Linear Equations and Inequalities in Two Variables

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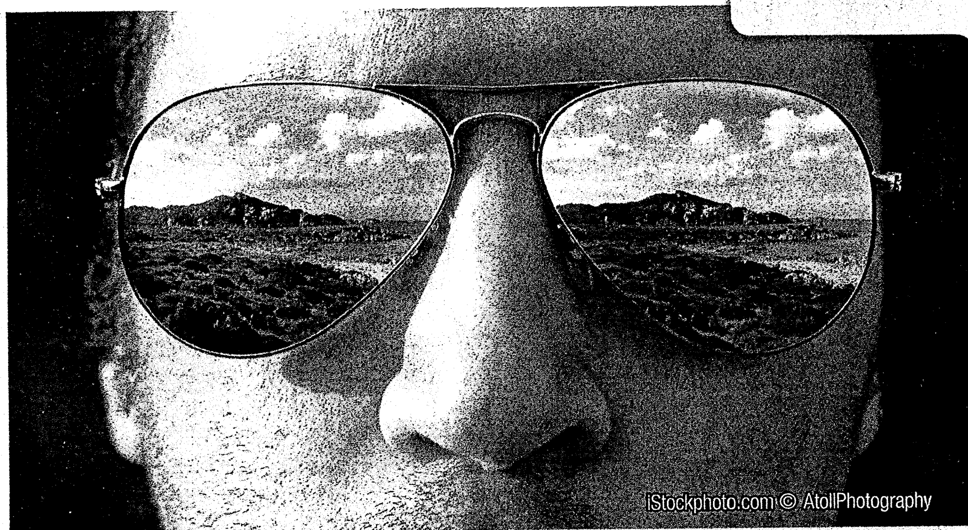


Chapter Outline

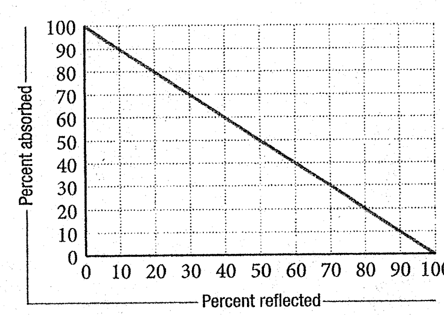
When light comes into contact with a surface that does not transmit light, then all the light that contacts the surface is either reflected off the surface or absorbed into the surface. If we let R represent the percentage of light reflected and A represent the percentage of light absorbed, then the relationship between these two variables can be written as

$$R + A = 100$$

which is a linear equation in two variables. The following table and graph show the same relationship as that described by the equation. The table is a numerical description; the graph is a visual description.

Reflected and Absorbed Light

Percent Reflected	Percent Absorbed
0	100
20	80
40	60
60	40
80	20
100	0



In this chapter we learn how to build tables and draw graphs from linear equations in two variables.

If you have successfully completed Chapter 1, then you have made a good start at developing the study skills necessary to succeed in all math classes. Some of the study skills for this chapter are a continuation of the skills from Chapter 1, while others are new to this chapter.

1. **Continue to Set and Keep a Schedule** Sometimes I find students do well in Chapter 1 and then become overconfident. They will begin to put in less time with their homework. Don't do it. Keep to the same schedule.

2. **Increase Effectiveness** You want to become more and more effective with the time you spend on your homework. Increase those activities that are the most beneficial and decrease those that have not given you the results you want.

3. **List Difficult Problems** Begin to make lists of problems that give you the most difficulty. These are the problems in which you are repeatedly making mistakes.

4. **Begin to Develop Confidence With Word Problems** It seems that the main difference between people who are good at working word problems and those who are not is confidence. People with confidence know that no matter how long it takes them, they will eventually be able to solve the problem. Those without confidence begin by saying to themselves, "I'll never be able to work this problem." If you are in this second category, then instead of telling yourself that you can't do word problems, decide to do whatever it takes to master them. The more word problems you work, the better you will become at them.

   Many of my students keep a notebook that contains everything that they need for the course: class notes, homework, quizzes, tests, and research projects. A three-ring binder with tabs is ideal. Organize your notebook so that you can easily get to any item you want to look at.

