$

Using the point (–1, –6), we get the following point-slope equation:

$y - y_1 = m(x - x_1)$

$-(-6) = -5[x - (-1)]$

$+ 6 = -5(x + 1)$

Solve the equation for

y: $y + 1 = -5(x + 2)$

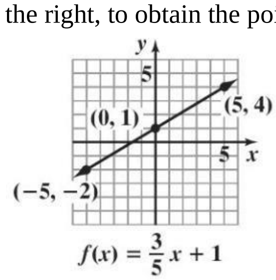
$y + 1 = -5x - 10$

$y = -5x - 11$.

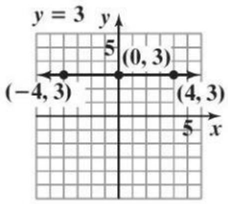
The slope m is $\frac{3}{5}$ and the y-intercept is 1, so one point on the line is (0, 1). We can find a second point

startingonthelinebyusingtheslope $m = \frac{3}{5} = \frac{\text{Rise}}{\text{Run}}$: at

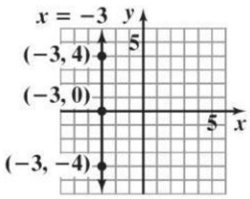
the point (0, 1), move 3 units up and 5 units to the right, to obtain the point (5, 4).



$y = 3$ is a horizontal line.



6. All ordered pairs that are solutions of $x = -3$ have a value of x that is always –3. Any value can be used for y.

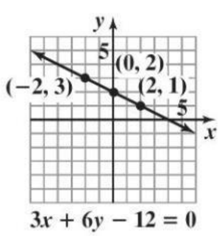


$3x + 6y - 12 = 0$

$6y = -3x + 12$

$= -\frac{3}{6}x + \frac{12}{6}$

$y = -\frac{1}{2}x + 2$



The slope is $-\frac{1}{2}$ and the y-intercept is 2.

Find the x-intercept:

$3x - 2y - 6 = 0$

$3x - 2(0) - 6 = 0$

$3x - 6 = 0$

$3x = 6$

$x = 2$

Find the y-intercept:

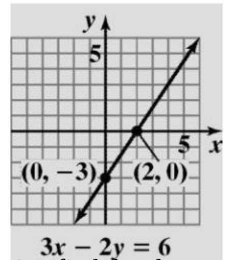
$3x - 2y - 6 = 0$

$3(0) - 2y - 6 = 0$

$-2y - 6 = 0$

$-2y = 6$

$= -3$



First find the slope.

$m = \frac{\text{Change in } y}{\text{Change in } x} = \frac{57.64 - 57.04}{354 - 317} = \frac{0.6}{7} \approx 0.016$

Use the point-slope form and then find slope-intercept form.

$y - y_1 = m(x - x_1)$

$y - 57.04 = 0.016(x - 317)$

$- 57.04 = 0.016x - 5.072$

$y = 0.016x + 51.968$

$(x) = 0.016x + 52.0$

Find the temperature at a concentration of 600 parts per million.

$(x) = 0.016x + 52.0\ (600)$

$= 0.016(600) + 52.0$

61.6

The temperature at a concentration of 600 parts per million would be 61.6°F.

Concept and Vocabulary Check 2.3

scatter plot; regression

$\frac{y_2 - y_1}{x_2 - x_1}$

positive

negative

zero

undefined

$y - y_1 = m(x - x_1)$

$y = mx + b$; slope; y-intercept

(0, 3) ; 2; 5

horizontal

vertical

general

Exercise Set 2.3

m = 108−−47 = 43 ; rises

m = 34−− 21 = 13 = 3; rises

m = 2 −2 (−−12) = 41 ; rises

m = 2 4− −(−31) = 31 ; rises

m = 2 3− −(−42) = −01 = 0; horizontal

m = −13−−(4−1) = −01 = 0; horizontal

m = −1−−1 −(−42) = −15 = −5; falls

m = −24−−(−6 4) = −22 = −1; falls

m = −52−−53 = −05 undefined; vertical

m = 5 −3 −(−34) = 90 undefined; vertical

$m = 2$, $x_1 = 3$, $y_1 = 5$;
point-slope form: $y - 5 = 2(x - 3)$;
slope-intercept form: $y - 5 = 2x - 6$
$y = 2x - 1$

point-slope form: $y - 3 = 4(x - 1)$; $m = 4$, $x_1 = 1$, $y_1 = 3$; slope-intercept form: $y = 4x - 1$

$m = 6$, $x_1 = -2$, $y_1 = 5$;
point-slope form: $y - 5 = 6(x + 2)$;
slope-intercept form: $y - 5 = 6x + 12$
$y = 6x + 17$

point-slope form: $y + 1 = 8(x - 4)$; $m = 8$, $x_1 = 4$, $y_1 = -1$; slope-intercept form: $y = 8x - 33$

$m = -3$, $x_1 = -2$, $y_1 = -3$;
point-slope form: $y + 3 = -3(x + 2)$;
slope-intercept form: $y + 3 = -3x - 6$
$y = -3x - 9$

point-slope form: $y + 2 = -5(x + 4)$; $m = -5$, $x_1 = -4$, $y_1 = -2$; slope-intercept form: $y = -5x - 22$

$m = -4$, $x_1 = -4$, $y_1 = 0$;
point-slope form: $y - 0 = -4(x + 4)$;
slope-intercept form: $y = -4(x + 4)$
$= -4x - 16$

point-slope form: $y + 3 = -2(x - 0)$; $m = -2$, $x_1 = 0$, $y_1 = -3$; slope-intercept form: $y = -2x - 3$

19. $m = -1$, $x_1 = \frac{-1}{2}$, $y_1 = -2$;

point-slope form: $y + 2 = -1\left(x + \frac{1}{2}\right)$;

slope-intercept form: $y + 2 = -x - \frac{1}{2}$

20. point-slope form: $y + \frac{1}{4} = -1(x + 4)$;
$m = -1$, $x_1 = -4$, $y_1 = -\frac{1}{4}$;

slope-intercept form: $y = -x - \frac{17}{4}$

21. $m = \frac{1}{2}$, $x_1 = 0$, $y_1 = 0$;

slope-intercept form: $y = \frac{1}{2}x$

point-slope form: $y - 0 = \frac{3}{1}(x - 0)$;

$m = \frac{3}{1}$, $x_1 = 0$, $y_1 = 0$;

slope-intercept form: $y = 3x$

$m = -\frac{2}{3}$, $x_1 = 6$, $y_1 = -2$;

point-slope form: $y + 2 = -\frac{2}{3}(x - 6)$;

slope-intercept form: $y + 2 = -\frac{2}{3}x + 4$

point-slope form: $y + 4 = -\frac{3}{5}(x - 10)$;

$m = -\frac{3}{5}$, $x_1 = 10$, $y_1 = -4$;

slope-intercept form: $y = -\frac{3}{5}x + 2$

25. $m = \frac{10 - 2}{5 - 1} = \frac{8}{4} = 2$;

point-slope form: $y - 2 = 2(x - 1)$ using $(x_1, y_1) = (1, 2)$, or $y - 10 = 2(x - 5)$ using $(x_1, y_1) = (5, 10)$;

slope-intercept form: $y - 2 = 2x - 2$ or

$y - 10 = 2x - 10$,

$y = 2x$

$m = \frac{15 - 5}{8 - 3} = \frac{10}{5} = 2$;

point-slope form: $y - 5 = 2(x - 3)$ using $(x_1, y_1) = (3, 5)$, or $y - 15 = 2(x - 8)$ using $(x_1, y_1) = (8, 15)$;

slope-intercept form: $y = 2x - 1$

$m = \frac{3 - 0}{0 - (-3)} = \frac{3}{3} = 1$;

point-slope form: $y - 0 = 1(x + 3)$ using $(x_1, y_1) = (-3, 0)$, or $y - 3 = 1(x - 0)$ using $(x_1, y_1) = (0, 3)$; slope-intercept form: $y = x + 3$

