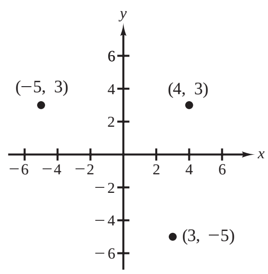
C H A P T E R 2
Graphs and Functions

Section 2.1 The Rectangular Coordinate System

Solutions to Odd-Numbered Exercises

1.

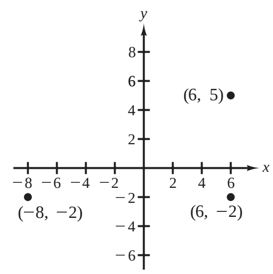


$(4, 3)$ is 4 units to the right of the vertical axis and 3 units above the horizontal axis.

$(-5, 3)$ is 5 units to the left of the vertical axis and 3 units above the horizontal axis.

$(3, -5)$ is 3 units to the right of the vertical axis and 5 units below the horizontal axis.

3.

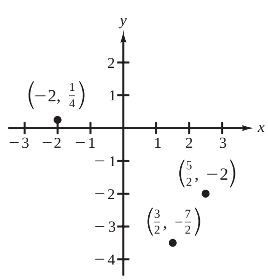


$(-8, -2)$ is 8 units to the left of the vertical axis and 2 units below the horizontal axis.

$(6, -2)$ is 6 units to the right of the vertical axis and 2 units below the horizontal axis.

$(6, 5)$ is 6 units to the right of the vertical axis and 5 units above the horizontal axis.

5.

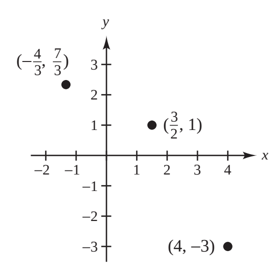


$\left(\frac{5}{2}, -2\right)$ is $\frac{5}{2}$ units to the right of the vertical axis and 2 units below the horizontal axis.

$\left(-2, \frac{1}{4}\right)$ is 2 units to the left of the vertical axis and $\frac{1}{4}$ units above the horizontal axis.

$\left(\frac{3}{2}, -\frac{7}{2}\right)$ is $\frac{3}{2}$ units to the right of the vertical axis and $\frac{7}{2}$ units below the horizontal axis.

7.



$\left(\frac{3}{2}, 1\right)$ is $\frac{3}{2}$ units to the right of the vertical axis and 1 unit above the horizontal axis.

$(4, -3)$ is 4 units to the right of the vertical axis and 3 units below the horizontal axis.

$\left(-\frac{4}{3}, \frac{7}{3}\right)$ is $\frac{4}{3}$ units to the left of the vertical axis and $\frac{7}{3}$ units above the horizontal axis.

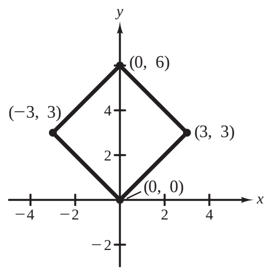
9.

Point	*Position*	*Coordinates*
A	2 left, 4 up	$(-2, 4)$
B	0 right or left, 2 down	$(0, -2)$
C	4 right, 2 down	$(4, -2)$

11.

Point	*Position*	*Coordinates*
A	4 right, 2 down	$(4, -2)$
B	3 left, $\frac{5}{2}$ down	$\left(-3, -\frac{5}{2}\right)$
C	3 right, $\frac{1}{2}$ up	$\left(3, \frac{1}{2}\right)$

13.



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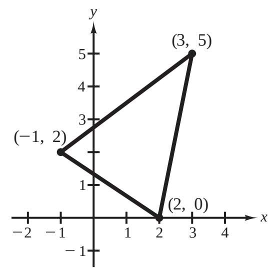

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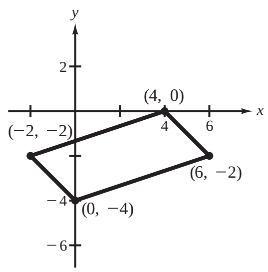

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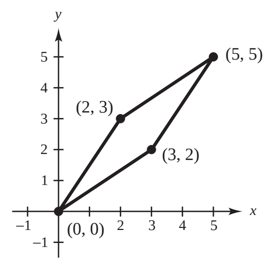


21. Point 5 units left of y-axis and 2 units above x-axis $= (-5, 2)$

23. Point 3 units right of y-axis and 2 units below x-axis $= (3, -2)$

25. The coordinates of the point are equal and located in Quadrant III, 10 units left of y-axis $= (-10, -10)$.

27. Point on positive x-axis 10 units from the origin $= (10, 0)$.

29. $(-3, -5)$ is in Quadrant III.

