

Chapter 3 GRAPHS, LINEAR EQUATIONS, AND FUNCTIONS

3.1 The Rectangular Coordinate System

Learning Objectives

- 1 Interpret a line graph.
- 2 Plot ordered pairs.
- 3 Find ordered pairs that satisfy a given equation.
- 4 Graph lines.
- 5 Find x - and y -intercepts.
- 6 Recognize equations of horizontal and vertical lines.
- 7 Use the midpoint formula.

Key Terms

Use the vocabulary terms listed below to complete each statement in exercises 1–14.

ordered pair	origin	x-axis	y-axis
rectangular (Cartesian) coordinate system			plot
components	coordinate	quadrant	graph of an equation
first-degree equation		linear equation in two variables	
y-intercept	x-intercept		

1. If a graph intersects the y -axis at k , then the _____ is $(0, k)$.
2. An equation that can be written in the form $Ax + By = C$, where A , B , and C are real numbers and $A, B \neq 0$, is called a _____.
3. Each number in an ordered pair represents a _____ of the corresponding point.
4. The axis lines in a coordinate system intersect at the _____.
5. If a graph intersects the x -axis at k , then the _____ is $(k, 0)$.
6. In a rectangular coordinate system, the horizontal number line is called the _____.
7. A _____ is one of the four regions in the plane determined by a rectangular coordinate system.
8. A pair of numbers written between parentheses in which order is important is called a(n) _____.
9. In a rectangular coordinate system, the vertical number line is called the _____.

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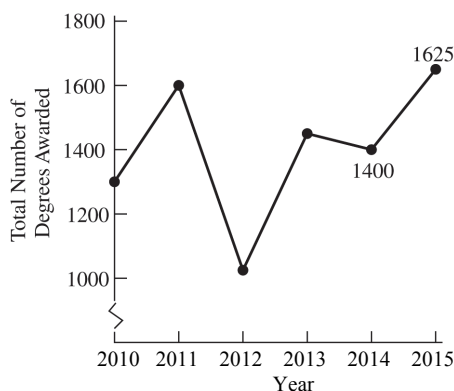
10. The two numbers in an ordered pair are the _____ of the ordered pair.
11. To _____ an ordered pair is to locate the corresponding point on a coordinate system.
12. Together, the x -axis and the y -axis form a _____.
13. The _____ is the set of points corresponding to all ordered pairs that satisfy the equation.
14. A _____ has no term with a variable to a power greater than one.

Objective 1 Interpret a line graph.

Objective 1 Practice Exercises

For extra help, see page 162 of your text.

The line graph shows the number of degrees awarded by a university for the years 2010–2015. Use this graph to answer exercises 1–3.



1. If the ordered pair (x, y) represents a point on the graph, what does x represent? What does y represent?
1. x : _____
 y : _____
2. Between which two years did the total number of degrees awarded show the smallest change?
2. _____
3. Between which two years did the total number of degrees awarded show the greatest decline?
3. _____

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Objective 2 Plot ordered pairs.

Objective 2 Practice Exercises

For extra help, see pages 162–163 of your text.

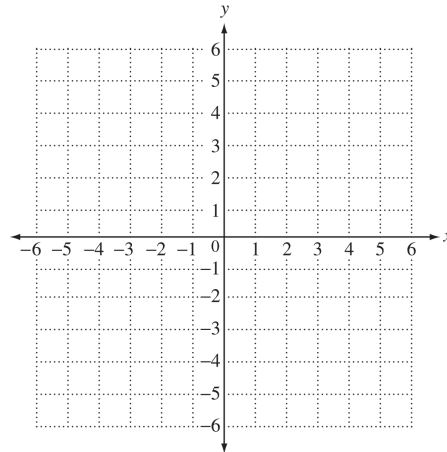
Plot each ordered pair on a coordinate system.

4. $(0, -2)$

4.–6.

5. $(-3, 4)$

6. $(2, -5)$



Objective 3 Find ordered pairs that satisfy a given equation.