$m = \frac{2 - 0}{0 - (-2)} = \frac{2}{2} = 1$;

point-slope form: $y - 0 = 1(x + 2)$ using $(x_1, y_1) = (-2, 0)$, or $y - 2 = 1(x - 0)$ using $(x_1, y_1) = (0, 2)$;

slope-intercept form: $y = x + 2$

$m = \frac{4 - (-1)}{2 - (-3)} = \frac{5}{5} = 1$;

point-slope form: $y + 1 = 1(x + 3)$ using $(x_1, y_1) = (-3, -1)$, or $y - 4 = 1(x - 2)$ using $(x_1, y_1) = (2, 4)$; slope-intercept form:

$y + 1 = x + 3$ or

$y - 4 = x - 2$

$y = x + 2$

30. $m = \frac{-1 - (-4)}{1 - (-2)} = \frac{3}{3} = 1$;

point-slope form: $y + 4 = 1(x + 2)$ using $(x_1, y_1) = (-2, -4)$, or $y + 1 = 1(x - 1)$ using $(x_1, y_1) = (1, -1)$

slope-intercept form: $y = x - 2$

$m = \frac{6 - (-2)}{3 - (-3)} = \frac{8}{6} = \frac{4}{3}$;

point-slope form: $y + 2 = \frac{4}{3}(x + 3)$ using $(x_1, y_1) = (-3, -2)$, or $y - 6 = \frac{4}{3}(x - 3)$ using $(x_1, y_1) = (3, 6)$;

slope-intercept form: $y + 2 = \frac{4}{3}x + 4$ or

$y - 6 = \frac{4}{3}x - 4$,

$y = \frac{4}{3}x + 2$

32. $m = \frac{-2 - 6}{3 - (-3)} = \frac{-8}{6} = -\frac{4}{3}$;

point-slope form: $y - 6 = -\frac{4}{3}(x + 3)$ using $(x_1, y_1) = (-3, 6)$, or $y + 2 = -\frac{4}{3}(x - 3)$ using $(x_1, y_1) = (3, -2)$;

slope-intercept form: $y = -\frac{4}{3}x + 2$

$m = \frac{-1 - (-1)}{4 - (-3)} = \frac{0}{7} = 0$;
point-slope form: $y + 1 = 0(x + 3)$ using $(x_1, y_1) = (-3, -1)$, or $y + 1 = 0(x - 4)$ using $(x_1, y_1) = (4, -1)$;
slope-intercept form: $y + 1 = 0$, so
$y = -1$

$m = \frac{-5 - (-5)}{6 - (-2)} = \frac{0}{8} = 0$;
point-slope form: $y + 5 = 0(x + 2)$ using $(x_1, y_1) = (-2, -5)$, or $y + 5 = 0(x - 6)$ using $(x_1, y_1) = (6, -5)$;
slope-intercept form: $y + 5 = 0$, so
$y = -5$

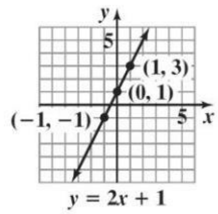
$m = \frac{0 - 4}{-2 - 2} = \frac{-4}{-4} = 1$;
point-slope form: $y - 4 = 1(x - 2)$ using $(x_1, y_1) = (2, 4)$, or $y - 0 = 1(x + 2)$ using $(x_1, y_1) = (-2, 0)$;
slope-intercept form: $y - 9 = x - 2$, or
$y = x + 2$

$m = \frac{0 - (-3)}{-1 - 1} = \frac{3}{-2} = -\frac{3}{2}$
point-slope form: $y + 3 = -\frac{3}{2}(x - 1)$ using $(x_1, y_1) = (1, -3)$, or $y - 0 = -\frac{3}{2}(x + 1)$ using $(x_1, y_1) = (-1, 0)$;
slope-intercept form: $y + 3 = -\frac{3}{2}x + \frac{3}{2}$, or
$y = -\frac{3}{2}x - \frac{3}{2}$

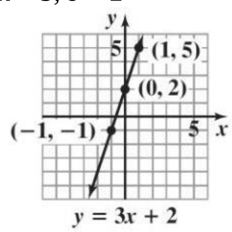
37. $m = \frac{4 - 0}{0 - \left(-\frac{1}{2}\right)} = \frac{4}{\frac{1}{2}} = 8$;
point-slope form: $y - 4 = 8(x - 0)$ using $(x_1, y_1) = (0, 4)$, or $y - 0 = 8\left(x + \frac{1}{2}\right)$ using $(x_1, y_1) = \left(-\frac{1}{2}, 0\right)$; or $y - 0 = 8\left(x + \frac{1}{2}\right)$
or
slope-intercept form: $y = 8x + 4$

$m = \frac{0 - (-2)}{4 - 0} = \frac{2}{4} = \frac{1}{2}$;
point-slope form: $y - 0 = \frac{1}{2}(x - 4)$ using $(x_1, y_1) = (4, 0)$,
or $y + 2 = \frac{1}{2}(x - 0)$ using $(x_1, y_1) = (0, -2)$; slope-intercept form: $y = \frac{1}{2}x - 2$

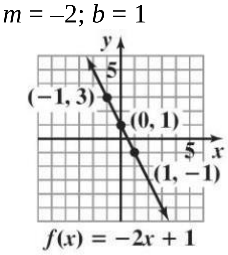
$m = 2$; $b = 1$



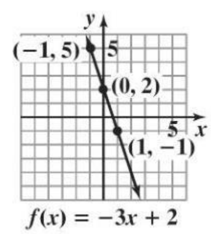
$m = 3$; $b = 2$

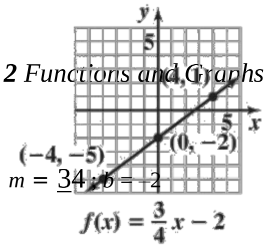


$m = -2$; $b = 1$



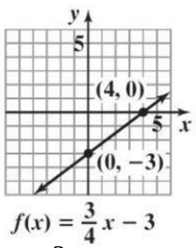
$m = -3$; $b = 2$



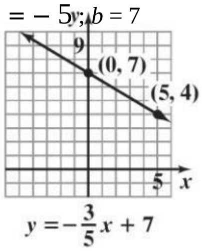


$m = \frac{3}{4}$; $b = -2$

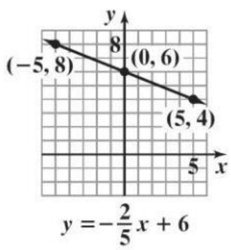
$m = \frac{3}{4}$; $b = -3$



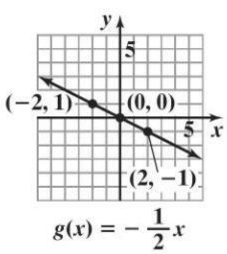
45. $m = -\frac{3}{5}$; $b = 7$



$m = -\frac{2}{5}$; $b = 6$

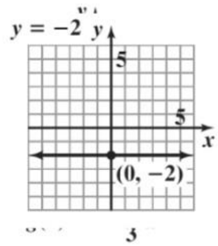


$m = -\frac{1}{2}$; $b = 0$

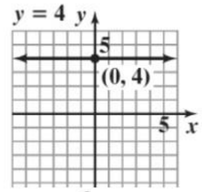


$m = -\frac{1}{3}$; $b = 0$

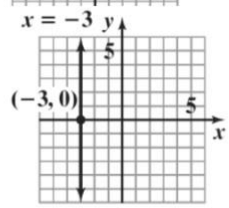
49.