31. $\left(3, -\frac{5}{8}\right)$ is in Quadrant IV.

33. $(200, 1365.6)$ is in Quadrant I.

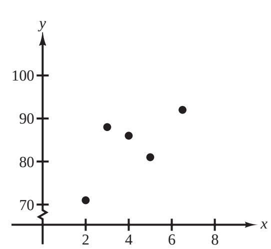
35. $(x, y), x > 0, y < 0$ is in Quadrant IV.

37. $(x, 4)$ is in Quadrants I or II.

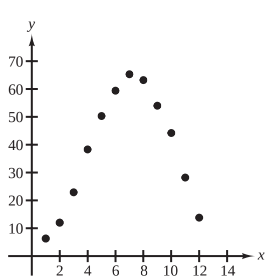
39. $(-3, y)$ is in Quadrants II or III.

41. $(x, y), xy > 0$ is in Quadrants I or III.

43.



45.



The relationship between x and y is as x increases from 1 to 7, y also increases, but as x increases from 7 to 12, y decreases.

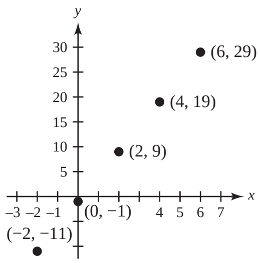
47. $(-2, -1)$ shifted 2 units right and 5 units up $= (0, 4)$

$(-3, -4)$ shifted 2 units right and 5 units up $= (-1, 1)$

$(1, -3)$ shifted 2 units right and 5 units up $= (3, 2)$

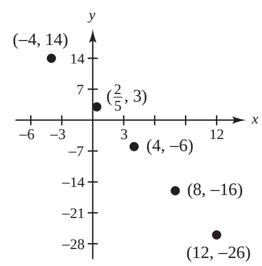
49.

x	-2	0	2	4	6
$y = 5x - 1$	-11	-1	9	19	29



51.

x	-4	$\frac{2}{5}$	4	8	12
$y = -\frac{5}{2}x + 4$	14	3	-6	-16	-26



$$y = \frac{-5}{2}(-4) + 4 = 10 + 4 = 14$$

$$y = \frac{-5}{2}\left(\frac{2}{5}\right) + 4 = -1 + 4 = 3$$

$$y = \frac{-5}{2}(4) + 4 = -10 + 4 = -6$$

$$y = \frac{-5}{2}(8) + 4 = -20 + 4 = -16$$

$$y = \frac{-5}{2}(12) + 4 = -30 + 4 = -26$$

53.

x	-2	0	2	4	6
$y = 4x^2 + x - 2$	12	-2	16	66	148

Keystrokes: [Y=] 4 [X,T,θ] [x^2] [+] [X,T,θ] [−] 2 [GRAPH]