Video Examples

Review these examples for Objective 3:

1. In parts (a)–(d), complete each ordered pair for $5x + 4y = 20$. Then part (e), write the results as a table of ordered pairs.

a. $(0, \underline{\hspace{1cm}})$

$$5x + 4y = 20$$

$$5(0) + 4y = 20$$

$$4y = 20$$

$$y = 5$$

The ordered pair is $(0, 5)$.

b. $(\underline{\hspace{1cm}}, 0)$

$$5x + 4y = 20$$

$$5x + 4(0) = 20$$

$$5x = 20$$

$$x = 4$$

The ordered pair is $(4, 0)$.

Now Try:

1. In parts (a)–(d), complete each ordered pair for $2x - 5y = 10$. Then part (e), write the results as a table of ordered pairs.

a. $(0, \underline{\hspace{1cm}})$

b. $(\underline{\hspace{1cm}}, 0)$

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c. $(-4, \underline{\hspace{1cm}})$

$$5x + 4y = 20$$

$$5(-4) + 4y = 20$$

$$-20 + 4y = 20$$

$$4y = 40$$

$$y = 10$$

The ordered pair is $(-4, 10)$.

d. $(\underline{\hspace{1cm}}, -5)$

$$5x + 4y = 20$$

$$5x + 4(-5) = 20$$

$$5x - 20 = 20$$

$$5x = 40$$

$$x = 8$$

The ordered pair is $(8, -5)$.

e. Write the ordered pairs in a table.

x	y
0	5
4	0
-4	10
8	-5

c. $(-5, \underline{\hspace{1cm}})$

d. $(\underline{\hspace{1cm}}, 2)$

e. Write the ordered pairs in a table.

Objective 3 Practice Exercises

For extra help, see Example 1 on page 164 of your text.

For each of the given equations, complete the ordered pairs beneath it.

7. $5x + 4y = 10$

(a) $(2, \underline{\hspace{1cm}})$

(b) $(4, \underline{\hspace{1cm}})$

(c) $(\underline{\hspace{1cm}}, 3)$

(d) $(0, \underline{\hspace{1cm}})$

(e) $(\underline{\hspace{1cm}}, 2)$

7.

(a) _____

(b) _____

(c) _____

(d) _____

(e) _____

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Complete each table of values. Write the results as ordered pairs.

8. $-7x + 2y = -14$

8. _____

x	y
	0
0	
3	
	7

9. $y - 4 = 0$

9. _____

x	y
-4	
0	
6	
-12	

Objective 4 Graph lines.

Objective 4 Practice Exercises

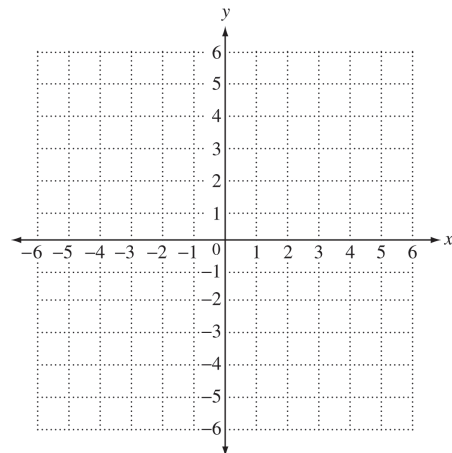
For extra help, see pages 164–165 of your text.

Complete the table of values for each equation. Then graph the equation by plotting the points and drawing a line through them.

10. $2y - 4 = x$

10.

x	y
0	
	0
-2	
	-1



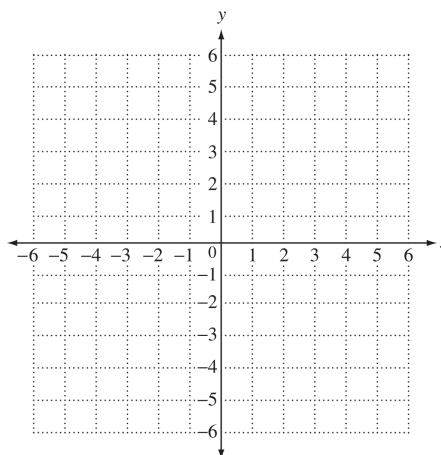
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11. $2x + 3y = 6$

x	y
0	
	0
-3	
	-2

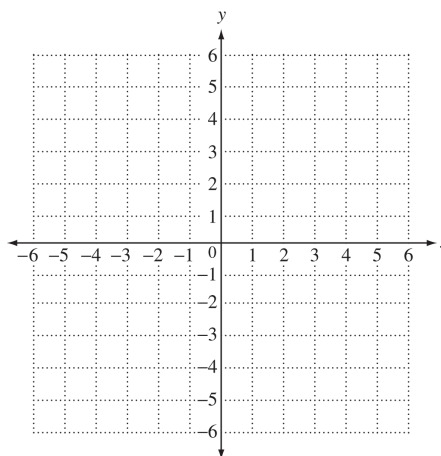
11.