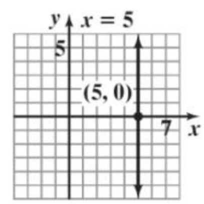
50.



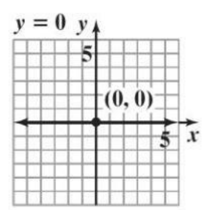
51.



52.

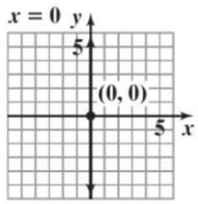


53.

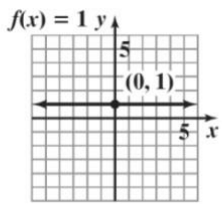


241

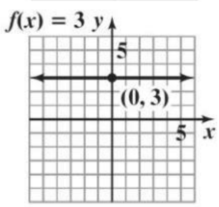
54.



55.



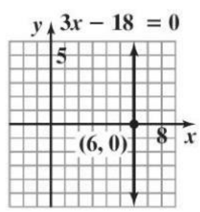
56.



$3x - 18 = 0$

$3x = 18$

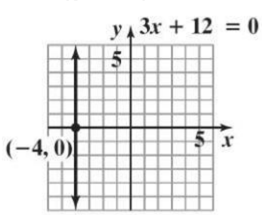
$= 6$



$3x + 12 = 0$

$3x = -12$

$x = -4$



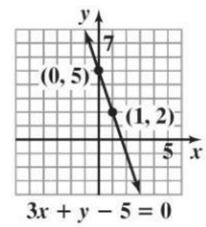
a. $3x + y - 5 = 0$

$y - 5 = -3x$

$y = -3x + 5$

$m = -3$; $b = 5$

c.

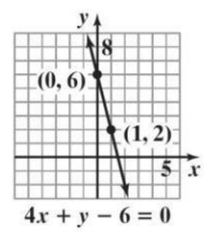


a. $4x + y - 6 = 0$

$y - 6 = -4x$

$= -4x + 6$

b. $m = -4$; $b = 6$



c.

a. $2x + 3y - 18 = 0$

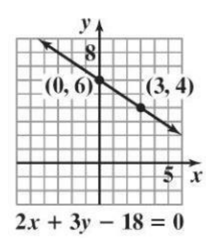
$2x - 18 = -3y$

$-3y = 2x - 18$

$y = \frac{2}{-3}x - \frac{18}{-3}$

$y = -\frac{2}{3}x + 6$

b. $m = -\frac{2}{3}$; $b = 6$



c.

a. $4x + 6y + 12 = 0$ $4x + 12 = -6y$

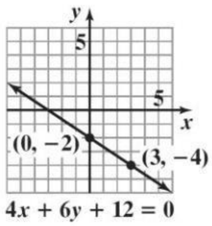
$-6y = 4x + 12$

$= \frac{4}{-6}x + \frac{12}{-6}$

$y = -\frac{2}{3}x - 2$

$m = -\frac{2}{3}$; $b = -2$

c.



a. $8x - 4y - 12 = 0$

$8x - 12 = 4y$

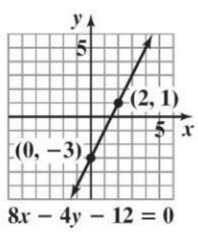
$4y = 8x - 12$

$y = \frac{8}{4}x - \frac{12}{4}$

$y = 2x - 3$

$m = 2$; $b = -3$

c.



a. $6x - 5y - 20 = 0$

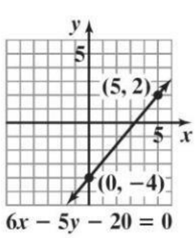
$6x - 20 = 5y$

$5y = 6x - 20$

$y = \frac{6}{5}x - \frac{20}{5}$

$m = \frac{6}{5}$; $b = -4$

c.



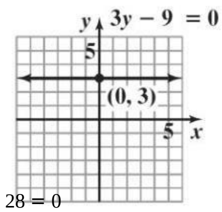
a. $3y - 9 = 0$

$3y = 9$

$= 3$

b. $m = 0$; $b = 3$

c.



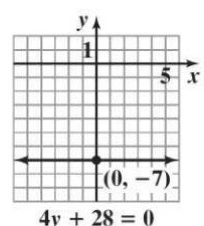
a. $4y + 28 = 0$

$4y = -28$

$y = -7$

$m = 0$; $b = -7$

c.



Find the *x*-intercept:

$6x - 2y - 12 = 0$

$6x - 2(0) - 12 = 0$

$6x - 12 = 0$

$6x = 12$

$x = 2$

Find the *y*-intercept:

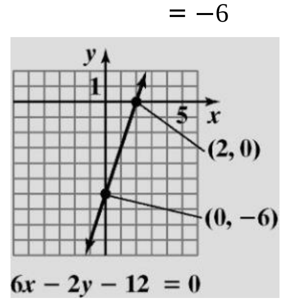
$6x - 2y - 12 = 0$

$6(0) - 2y - 12 = 0$

$-2y - 12 = 0$

$-2y = 12$

$= -6$

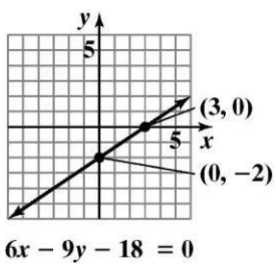


Find the x-intercept:

$$6x - 9y - 18 = 0$$
$$6x - 9(0) - 18 = 0$$
$$6x - 18 = 0$$
$$6x = 18$$
$$x = 3$$

Find the y-intercept:

$$6x - 9y - 18 = 0$$
$$6(0) - 9y - 18 = 0$$
$$-9y - 18 = 0$$
$$-9y = 18$$
$$y = -2$$

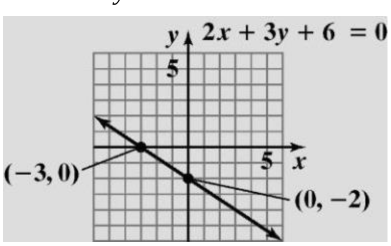


Find the x-intercept:

$$2x + 3y + 6 = 0$$
$$2x + 3(0) + 6 = 0$$
$$2x + 6 = 0$$
$$2x = -6$$
$$x = -3$$

Find the y-intercept:

$$2x + 3y + 6 = 0$$
$$2(0) + 3y + 6 = 0$$
$$3y + 6 = 0$$
$$3y = -6$$
$$y = -2$$

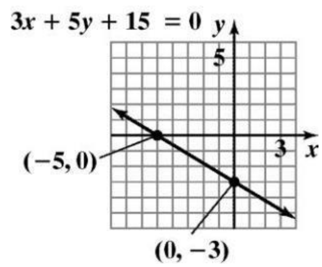


Find the x-intercept:

$$3x + 5y + 15 = 0$$
$$3x + 5(0) + 15 = 0$$
$$3x + 15 = 0$$
$$3x = -15$$
$$= -5$$