Paired Data and Graphing Ordered Pairs 2.1

This table and figure show the relationship between the table of values for the speed of a race car and the corresponding bar chart. In Figure 1, the horizontal line that shows the elapsed time in seconds is called the *horizontal axis*, and the vertical line that shows the speed in miles per hour is called the *vertical axis*.

The data in the table are called *paired data* because the information is organized so that each number in the first column is paired with a specific number in the second column. Each pair of numbers is associated with one of the solid bars in Figure 1. For example, the third bar in the bar chart is associated with the pair of numbers 3 seconds and 162.8 miles per hour. The first number, 3 seconds, is associated with the horizontal axis, and the second number, 162.8 miles per hour, is associated with the vertical axis.

Speed of a Race Car

Time in Seconds	Speed in Miles per Hour
0	0
1	72.7
2	129.9
3	162.8
4	192.2
5	212.4
6	228.1

Visually

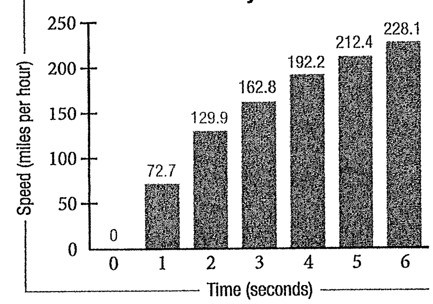


FIGURE 1

Scatter Diagrams and Line Graphs

The information in the table can be visualized with a *scatter diagram* and *line graph* as well. Figure 2 is a scatter diagram of the information in Table 1. We use dots instead of the bars shown in Figure 1 to show the speed of the race car at each second during the race. Figure 3 is called a *line graph*. It is constructed by taking the dots in Figure 2 and connecting each one to the next with a straight line. Notice that we have labeled the axes in these two figures a little differently than we did with the bar chart by making the axes intersect at the number 0.

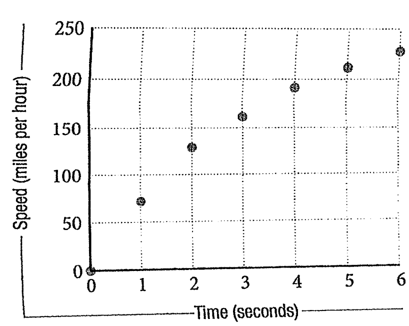


FIGURE 2

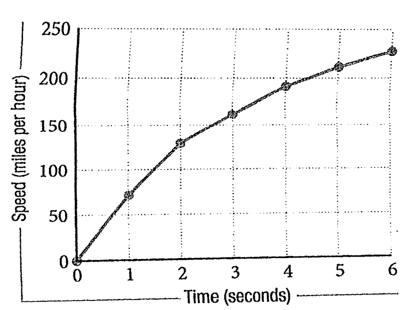


FIGURE 3

The number sequences we have worked with in the past can also be written as paired data by associating each number in the sequence with its position in the sequence. For instance, in the sequence of odd numbers

$$1, 3, 5, 7, 9, \ldots$$

the number 7 is the fourth number in the sequence. Its position is 4, and its value is 7. Here is the sequence of odd numbers written so that the position of each term is noted:

Position	$1, 2, 3, 4, 5, \ldots$
Value	$1, 3, 5, 7, 9, \ldots$

EXAMPLE 1 The tables below give the first five terms of the sequence of odd numbers and the sequence of squares as paired data. In each case construct a scatter diagram.

Odd Numbers

Position	Value
1	1
2	3
3	5
4	7
5	9

Squares

Position	Value
1	1
2	4
3	9
4	16
5	25

SOLUTION The two scatter diagrams are based on the data from these tables shown here. Notice how the dots in Figure 4 seem to line up in a straight line, whereas the dots in Figure 5 give the impression of a curve. We say the points in Figure 4 suggest a linear relationship between the two sets of data, whereas the points in Figure 5 suggest a nonlinear relationship.