12. $x - y = 4$

x	y
0	
	0
-2	
	-2

12.



Objective 5 Find x - and y -intercepts.

Video Examples

Review these examples for Objective 5:

2. Find the x - and y -intercepts of $3x + y = 6$ and graph the equation.

To find the y -intercept, let $x = 0$.

To find the x -intercept, let $y = 0$.

$$\begin{array}{l|l} 3(0) + y = 6 & 3x + 0 = 6 \\ 0 + y = 6 & 3x = 6 \\ y = 6 & x = 2 \end{array}$$

The intercepts are $(0, 6)$ and $(2, 0)$. To find a third point, as a check, we let $x = 1$.

Now Try:

2. Find the x - and y -intercepts of $5x - 2y = -10$ and graph the equation.

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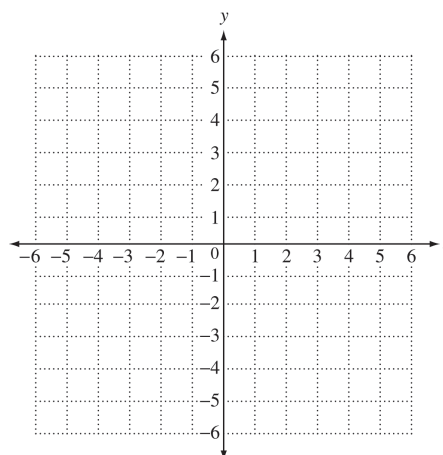
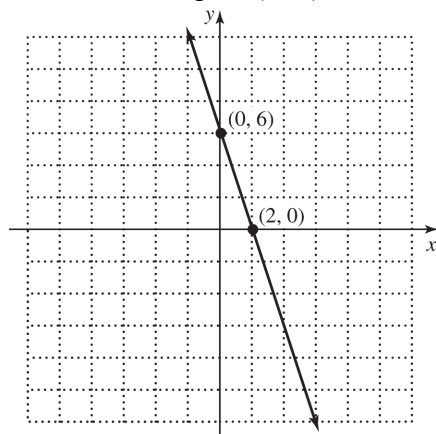
$$3(1) + y = 6$$

$$3 + y = 6$$

$$y = 3$$

This gives the ordered pair (1, 3).

x	y
0	6
2	0
1	3



3. Graph $x + 5y = 0$.

To find the y -intercept, let $x = 0$.

To find the x -intercept, let $y = 0$.

$$0 + 5y = 0 \quad | \quad x + 5(0) = 0$$

$$5y = 0 \quad | \quad x + 0 = 0$$

$$y = 0 \quad | \quad x = 0$$

The x - and y -intercepts are the same point (0, 0).

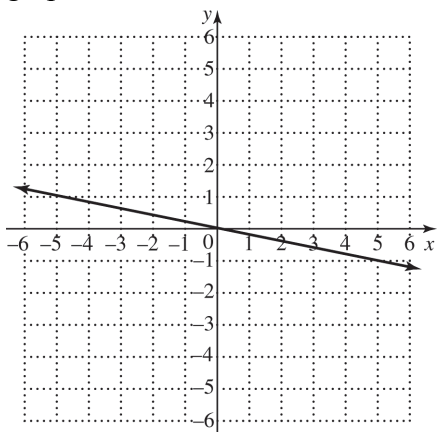
We must select two other values for x or y to find two other points. We choose $y = 1$ and $y = -1$.

$$x + 5(1) = 0 \quad | \quad x + 5(-1) = 0$$

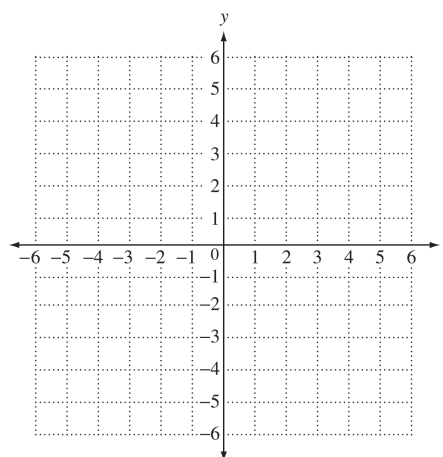
$$x + 5 = 0 \quad | \quad x - 5 = 0$$

$$x = -5 \quad | \quad x = 5$$

We use $(-5, 1)$, $(0, 0)$, and $(5, -1)$ to draw the graph.