Find the y-intercept:

$$3x + 5y + 15 = 0$$
$$3(0) + 5y + 15 = 0$$
$$5y + 15 = 0$$
$$5y = -15$$
$$= -3$$

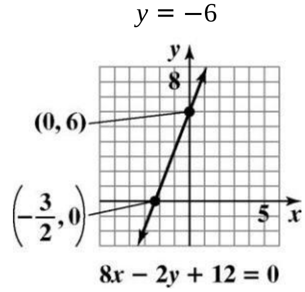


Find the x-intercept:

$$8x - 2y + 12 = 0$$
$$8x - 2(0) + 12 = 0$$
$$8x + 12 = 0$$
$$8x = -12$$
$$\frac{8x}{8} = \frac{-12}{8}$$

Find the y-intercept:

$$8x - 2y + 12 = 0$$
$$8(0) - 2y + 12 = 0$$
$$-2y + 12 = 0$$
$$-2y = -12$$
$$y = -6$$



Find the x-intercept:

$6x - 3y + 15 = 0$

$6x - 3(0) + 15 = 0$

$6x + 15 = 0$

$6x = -15$

$\frac{6x}{6} = \frac{-15}{6}$

$= -\frac{5}{2}$

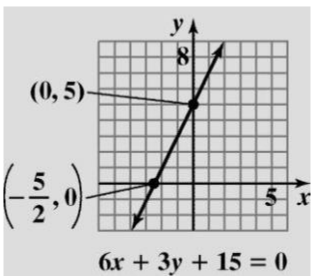
Find the y-intercept: $6x - 3y + 15 = 0$

$6(0) - 3y + 15 = 0$

$-3y + 15 = 0$

$-3y = -15$

$= 5$



$m = \frac{0 - a}{b - 0} = \frac{-a}{b} = -\frac{a}{b}$

Since a and b are both positive, $-\frac{a}{b}$ is negative. Therefore, the line falls.

74. $m = \frac{-b - 0}{0 - (-a)} = \frac{-b}{a} = -\frac{b}{a}$

Since a and b are both positive, $-\frac{b}{a}$ is

$m = \frac{(b + c) - b}{a - a} = \frac{c}{0}$

The slope is undefined.
The line is vertical.

76. $m = \frac{(a + c) - c}{a - (a - b)} = \frac{a}{b}$

Since a and b are both positive, $\frac{a}{b}$ is positive. Therefore, the line rises.

$Ax + By = C$

$By = -Ax + C$

$y = -\frac{A}{B}x + \frac{C}{B}$

The slope is $-\frac{A}{B}$ and the y-intercept is $\frac{C}{B}$.

$Ax = By - C$

$Ax + C = By$

$\frac{A}{B}x + \frac{C}{B} = y$

The slope is $\frac{A}{B}$ and the y-intercept is $\frac{C}{B}$.

$-3 = \frac{4 - y}{-3}$

$-3 = \frac{4 - y}{-2}$

$6 = 4 - y$

$2 = -y$

$-2 = y$

$\frac{1}{3} = \frac{-4 - y}{4 - (-2)}$

$= \frac{-4 - y}{4 + 2}$

$\frac{1}{3} = \frac{-4 - y}{6}$

$6 = 3(-4 - y)$

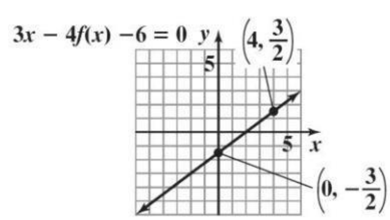
$6 = -12 - 3y$

$18 = -3y$

$-6 = y$

$3x - 4f(x) = 6$
$-4f(x) = -3x + 6$

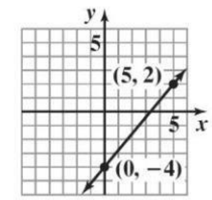
$f(x) = \frac{3}{4}x - \frac{3}{2}$



$6x - 5f(x) = 20 - 5f$

$(x) = -6x + 20$

$(x) = 65x - 4$



$6x - 5f(x) - 20 = 0$

Using the slope-intercept form for the equation of a line:

$-1 = -2(3) + b$

$-1 = -6 + b$

$5 = b$

$-6 = -32(2) + b$

$-6 = -3 +$

$b - 3 = b$

m_1, m_3, m_2, m_4

b_2, b_1, b_4, b_3

a. First, find the slope using $(20, 38.9)$ and $(30, 47.8)$.

$m = \frac{47.8 - 38.9}{30 - 20} = \frac{8.9}{10} = 0.89$

Then use the slope and one of the points to write the equation in point-slope form.

$y - y1 = m(x - x1)$

$- 47.8 = 0.89(x - 30)$

or

$- 38.9 = 0.89(x - 20)$

b. $y - 47.8 = 0.89(x - 30)$ y

$47.8 = 0.89x - 26.7$ $y =$

$0.89x + 21.1$

$(x) = 0.89x + 21.1$

c. $f(40) = 0.89(40) + 21.1 = 56.7$

The linear function predicts the percentage of never married American females, ages 25 – 29, to be 56.7% in 2020.

a. First, find the slope using $(20, 51.7)$ and $(30, 62.6)$.

$m = \frac{51.7 - 62.6}{20 - 30} = \frac{-10.9}{-10} = 1.09$

Then use the slope and one of the points to write the equation in point-slope form.

$y - y1 = m(x - x1)$

$- 62.6 = 1.09(x - 30)$ or

$- 51.7 = 1.09(x - 20)$

$y - 62.6 = 1.09(x - 30)$

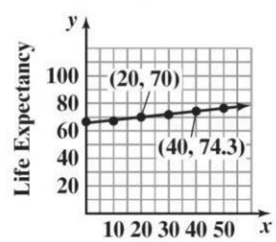
$- 62.6 = 1.09x - 32.7$

$y = 1.09x + 29.9$

$(x) = 1.09x + 29.9$

c. $f(35) = 1.09(35) + 29.9 = 68.05$

The linear function predicts the percentage of never married American males, ages 25 – 29, to be 68.05% in 2015.



a.

b. $m = \frac{\text{Change in } y}{\text{Change in } x} = \frac{74.3 - 70.0}{40 - 20} = 0.215$

$y - y_1 = m(x - x_1)$

$- 70.0 = 0.215(x - 20)$

$y - 70.0 = 0.215x - 4.3$

$y = 0.215x + 65.7$

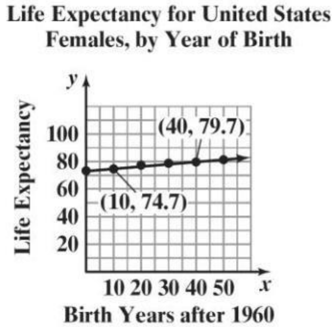
$E(x) = 0.215x + 65.7$

$E(x) = 0.215x + 65.7$

$E(60) = 0.215(60) + 65.7$

78.6

The life expectancy of American men born in 2020 is expected to be 78.6.



a.

b. $m = \dfrac{\text{Change in } y}{\text{Change in } x} = \dfrac{79.7 - 74.7}{40 - 10} \approx 0.17$

$y - y_1 = m(x - x_1)$

$-74.7 = 0.17(x - 10)\ y$

$-74.7 = 0.17x - 1.7$

$y = 0.17x + 73$

$E(x) = 0.17x + 73$

$E(x) = 0.17x + 73$

$E(60) = 0.17(60) + 73$

83.2

The life expectancy of American women born in 2020 is expected to be 83.2.