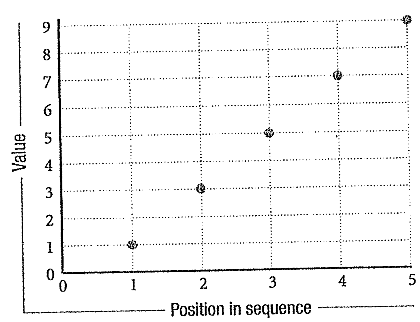


FIGURE 4

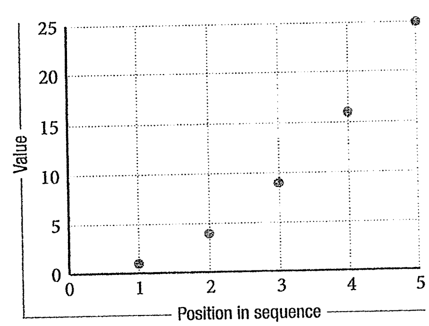


FIGURE 5

As you know, each dot in Figures 4 and 5 corresponds to a pair of numbers, one of which is associated with the horizontal axis and the other with the vertical axis. Paired data play a very important role in the equations we will solve in the next section. To prepare ourselves for those equations, we need to expand the concept of paired data to include negative numbers. At the same time, we want to standardize the position of the axes in the diagrams that we use to visualize paired data.

DEFINITION *x-coordinate, y-coordinate*

A pair of numbers enclosed in parentheses and separated by a comma, such as $(-2, 1)$, is called an ordered pair of numbers. The first number in the pair is called the x-coordinate of the ordered pair; the second number is called the y-coordinate. For the ordered pair $(-2, 1)$, the x-coordinate is -2 and the y-coordinate is 1.

Ordered pairs of numbers are important in the study of mathematics because they give us a way to visualize solutions to equations. To see the visual component of ordered pairs, we need the diagram shown in Figure 6. It is called the *rectangular coordinate system.*

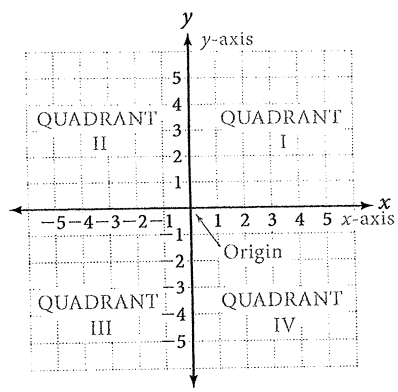
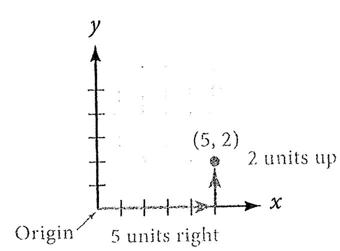


FIGURE 6

The rectangular coordinate system is built from two number lines oriented perpendicular to each other. The horizontal number line is exactly the same as our real number line and is called the *x-axis*. The vertical number line is also the same as our real number line with the positive direction up and the negative direction down. It is called the *y-axis*. The point where the two axes intersect is called the *origin*. As you can see from Figure 6, the axes divide the plane into four *quadrants*, which are numbered I through IV in a counterclockwise direction.

Graphing Ordered Pairs

To graph the ordered pair (a, b), we start at the origin and move a units forward or back (forward if a is positive and back if a is negative). Then we move b units up or down (up if b is positive, down if b is negative). The point where we end up is the graph of the ordered pair (a, b). To graph the ordered pair $(5, 2)$, we start at the origin and move 5 units to the right. Then, from that position, we move 2 units up.



EXAMPLE 2 Graph the ordered pairs (3, 4), (3, −4), (−3, 4), and (−3, −4).

SOLUTION

Note: It is very important that you graph ordered pairs quickly and accurately. Remember, the first coordinate goes with the horizontal axis and the second coordinate goes with the vertical axis.

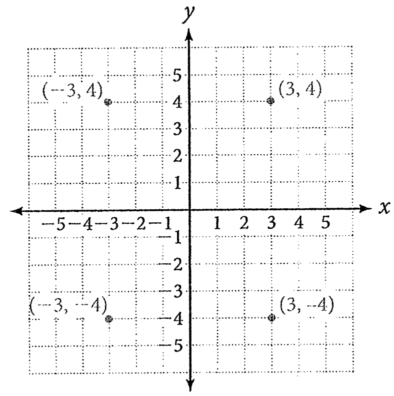


FIGURE 7

We can see in Figure 7 that when we graph ordered pairs, the x-coordinate corresponds to movement parallel to the x-axis (horizontal) and the y-coordinate corresponds to movement parallel to the y-axis (vertical).