3. Graph $3x - y = 0$.



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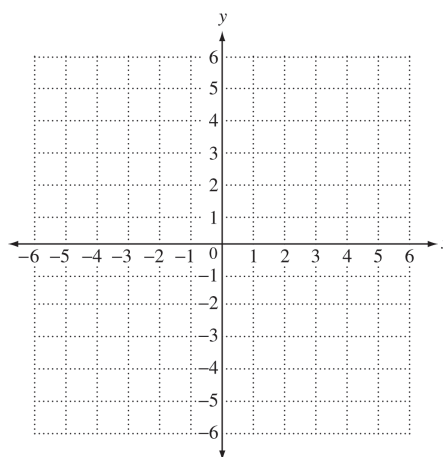
Objective 5 Practice Exercises

For extra help, see Examples 2–3 on pages 166–167 of your text.

Find the intercepts, then graph the equation.

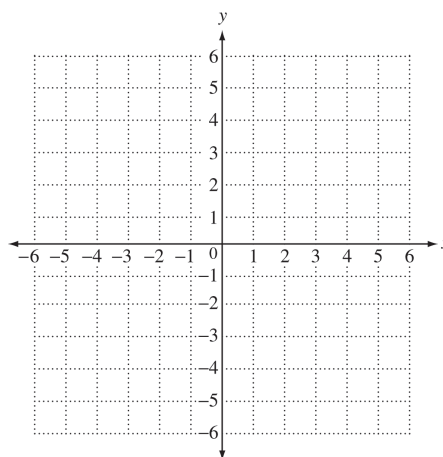
13. $4x - y = 4$

13. _____



14. $2x - 3y = 6$

14. _____



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Objective 6 Recognize equations of horizontal and vertical lines.

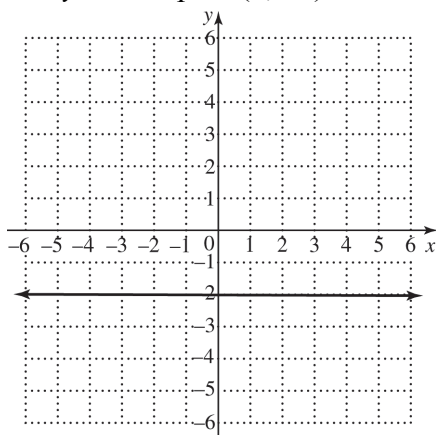
Video Examples

Review these examples for Objective 6:

4. Graph each equation.

a. $y = -2$

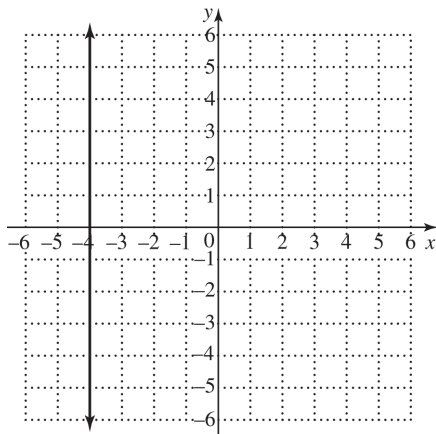
For any value of x , y is always -2 . Three ordered pairs that satisfy the equation are $(-4, -2)$, $(0, -2)$ and $(2, -2)$. Drawing a line through these points gives the horizontal line. The y -intercept is $(0, -2)$. There is no x -intercept.



b. $x + 4 = 0$

First we subtract 4 from each side of the equation to get the equivalent equation $x = -4$. All ordered-pair solutions of this equation have x -coordinate -4 .