(10, 230) (60, 110) Points may vary.

$m = \dfrac{110 - 230}{60 - 10} = -\dfrac{120}{0} = -2.$

$-230 = -2.4(x - 10)$

$y - 230 = -2.4x + 24$

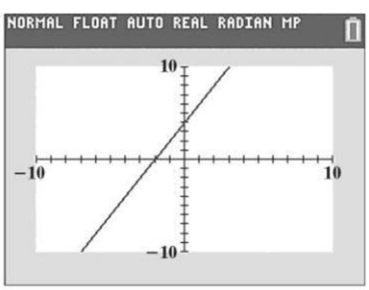
$= -2.4x + 254$

Answers will vary for predictions.

– 99. Answers will vary.

Two points are (0,4) and (10,24). m

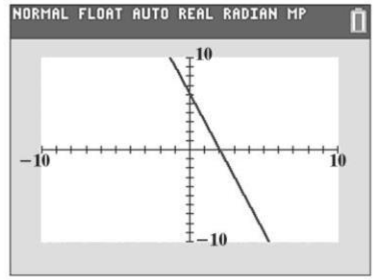
$= 1024 -- 04 = 1020 = 2.$



Two points are (0, 6) and (10, –24). m

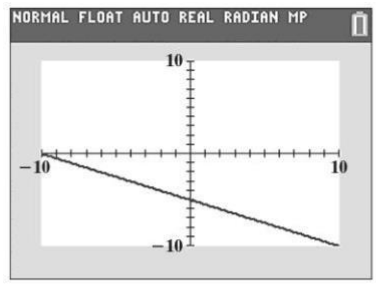
$= -1024 - -06 = -1030 = -3.$

Check: $y = mx + b : y = -3x + 6$.



Two points are (0,–5) and (10,–10).

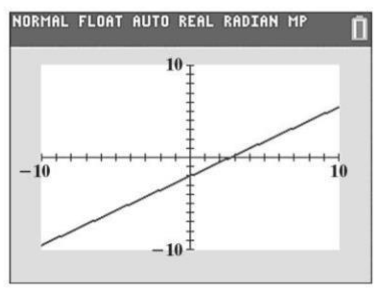
$= \dfrac{-10 - (-5)}{10 - 0} = \dfrac{-5}{10} = -\dfrac{1}{2}.$



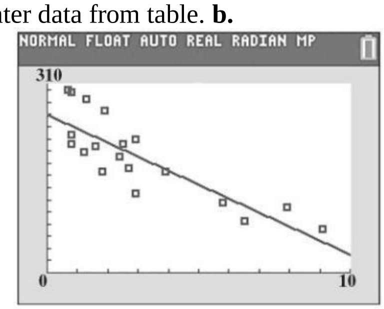
Two points are (0, –2) and (10, 5.5).

$m = \dfrac{5.5 - (-2)}{10 - 0} = \dfrac{7.5}{10} = 0.75 \text{ or } \dfrac{3}{4}.$

Check: $y = mx + b : y = 34\,x - 2$.

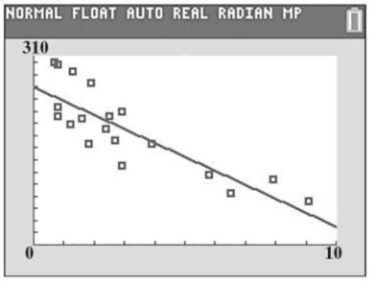


a. Enter data from table. **b.**



$a = -22.96876741$
$b = 260.5633751$ $r = -0.8428126855$

d.



does not make sense; Explanations will vary. Sample explanation: Linear functions never change from increasing to decreasing.

does not make sense; Explanations will vary. Sample explanation: Since college cost are going up, this function has a positive slope.

does not make sense; Explanations will vary. Sample explanation: The slope of line's whose equations are in this form can be determined in several ways. One such way is to rewrite the equation in slope-intercept form.

makes sense

false; Changes to make the statement true will vary. A sample change is: It is possible for *m* to equal *b*.

false; Changes to make the statement true will vary. A sample change is: Slope-intercept form is $y = mx + b$. Vertical lines have equations of the form $x = a$. Equations of this form have undefined slope and cannot be written in slope-intercept form.

true

false; Changes to make the statement true will vary. A sample change is: The graph of $x = 7$ is a vertical line through the point (7, 0).

113. We are given that the $x-$ intercept is -2 and the $y-$ intercept is 4. We can use the points $(-2, 0)$ and $(0, 4)$ to find the slope.

$$m = \frac{4-0}{0-(-2)} = \frac{4}{0+2} = \frac{4}{2} = 2$$

Using the slope and one of the intercepts, we can write the line in point-slope form.

$$y - y_1 = m(x - x_1)$$
$$y - 0 = 2(x - (-2))$$
$$y = 2(x + 2)$$
$$y = 2x + 4$$
$$-2x + y = 4$$

Find the *x*– and *y*–coefficients for the equation of the line with right-hand-side equal to 12. Multiply both sides of $-2x + y = 4$ by 3 to obtain 12 on the right-hand-side.

$$-2x + y = 4$$
$$3(-2x + y) = 3(4)$$
$$-6x + 3y = 12$$

Therefore, the coefficient of *x* is –6 and the coefficient of *y* is 3.

114. We are given that the $y-$ intercept is -6 and the slope is $\frac{1}{2}$.

So the equation of the line is $y = \frac{1}{2}x - 6$.

We can put this equation in the form $ax + by = c$ to find the missing coefficients.

$$y = \frac{1}{2}x - 6$$
$$y - \frac{1}{2}x = -6$$
$$2\left(y - \frac{1}{2}x\right) = 2(-6)$$
$$2y - x = -12$$
$$x - 2y = 12$$

Therefore, the coefficient of *x* is 1 and the coefficient of *y* is -2.

Answers will vary.

Let (25, 40) and (125, 280) be ordered pairs (*M*, *E*) where *M* is degrees Madonna and *E* is degrees Elvis. Then

$$m = \frac{280-40}{125-25} = \frac{240}{100} = 2.4.$$ Using $(x_1, y_1) = (25, 40)$, point-slope form tells us that $E - 40 = 2.4(M - 25)$ or

$E = 2.4M - 20$.

Answers will vary.

Let x = the number of years after 1994.

$714 - 17x = 289$

$-17x = -425$

$x = 25$

Violent crime incidents will decrease to 289 per 100,000 people 25 years after 1994, or 2019.

$\frac{x+3}{4} \geq \frac{x-2}{3} + 1$

$12\left(\frac{x+3}{4}\right) \geq 12\left(\frac{x-2}{3} + 1\right)$

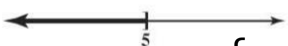
$3(x+3) \geq 4(x-2) + 12$

$3x + 9 \geq 4x - 8 + 12$

$3x + 9 \geq 4x + 4$

$5 \geq x$

$x \leq 5$



The solution set is $\{x \mid x \leq 5\}$ or $(-\infty, 5]$.