EXAMPLE 3 Graph the ordered pairs (−1, 3), (2, 5), (0, 0), (0, −3), and (4, 0).

SOLUTION See Figure 8.

Note: If we do not label the axes of a coordinate system, we assume that each square is one unit long and one unit wide.

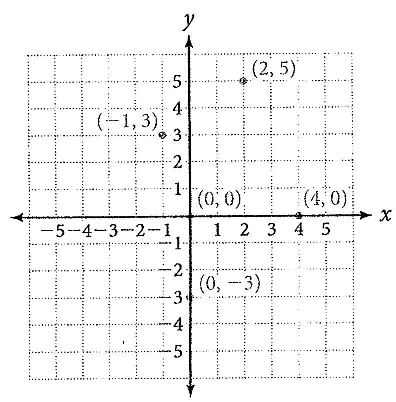


FIGURE 8

GETTING READY FOR CLASS

After reading through the preceding section, respond in your own words and in complete sentences.

A. What is an ordered pair of numbers?
B. Explain in words how you would graph the ordered pair (3, 4).
C. How do you construct a rectangular coordinate system?
D. Where is the origin on a rectangular coordinate system?

Problem Set 2.1

Graph the following ordered pairs.

1. $(3, 2)$ **2.** $(3, -2)$ **3.** $(-3, 2)$ **4.** $(-3, -2)$

5. $(5, 1)$ **6.** $(5, -1)$ **7.** $(1, 5)$ **8.** $(1, -5)$

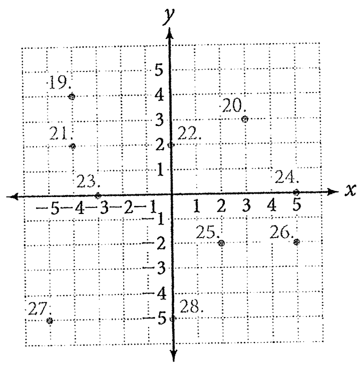
9. $(-1, 5)$ **10.** $(-1, -5)$ **11.** $\left(2, \frac{1}{2}\right)$ **12.** $\left(3, \frac{3}{2}\right)$

13. $\left(-4, -\frac{5}{2}\right)$ **14.** $\left(-5, -\frac{3}{2}\right)$ **15.** $(3, 0)$ **16.** $(-2, 0)$

17. $(0, 5)$ **18.** $(0, 0)$

Give the coordinates of each numbered point in the figure.

19–28.



Graph the points (4, 3) and (−4, −1), and draw a straight line that passes through both of them. Then answer the following questions.

29. Does the graph of (2, 2) lie on the line?

30. Does the graph of (−2, 0) lie on the line?

31. Does the graph of (0, −2) lie on the line?

32. Does the graph of (−6, 2) lie on the line?

Graph the points (−2, 4) and (2, −4), and draw a straight line that passes through both of them. Then answer the following questions.

33. Does the graph of (0, 0) lie on the line?

34. Does the graph of (−1, 2) lie on the line?

35. Does the graph of (2, −1) lie on the line?

36. Does the graph of (1, −2) lie on the line?

Draw a straight line that passes through the points (3, 4) and (3, −4). Then answer the following questions.

37. Is the graph of (3, 0) on this line?

38. Is the graph of (0, 3) on this line?

39. Is there any point on this line with an x-coordinate other than 3?

40. If you extended the line, would it pass through a point with a y-coordinate of 10?

Draw a straight line that passes through the points (3, 4) and (−3, 4). Then answer the following questions.

41. Is the graph of (4, 0) on this line?

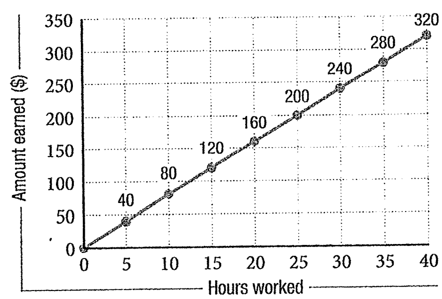
42. Is the graph of (0, 4) on this line?