55. $x^2 + 3y = -5$

(a) $(3, -2)$

$$3^2 + 3(-2) \stackrel{?}{=} -5$$
$$9 - 6 \stackrel{?}{=} -5$$
$$3 \neq -5$$

Not a solution

(b) $(-2, -3)$

$$(-2)^2 + 3(-3) \stackrel{?}{=} -5$$
$$4 - 9 \stackrel{?}{=} -5$$
$$-5 = -5$$

Solution

(c) $(3, -5)$

$$3^2 + 3(-5) \stackrel{?}{=} -5$$
$$9 - 15 \stackrel{?}{=} -5$$
$$-6 \neq -5$$

Not a solution

(d) $(4, -7)$

$$4^2 + 3(-7) \stackrel{?}{=} -5$$
$$16 - 21 \stackrel{?}{=} -5$$
$$-5 = -5$$

Solution

57. $4y - 2x + 1 = 0$

(a) $(0, 0)$

$4(0) - 2(0) + 1 \stackrel{?}{=} 0$

$1 \neq 0$

Not a solution

(b) $\left(\frac{1}{2}, 0\right)$

$4(0) - 2\left(\frac{1}{2}\right) + 1 \stackrel{?}{=} 0$

$0 - 1 + 1 \stackrel{?}{=} 0$

$0 = 0$

Solution

(c) $\left(-3, -\frac{7}{4}\right)$

$4\left(-\frac{7}{4}\right) - 2(-3) + 1 \stackrel{?}{=} 0$

$-7 + 6 + 1 \stackrel{?}{=} 0$

$0 = 0$

Solution

(d) $\left(1, -\frac{3}{4}\right)$

$4\left(-\frac{3}{4}\right) - 2(1) + 1 \stackrel{?}{=} 0$

$-3 - 2 + 1 \stackrel{?}{=} 0$

$-4 \neq 0$

Not a solution

59. $y = \frac{7}{8}x + 3$

(a) $\left(\frac{8}{7}, 4\right)$

$4 \stackrel{?}{=} \frac{7}{8}\left(\frac{8}{7}\right) + 3$

$4 \stackrel{?}{=} 1 + 3$

$4 = 4$

Solution

(b) $(8, 10)$

$10 \stackrel{?}{=} \frac{7}{8}(8) + 3$

$10 \stackrel{?}{=} 7 + 3$

$10 = 10$

Solution

(c) $(0, 0)$

$0 \stackrel{?}{=} \frac{7}{8}(0) + 3$

$0 \stackrel{?}{=} 0 + 3$

$0 \neq 3$

Not a solution

(d) $(-16, 14)$

$14 \stackrel{?}{=} \frac{7}{8}(-16) + 3$

$14 \stackrel{?}{=} -14 + 3$

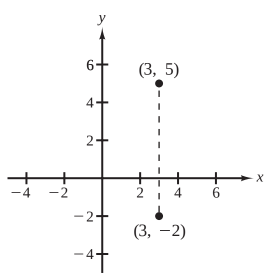
$14 \neq -11$

Not a solution

61. $d = |5 - (-2)|$

$= |7|$

$= 7$

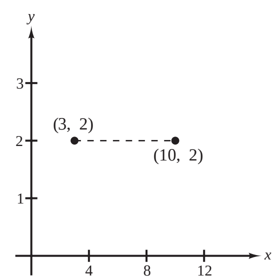


Vertical line

63. $d = |10 - 3|$

$= |7|$

$= 7$

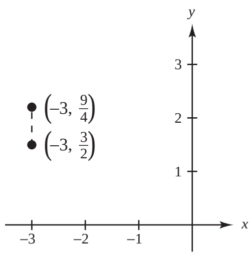


Horizontal line

65. $d = \left|\frac{3}{2} - \frac{9}{4}\right|$

$= \left|\frac{6}{4} - \frac{9}{4}\right|$

$= \frac{3}{4}$



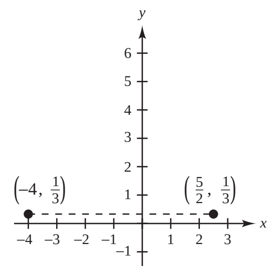
Vertical line

67. $d = \left|\frac{5}{2} - (-4)\right|$

$= \left|\frac{5}{2} + \frac{8}{2}\right|$

$= \left|\frac{13}{2}\right|$

$= \frac{13}{2}$



Horizontal line

69. $d = \sqrt{(3-4)^2 + (7-5)^2}$

$= \sqrt{(-1)^2 + (2)^2} = \sqrt{1+4} = \sqrt{5}$

71. $d = \sqrt{(1-5)^2 + (3-6)^2}$

$= \sqrt{16+9} = \sqrt{25} = 5$

73. $d = \sqrt{(-3-4)^2 + [0-(-3)]^2}$

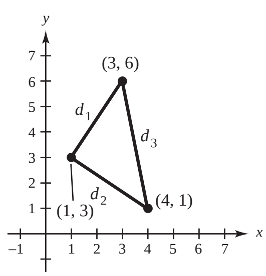
$= \sqrt{(-7)^2 + (3)^2} = \sqrt{49+9} = \sqrt{58}$

75. $d = \sqrt{(-2-4)^2 + (-3-2)^2}$

$= \sqrt{36+25} = \sqrt{61}$

77. $d = \sqrt{(1-3)^2 + [3-(-2)]^2} = \sqrt{4+25} = \sqrt{29}$

79.



$d_1 = \sqrt{(1-3)^2 + (3-6)^2} = \sqrt{4+9} = \sqrt{13}$

$d_2 = \sqrt{(1-4)^2 + (3-1)^2} = \sqrt{9+4} = \sqrt{13}$

$d_3 = \sqrt{(3-4)^2 + (6-1)^2} = \sqrt{1+25} = \sqrt{26}$

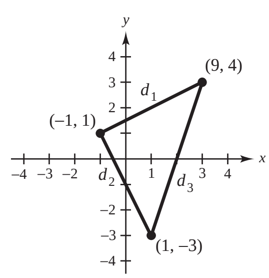
$\left(\sqrt{13}\right)^2 + \left(\sqrt{13}\right)^2 \stackrel{?}{=} \left(\sqrt{26}\right)^2$

$13 + 13 \stackrel{?}{=} 26$

$26 = 26$

By the Pythagorean Theorem, it is a right triangle.

81.



$d_1 = \sqrt{(-1-3)^2 + (1-3)^2} = \sqrt{16+4} = \sqrt{20}$

$d_2 = \sqrt{(-1-1)^2 + [1-(-3)]^2} = \sqrt{4+16} = \sqrt{20}$

$d_3 = \sqrt{(1-3)^2 + (-3-3)^2} = \sqrt{4+36} = \sqrt{40}$

$\left(\sqrt{20}\right)^2 + \left(\sqrt{20}\right)^2 \stackrel{?}{=} \left(\sqrt{40}\right)^2$

$20 + 20 \stackrel{?}{=} 40$

$40 = 40$

By the Pythagorean Theorem, it is a right triangle.