$3|2x + 6| - 9 < 15$

$3|2x + 6| < 24$

$\frac{3|2x+6|}{3} < \frac{24}{3}$

$|2x + 6| < 8$

$-8 < 2x + 6 < 8$

$-14 < 2x < 2$

$-7 < x < 1$

The solution set is $\{x \mid -7 < x < 1\}$ or $(-7, 1)$.

121. Since the slope is the same as the slope of $y = 2x + 1$, then $m = 2$.

$y - y_1 = m(x - x_1)$

$y - 1 = 2(x - (-3))$

$y - 1 = 2(x + 3)$

$y - 1 = 2x + 6$

$y = 2x + 7$

Since the slope is the negative reciprocal of $-\frac{1}{4}$, then $m = 4$.

$y - y_1 = m(x - x_1)$

$y - (-5) = 4(x - 3)$

$y + 5 = 4x - 12$

$-4x + y + 17 = 0$

$4x - y - 17 = 0$

123. $\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{f(4) - f(1)}{4 - 1}$

$= \frac{4^2 - 1^2}{4 - 1}$

$= \frac{15}{3}$

$= 5$

Section 2.4

Check Point Exercises

1. The slope of the line $y = 3x + 1$ is 3.

$y - y_1 = m(x - x_1)$

$y - 5 = 3(x - (-2))$

$y - 5 = 3(x + 2)$ point-slope

$y - 5 = 3x + 6$

$y = 3x + 11$ slope-intercept

2. **a.** Write the equation in slope-intercept form: $x + 3y - 12 = 0$

$3y = -x + 12$

$y = -\frac{1}{3}x + 4$

The slope of this line is $-\frac{1}{3}$ thus the slope of any line perpendicular to this line is 3.

Use $m = 3$ and the point (–2, –6) to write the equation.

$y - y_1 = m(x - x_1)$

$y - (-6) = 3(x - (-2))$

$y + 6 = 3(x + 2)$

$y + 6 = 3x + 6$

$-3x + y = 0$

$3x - y = 0$ general form

3. $m = \frac{\text{Change in } y}{\text{Change in } x} = \frac{15 - 11.2}{2013 - 2000} = \frac{3.8}{13} \approx 0.29$

The slope indicates that the number of U.S. men living alone increased at a rate of 0.29 million each year.
The rate of change is 0.29 million men per year.

4. a. $\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{1^3 - 0^3}{1 - 0} = 1$

b. $\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{2^3 - 1^3}{2 - 1} = \frac{8 - 1}{1} = 7$

c. $\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{0^3 - (-2)^3}{0 - (-2)} = \frac{8}{2} = 4$

$\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{f(3) - f(1)}{3 - 1}$

$= \frac{0.05 - 0.03}{3 - 1}$

$= 0.01$

The average rate of change in the drug's concentration between 1 hour and 3 hours is 0.01 mg per 100 mL per hour.

Concept and Vocabulary Check 2.4

the same

-1

$-\frac{1}{3}$; 3

-2; $\frac{1}{2}$

y; x

$\frac{f(x_2) - f(x_1)}{x_2 - x_1}$

Exercise Set 2.4

Since L is parallel to $y = 2x$, we know it will have slope $m = 2$. We are given that it passes through $(4, 2)$. We use the slope and point to write the equation in point-slope form.

$y - y_1 = m(x - x_1)$

$y - 2 = 2(x - 4)$

Solve for y to obtain slope-intercept form. $y - 2 = 2(x - 4)$

$y - 2 = 2x - 8$

$y = 2x - 6$

In function notation, the equation of the line is $f(x) = 2x - 6$.

L will have slope $m = -2$. Using the point and the slope, we have $y - 4 = -2(x - 3)$. Solve for y to obtain slope-intercept form.

$y - 4 = -2x + 6$

$y = -2x + 10$

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

Since L is perpendicular to $y = 2x$, we know it will have slope $m = -\frac{1}{2}$. We are given that it passes through (2, 4). We use the slope and point to write the equation in point-slope form.

$y - y_1 = m(x - x_1)$

$y - 4 = -\frac{1}{2}(x - 2)$

Solve for y to obtain slope-intercept form.

$y - 4 = -\frac{1}{2}(x - 2)$

$y - 4 = -\frac{1}{2}x + 1$

$y = -\frac{1}{2}x + 5$

In function notation, the equation of the line is $f(x) = -\frac{1}{2}x + 5$.

L will have slope $m = \frac{1}{2}$. The line passes through (–1, 2). Use the slope and point to write the equation in point-slope form.

$$y - 2 = \frac{1}{2}(x - (-1))$$

$$y - 2 = \frac{1}{2}(x + 1)$$

Solve for y to obtain slope-intercept form.

$$y - 2 = \frac{1}{2}x + \frac{1}{2}$$

$$y = \frac{1}{2}x + \frac{1}{2} + 2$$

$$y = \frac{1}{2}x + \frac{5}{2}$$

$$f(x) = \frac{1}{2}x + \frac{5}{2}$$

5. $m = -4$ since the line is parallel to $y = -4x + 3$; $x_1 = -8$, $y_1 = -10$;
point-slope form: $y + 10 = -4(x + 8)$
slope-intercept form: $y + 10 = -4x - 32$
$y = -4x - 42$

6. $m = -5$ since the line is parallel to $y = -5x + 4$;
$x_1 = -2$, $y_1 = -7$;
point-slope form: $y + 7 = -5(x + 2)$
slope-intercept form: $y + 7 = -5x - 10$
$y = -5x - 17$

$m = -5$ since the line is perpendicular to
$y = \frac{1}{5}x + 6$; $x_1 = 2$, $y_1 = -3$;
point-slope form: $y + 3 = -5(x - 2)$
slope-intercept form: $y + 3 = -5x + 10$
$y = -5x + 7$

8. $m = -3$ since the line is perpendicular to $y = \frac{1}{3}x + 7$;
$x_1 = -4$, $y_1 = 2$;
point-slope form: $y - 2 = -3(x + 4)$
slope-intercept form: $y - 2 = -3x - 12$
$y = -3x - 10$

9. $2x - 3y - 7 = 0$

$$-3y = -2x + 7$$

$$y = \frac{2}{3}x - \frac{7}{3}$$

The slope of the given line is $\frac{2}{3}$, so $m = \frac{2}{3}$ since the lines are parallel.

point-slope form: $y - 2 = \frac{2}{3}(x + 2)$
general form: $2x - 3y + 10 = 0$

$3x - 2y - = 0$

$$-2y = -3x + 5$$

$$y = \frac{3}{2}x - \frac{5}{2}$$

The slope of the given line is $\frac{3}{2}$, so $m = \frac{3}{2}$ since the lines are parallel.
point-slope form: $y - 3 = \frac{3}{2}(x + 1)$
general form: $3x - 2y + 9 = 0$

$x - 2y - 3 = 0$

$$-2y = -x + 3$$

$$y = \frac{1}{2}x - \frac{3}{2}$$

The slope of the given line is $\frac{1}{2}$, so $m = -2$ since the lines are perpendicular.
point-slope form: $y + 7 = -2(x - 4)$
general form: $2x + y - 1 = 0$

$x + 7y - 12 = 0$

$$7y = -x + 12$$

$$= -\frac{1}{7}x + \frac{12}{7}$$

The slope of the given line is $-\frac{1}{7}$, so $m = 7$ since the lines are perpendicular.
point-slope form: $y + 9 = 7(x - 5)$
general form: $7x - y - 44 = 0$

13. $\frac{15 - 0}{5 - 0} = \frac{15}{5} = 3$

14. $\frac{24 - 0}{4 - 0} = \frac{24}{4} = 6$

15. $\frac{5^2+2\cdot 5-(3^2+2\cdot 3)}{5-3}=\frac{25+10-(9+6)}{2}$

$=\frac{20}{2}$

$=10$

16. $\frac{6^2-2(6)-(3^2-2\cdot 3)}{6-3}=\frac{36-12-(9-6)}{3}=\frac{21}{3}=7$

17. $\frac{\sqrt{9}-\sqrt{4}}{9-4}=\frac{3-2}{5}=$ [redacted] $\frac{1}{5}$

18. $\frac{\sqrt{\text{[redacted]}}-\sqrt{9}}{16-9}=\frac{4-3}{7}=\frac{1}{7}$

Since the line is perpendicular to $x=6$ which is a vertical line, we know the graph of f is a horizontal line with 0 slope. The graph of f passes through $(-1,5)$, so the equation of f is $f(x)=5$.