43. Is there any point on this line with a y-coordinate other than 4?

44. If you extended the line, would it pass through a point with an x-coordinate of 10?

Applying the Concepts

45. Hourly Wages Jane takes a job at the local Marcy's department store. Her job pays $8.00 per hour. The graph shows how much Jane earns for working from 0 to 40 hours in a week.



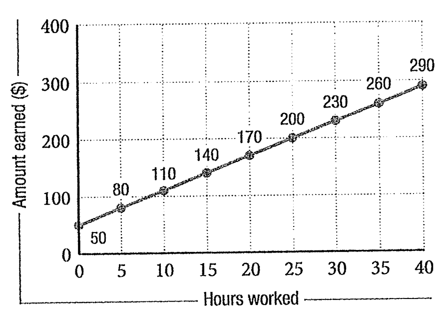
a. List three ordered pairs that lie on the line graph.

b. How much will she earn for working 40 hours?

c. If her check for one week is $240, how many hours did she work?

d. She works 35 hours one week, but her paycheck before deductions are subtracted out is for $260. Is this correct? Explain.

46. Hourly Wages Judy takes a job at Gigi's boutique. Her job pays $6.00 per hour plus $50 per week in commission. The graph shows how much Judy earns for working from 0 to 40 hours in a week.



a. List three ordered pairs that lie on the line graph.

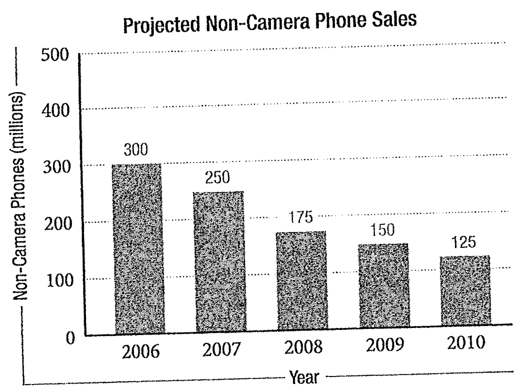
b. How much will she earn for working 40 hours?

c. If her check for one week is $230, how many hours did she work?

d. She works 35 hours one week, but her paycheck before deductions are subtracted out is for $260. Is this correct? Explain.

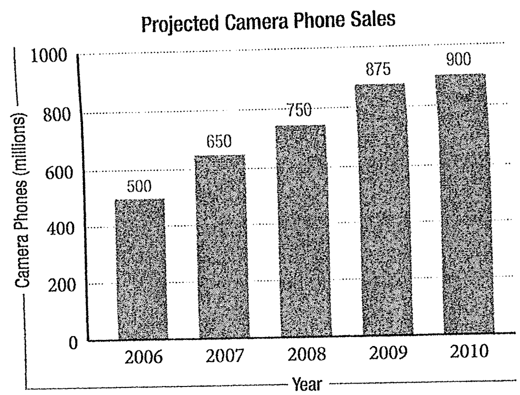
47. Non-Camera Phone Sales The table and bar chart shown here show what are the projected sales of non-camera phones for the years 2006–2010. Use the information from the table and chart to construct a line graph.

Year	Sales (in Millions)
2006	300
2007	250
2008	175
2009	150
2010	125

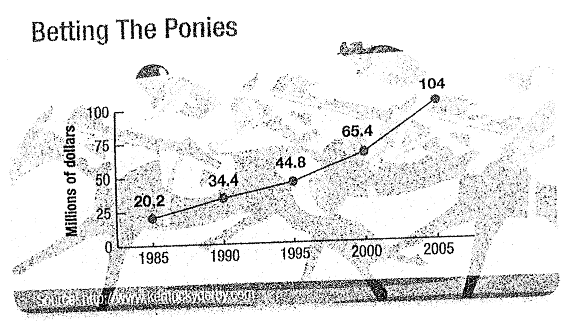


48. Camera Phone Sales The table and bar chart shown here show the projected sales of camera phones from 2006 to 2010. Use the information from the table and chart to construct a line graph.