83. $d = \sqrt{(2-2)^2 + (3-6)^2} = \sqrt{0+9} = 3$

$d = \sqrt{(2-6)^2 + (3-3)^2} = \sqrt{16+0} = 4$

$d = \sqrt{(2-6)^2 + (6-3)^2} = \sqrt{16+9} = 5$

$3 + 4 \neq 5$ Not collinear

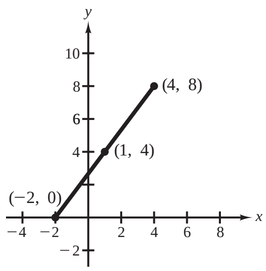
85. $d = \sqrt{(8-5)^2 + (3-2)^2} = \sqrt{9+1} = \sqrt{10}$

$d = \sqrt{(8-2)^2 + (3-1)^2} = \sqrt{36+4} = \sqrt{40} = 2\sqrt{10}$

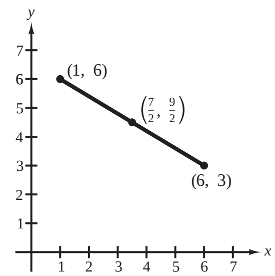
$d = \sqrt{(5-2)^2 + (2-1)^2} = \sqrt{9+1} = \sqrt{10}$

$\sqrt{10} + \sqrt{10} = 2\sqrt{10}$ Collinear

87. $M = \left(\frac{-2+4}{2}, \frac{0+8}{2}\right) = (1, 4)$



89. $M = \left(\frac{1+6}{2}, \frac{6+3}{2}\right) = \left(\frac{7}{2}, \frac{9}{2}\right)$



91.

x	100	150	200	250	300
$c = 28x + 3000$	5800	7200	8600	10,000	11,400

$y = 28(100) + 3000 = 2800 + 3000 = 5800$

$y = 28(150) + 3000 = 4200 + 3000 = 7200$

$y = 28(200) + 3000 = 5600 + 3000 = 8600$

$y = 28(250) + 3000 = 7000 + 3000 = 10{,}000$

$y = 28(300) + 3000 = 8400 + 3000 = 11{,}400$

For each additional 50 units produced, costs increase by \$1400.

93. $x^2 = 7^2 + 15^2$

$x^2 = 49 + 225$

$x = \sqrt{274} \approx 16.55294536$

Rafter $= 2 + x \approx 18.55294536 \approx 18.55$ feet

95. $d = \sqrt{(-2-0)^2 + (0-5)^2} = \sqrt{4+25} = \sqrt{29}$

$d = \sqrt{(0-1)^2 + (5-0)^2} = \sqrt{1+25} = \sqrt{26}$

$d = \sqrt{(-2-1)^2 + (0-0)^2} = \sqrt{9} = 3$

$P = \sqrt{29} + \sqrt{26} + 3 \approx 13.48$

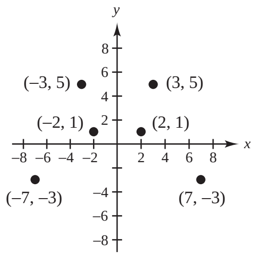
97. The word *ordered* is significant because each number in the pair has a particular interpretation. The first measures horizontal distance and the second measures vertical distance.

99. The x-coordinate of any point on the y-axis is 0.

The y-coordinate of any point on the x-axis is 0.

101. No. The scales on the x and y-axes are determined by the magnitudes of the quantities being measured by x and y.

103.



When the sign of the x-coordinate is changed, the point is on the opposite side of the y-axis as the original point.

Section 2.2 Graphs of Equations

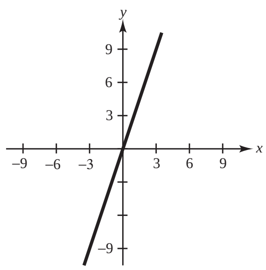
1. $y = 2$ matches graph (e).

3. $y = 2 - x$ matched graph (f)

5. $y = x^2 - 4$ matches graph (d).

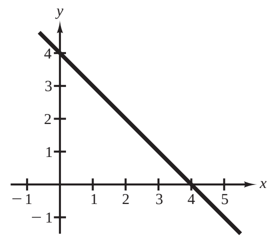
7.

x	-2	-1	0	1	2
$y = 3x$	-6	-3	0	3	6
Solution	$(-2, -6)$	$(-1, -3)$	(0, 0)	(1, 3)	(2, 6)



9.

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



11.

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