Since the line is perpendicular to $x=-4$ which is a vertical line, we know the graph of f is a horizontal line with 0 slope. The graph of f passes through $(-2,6)$, so the equation of f is $f(x)=6$.

First we need to find the equation of the line with $x-$ intercept of 2 and $y-$ intercept of -4. This line will pass through $(2,0)$ and $(0,-4)$. We use these points to find the slope.

$m=\frac{-4-0}{0-2}=\frac{-4}{-2}=2$

Since the graph of f is perpendicular to this line, it will have slope $m=-\frac{1}{2}$.

Use the point $(-6,4)$ and the slope $-\frac{1}{2}$ to find the equation of the line.

$y-y_1=m(x-x_1)$

$y-4=-\frac{1}{2}(x-(-6))$

$y-4=-\frac{1}{2}(x+6)$

$y-4=-\frac{1}{2}x-3$

$y=-\frac{1}{2}x+1$

$f(x)=-\frac{1}{2}x+1$

First we need to find the equation of the line with $x-$ intercept of 3 and $y-$ intercept of -9. This line will pass through $(3,0)$ and $(0,-9)$. We use these points to find the slope.

$m=\frac{-9-0}{0-3}=\frac{-9}{-3}=3$

Since the graph of f is perpendicular to this line, it will have slope $m=-\frac{1}{3}$.

Use the point $(-5,6)$ and the slope $-\frac{1}{3}$ to find the equation of the line.

$y-y_1=m(x-x_1)$

$y-6=-\frac{1}{3}(x-(-5))$

$y-6=-\frac{1}{3}(x+5)$

$y-6=-\frac{1}{3}x-\frac{5}{3}$

$y=-\frac{1}{3}x+\frac{13}{3}$

$f(x)=-\frac{1}{3}x+\frac{13}{3}$

First put the equation $3x - 2y - 4 = 0$ in slope-intercept form.

$3x - 2y - 4 = 0$

$-2y = -3x + 4$

$y = \frac{3}{2}x - 2$

The equation of f will have slope $-\frac{2}{3}$ since it is perpendicular to the line above and the same $y-$intercept -2.

So the equation of f is $f(x) = -\frac{2}{3}x - 2$.

First put the equation $4x - y - 6 = 0$ in slope-intercept form.

$4x - y - 6 = 0$

$y = -4x + 6$

$= 4x - 6$

The equation of f will have slope $-\frac{1}{4}$ since it is perpendicular to the line above and the same $y-$intercept -6.

So the equation of f is $f(x) = -\frac{1}{4}x - 6$.

$p(x) = -0.25x + 22$

$p(x) = 0.22x + 3$

27. $m = \frac{1163 - 617}{1998 - 1994} = \frac{546}{4} \approx 137$

There was an average increase of approximately 137 discharges per year.

28. $m = \frac{623 - 1273}{2006 - 2001} = \frac{-650}{5} \approx -130$

There was an average decrease of approximately 130 discharges per year.

a. $f(x) = 1.1x^3 - 35x^2 + 264x + 557$

$(0) = 1.1(0)^3 - 35(0)^2 + 264(0) + 557 = 557$

$(4) = 1.1(4)^3 - 35(4)^2 + 264(4) + 557 = 1123.4$

$m = \frac{1123.4 - 557}{4 - 0} \approx 142$

b. This overestimates by 5 discharges per year.

a. $f(x) = 1.1x^3 - 35x^2 + 264x + 557$

$(0) = 1.1(7)^3 - 35(7)^2 + 264(7) + 557 = 1067.3$

$(12) = 1.1(12)^3 - 35(12)^2 + 264(12) + 557 = 585.8$

$m = \frac{585.8 - 1067.3}{12 - 7} \approx -96$

This underestimates the decrease by 34 discharges per year.

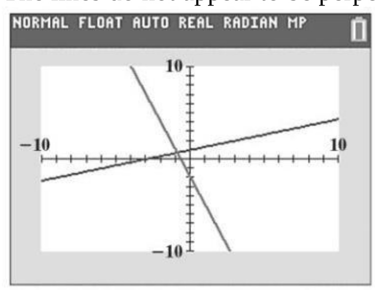
– 36. Answers will vary.

$y = \frac{1}{3}x + 1$

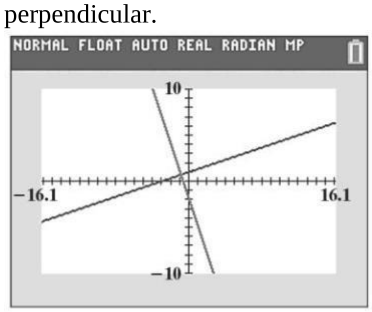
$= -3x - 2$

The lines are perpendicular because their slopes are negative reciprocals of each other. This is verified because product of their slopes is –1.

The lines do not appear to be perpendicular.



The lines appear to be perpendicular. The calculator screen is rectangular and does not have the same width and height. This causes the scale of the *x*–axis to differ from the scale on the *y*–axis despite using the same scale in the window settings. In part (b), this causes the lines not to appear perpendicular when indeed they are. The zoom square feature compensates for this and in part (c), the lines appear to be perpendicular.



does not make sense; Explanations will vary. Sample explanation: Perpendicular lines have slopes with opposite signs.

makes sense

does not make sense; Explanations will vary. Sample explanation: Slopes can be used for segments of the graph.

makes sense

Write $Ax + By + C = 0$ in slope-intercept form.

$$Ax + By + C = 0$$
$$By = -Ax - C$$
$$\frac{By}{B} = \frac{-Ax}{B} - \frac{C}{B}$$
$$y = -\frac{A}{B}x - \frac{C}{B}$$

The slope of the given line is $-\frac{A}{B}$.

The slope of any line perpendicular to

$Ax + By + C = 0$ is $\frac{B}{A}$.

The slope of the line containing $(1, -3)$ and $(-2, 4)$ has

slope $m = \frac{4-(-3)}{-2-1} = \frac{4+3}{-3} = \frac{7}{-3} = -\frac{7}{3}$

Solve $Ax + y - 2 = 0$ for y to obtain slope-intercept form.

$$Ax + y - 2 = 0$$
$$y = -Ax + 2$$

So the slope of this line is $-A$.

This line is perpendicular to the line above so its slope is $\frac{3}{7}$. Therefore, $-A = \frac{3}{7}$ so $A = -\frac{3}{7}$.

$$24 + 3(x + 2) = 5(x - 12)$$
$$24 + 3x + 6 = 5x - 60$$
$$3x + 30 = 5x - 60$$
$$= 2x$$
$$45 = x$$

The solution set is $\{45\}$.