Year	Sales (in Millions)
2006	500
2007	650
2008	750
2009	875
2010	900

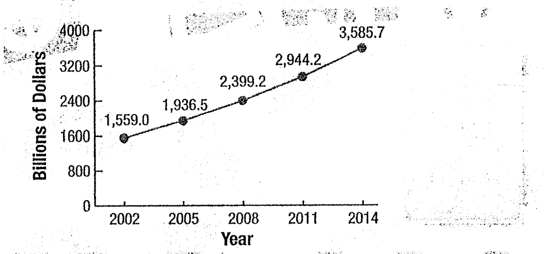


49. Kentucky Derby The line graph gives the monetary bets placed at the Kentucky Derby for specific years. If x represents the year in question and y represents the total wagering for that year, write five ordered pairs that describe the information in the table.



50. Health Care Costs Write 5 ordered pairs that lie on the curve shown below.

Health Care Costs on the Rise



Source: Centers for Medicare and Medicaid Services

51. Right triangle *ABC* (Figure 9) has legs of length 5. Point *C* is the ordered pair (6, 2). Find the coordinates of *A* and *B*.

52. Right triangle *ABC* (Figure 10) has legs of length 7. Point *C* is the ordered pair $(-8, -3)$. Find the coordinates of *A* and *B*.

53. Rectangle *ABCD* (Figure 11) has a length of 5 and a width of 3. Point *D* is the ordered pair (7, 2). Find points *A*, *B*, and *C*.

54. Rectangle *ABCD* (Figure 12) has a length of 5 and a width of 3. Point *D* is the ordered pair $(-1, 1)$. Find points *A*, *B*, and *C*.

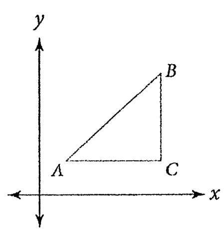


FIGURE 9

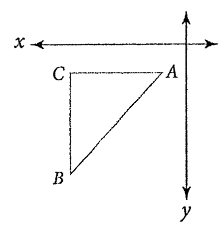


FIGURE 10

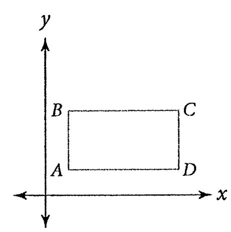


FIGURE 11

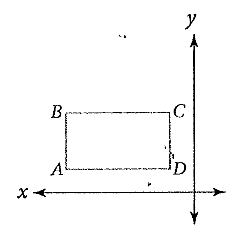


FIGURE 12

Getting Ready for the Next Section

55. Let $2x + 3y = 6$

a. Find x if $y = 4$ **b.** Find x if $y = -2$

c. Find y if $x = 3$ **d.** Find y if $x = 9$

56. Let $2x - 5y = 20$

a. Find x if $y = 0$ **b.** Find x if $y = -6$

c. Find y if $x = 0$ **d.** Find y if $x = 5$

57. Let $y = 2x - 1$

a. Find x if $y = 7$ **b.** Find x if $y = 3$

c. Find y if $x = 0$ **d.** Find y if $x = 5$

58. Let $y = 3x - 2$

a. Find x if $y = 4$ **b.** Find x if $y = 3$

c. Find y if $x = 2$ **d.** Find y if $x = -3$

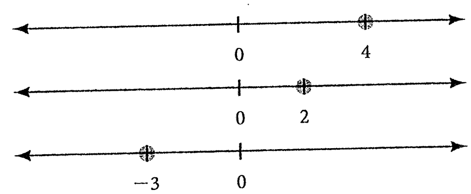
Solutions to Linear Equations in Two Variables

2.2

In this section we will begin to investigate equations in two variables. As you will see, equations in two variables have pairs of numbers for solutions. Because we know how to use paired data to construct tables, histograms, and other charts, we can take our work with paired data further by using equations in two variables to construct tables of paired data. Let's begin this section by reviewing the relationship between equations in one variable and their solutions.

If we solve the equation $3x - 2 = 10$, the solution is $x = 4$. If we graph this solution, we simply draw the real number line and place a dot at the point whose coordinate is 4. The relationship between linear equations in one variable, their solutions, and the graphs of those solutions look like this:

Equation	*Solution*	*Graph of Solution Set*
$3x - 2 = 10$	$x = 4$	
$x + 5 = 7$	$x = 2$	
$2x = -6$	$x = -3$	



Note: If this discussion seems a little long and confusing, you may want to look over some of the examples first and then come back and read this. Remember, it isn't always easy to read material in mathematics. What is important is that you understand what you are doing when you work problems. The reading is intended to assist you in understanding what you are doing. It is important to read everything in the book, but you don't always have to read it in the order it is written.