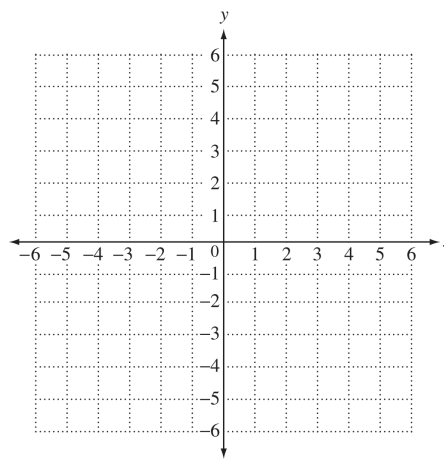
Three ordered pairs that satisfy the equation are $(-4, -1)$, $(-4, 0)$, and $(-4, 3)$. The graph is a vertical line. The x -intercept is $(-4, 0)$. There is no y -intercept.



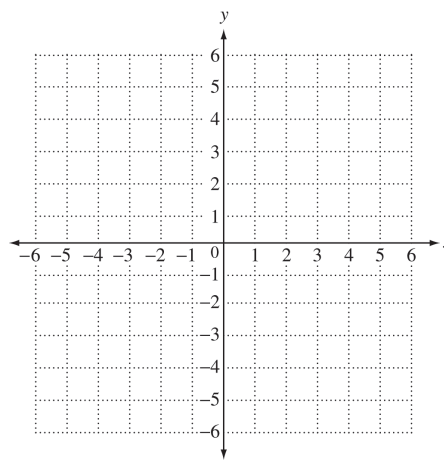
Now Try:

4. Graph each equation.

a. $y = 4$



b. $x = 0$



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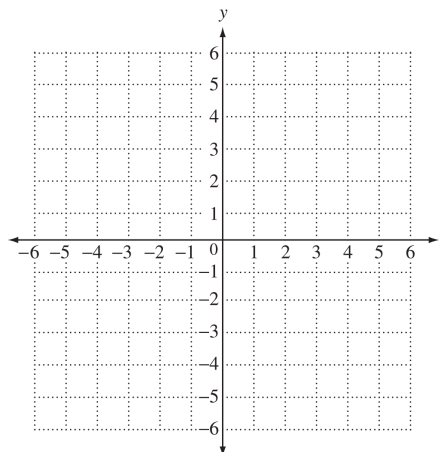
Objective 6 Practice Exercises

For extra help, see Example 4 on page 167 of your text.

Find the intercepts, and graph the line.

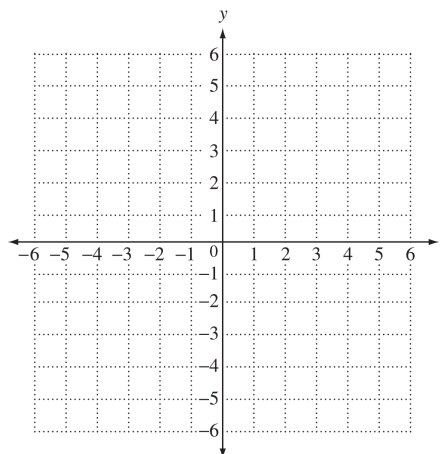
15. $x - 1 = 0$

15.



16. $y + 3 = 0$

16.



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Objective 7 Use the midpoint formula.

Video Examples

Review this example for Objective 7:

5. Find the coordinates of the midpoint of the line segment PQ with endpoints $P(8,-5)$ and $Q(4,-3)$.

$$P(8,-5) = (x_1, y_1) \text{ and } Q(4,-3) = (x_2, y_2)$$

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) = \left(\frac{8 + 4}{2}, \frac{-5 + (-3)}{2} \right)$$

$$= \left(\frac{12}{2}, \frac{-8}{2} \right)$$

$$= (6, -4)$$

The midpoint of PQ is $(6, -4)$.

Now Try:

5. Find the coordinates of the midpoint of the line segment PQ with endpoints $P(7,-6)$ and $Q(3, 2)$.

Objective 7 Practice Exercises

For extra help, see Example 5 on page 169 of your text.

Find the midpoint of each segment with the given endpoints.

17. $(-4, 8)$ and $(8, -4)$

17. _____

18. $(8, 5)$ and $(-3, -11)$

18. _____

19. $(-2.2, -9.3)$ and $(-8.4, 5.7)$

19. _____