Let x = the television's price before the reduction.

$$-0.30x = 980$$
$$0.70x = 980$$
$$x = \frac{980}{0.70}$$
$$= 1400$$

Before the reduction the television's price was $1400.

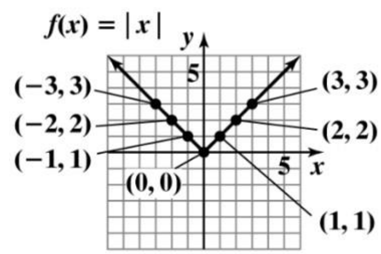
$$2x^{2/3} - 5x^{1/3} - 3 = 0$$

Let $t = x^{1/3}$.

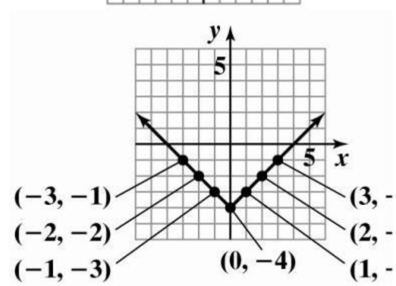
$$2t^2 - 5t - 3 = 0$$
$$(2t + 1)(t - 3) = 0$$
$$2t + 1 = 0 \quad \text{or} \quad t - 3 = 0$$
$$2t = -1 \qquad t = 3$$
$$t = -\frac{1}{2}$$
$$x^{1/3} = -\frac{1}{2} \qquad x^{1/3} = 3$$
$$x = -\left(\frac{1}{2}\right)^3 \qquad x = 3^3$$
$$x = -\frac{1}{8} \qquad x = 27$$

The solution set is $\left\{-\frac{1}{8}, 27\right\}$.

a.

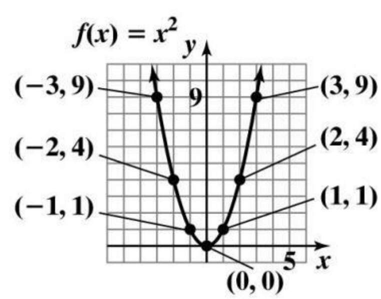


b.

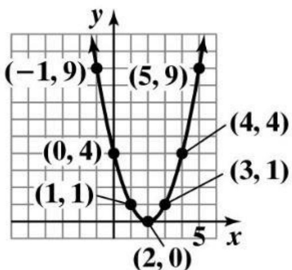


The graph in part (b) is the graph in part (a) shifted down 4 units.

a.

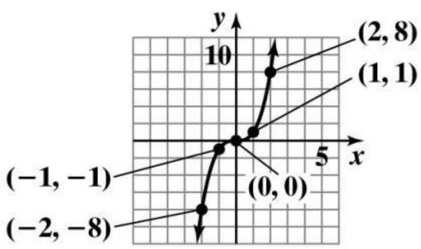


b.

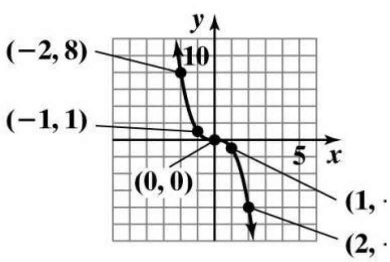


The graph in part (b) is the graph in part (a) shifted to the right 2 units.

a.



b.



The graph in part (b) is the graph in part (a) reflected across the *y*-axis.

Mid-Chapter 2 Check Point

The relation is not a function.
The domain is $\{1, 2\}$.
The range is $\{-6, 4, 6\}$.

The relation is a function.
The domain is $\{0, 2, 3\}$.
The range is $\{1, 4\}$.

The relation is a function.
The domain is $\{x \mid -2 \le x < 2\}$.
The range is $\{y \mid 0 \le y \le 3\}$.

The relation is not a function. The domain is $\{x \mid -3 < x \le 4\}$. The range is $\{y \mid -1 \le y \le 2\}$.

The relation is not a function. The domain is $\{-2, -1, 0, 1, 2\}$. The range is $\{-2, -1, 1, 3\}$.

The relation is a function.
The domain is $\{x \mid x \le 1\}$.
The range is $\{y \mid y \ge -1\}$.

$x^2 + y = 5$

$y = -x^2 + 5$

For each value of *x*, there is one and only one value for *y*, so the equation defines *y* as a function of *x*.

$x + y^2 = 5$

$y^2 = 5 - x$

$y = \pm\sqrt{5 - x}$

Since there are values of *x* that give more than one value for *y* (for example, if *x* = 4, then $y = \pm\sqrt{5 - 4} = \pm 1$), the equation does not define *y* as function of *x*.

No vertical line intersects the graph in more than one point. Each value of *x* corresponds to exactly one value of *y*.

Domain: $(-\infty, \infty)$

Range: $(-\infty, 4]$

x-intercepts: –6 and 2

y-intercept: 3

increasing: $(-\infty, -2)$

decreasing: $(-2, \infty)$

$x = -2$

$f(-2) = 4$

$f(-4) = 3$

19. $f(-7) = -2$ and $f(3) = -2$

20. $f(-6) = 0$ and $f(2) = 0$

$(-6, 2)$

$f(100)$ is negative.

neither; $f(-x) \neq x$ and $f(-x) \neq -x$

24. $\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{f(4) - f(-4)}{4 - (-4)} = \frac{-5 - 3}{4 + 4} = -1$

Test for symmetry with respect to the y-axis.

$= y^2 + 1$

$x = y^2 + 1$

$= -y^2 - 1$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the y-axis.

Test for symmetry with respect to the x-axis.

$= y^2 + 1$

$= (-y)^2 + 1$

$= y^2 + 1$

The resulting equation is equivalent to the original. Thus, the graph is symmetric with respect to the x-axis.

Test for symmetry with respect to the origin.

$= y^2 + 1$

$x = (-y)^2 + 1$

$x = y^2 + 1$

$= -y^2 - 1$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the origin.

Test for symmetry with respect to the y-axis. $y = x^3 - 1$

$= (-x)^3 - 1$

$= -x^3 - 1$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the y-axis.

Test for symmetry with respect to the x-axis.

$= x^3 - 1$

$y = x^3 - 1$

$= -x^3 + 1$

The resulting equation is not equivalent to the original. Thus, the graph is not symmetric with respect to the x-axis.

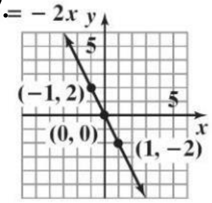
Test for symmetry with respect to the origin.

$y = x^3 - 1$

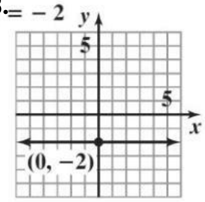
$y = (-x)^3 - 1$

$y = -x^3 - 1$

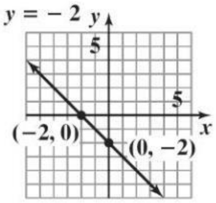
27. $y = -2x$



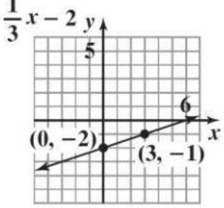
28. $y = -2$



29. $x + y = -2$



30. $y = \frac{1}{3}x - 2$



$x = 3.5$