When the equation has one variable, the solution is a single number whose graph is a point on a line.

Now, consider the equation $2x + y = 3$. The first thing we notice is that there are two variables instead of one. Therefore, a solution to the equation $2x + y = 3$ will be not a single number but a pair of numbers, one for x and one for y, that makes the equation a true statement. One pair of numbers that works is $x = 2$, $y = -1$ because when we substitute them for x and y in the equation, we get a true statement.

$$2(2) + (-1) \stackrel{?}{=} 3$$
$$4 - 1 = 3$$
$$3 = 3 \qquad \text{A true statement}$$

The pair of numbers $x = 2, y = -1$ is written as $(2, -1)$. As you know from Section 3.1, $(2, -1)$ is called an *ordered pair* because it is a pair of numbers written in a specific order. The first number is always associated with the variable x, and the second number is always associated with the variable y. We call the first number in the ordered pair the *x-coordinate* (or x component) and the second number the *y-coordinate* (or y component) of the ordered pair.

Let's look back to the equation $2x + y = 3$. The ordered pair $(2, -1)$ is not the only solution. Another solution is $(0, 3)$ because when we substitute 0 for x and 3 for y we get

$$2(0) + 3 \stackrel{?}{=} 3$$
$$0 + 3 = 3$$
$$3 = 3 \qquad \text{A true statement}$$

Still another solution is the ordered pair $(5, -7)$ because

$$2(5) + (-7) \stackrel{?}{=} 3$$
$$10 - 7 = 3$$
$$3 = 3 \qquad \text{A true statement}$$

As a matter of fact, for any number we want to use for x, there is another number we can use for y that will make the equation a true statement. There is an infinite number of ordered pairs that satisfy (are solutions to) the equation $2x + y = 3$; we have listed just a few of them.

EXAMPLE 1 Given the equation $2x + 3y = 6$, complete the following ordered pairs so they will be solutions to the equation: (0,), (, 1), (3,).

SOLUTION To complete the ordered pair (0,), we substitute 0 for x in the equation and then solve for y:

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

The ordered pair is (0, 2).

To complete the ordered pair (, 1), we substitute 1 for y in the equation and solve for x:

$$2x + 3(1) = 6$$
$$2x + 3 = 6$$
$$2x = 3$$
$$x = \frac{3}{2}$$

The ordered pair is $\left(\frac{3}{2}, 1\right)$.

To complete the ordered pair (3,), we substitute 3 for x in the equation and solve for y:

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

The ordered pair is (3, 0).

Notice in each case that once we have used a number in place of one of the variables, the equation becomes a linear equation in one variable. We then use the method explained in Chapter 2 to solve for that variable.

EXAMPLE 2 Complete the following table for the equation $2x - 5y = 20$.

x	y
0	
	2
	0
−5	

SOLUTION Filling in the table is equivalent to completing the following ordered pairs: (0,), (, 2), (, 0), (−5,). So we proceed as in Example 1.

When $x = 0$, we have

$$\begin{aligned} 2(0) - 5y &= 20 \\ 0 - 5y &= 20 \\ -5y &= 20 \\ y &= -4 \end{aligned}$$

When $y = 2$, we have

$$\begin{aligned} 2x - 5(2) &= 20 \\ 2x - 10 &= 20 \\ 2x &= 30 \\ x &= 15 \end{aligned}$$

When $y = 0$, we have

$$\begin{aligned} 2x - 5(0) &= 20 \\ 2x - 0 &= 20 \\ 2x &= 20 \\ x &= 10 \end{aligned}$$

When $x = -5$, we have

$$\begin{aligned} 2(-5) - 5y &= 20 \\ -10 - 5y &= 20 \\ -5y &= 30 \\ y &= -6 \end{aligned}$$

The completed table looks like this:

x	y
0	−4
15	2
10	0
−5	−6

which is equivalent to the ordered pairs (0, −4), (15, 2), (10, 0), and (−5, −6).

EXAMPLE 3 Complete the following table for the equation $y = 2x - 1$.

x	y
0	
5	
	7
	3

SOLUTION When $x = 0$, we have

$$\begin{aligned} y &= 2(0) - 1 \\ y &= 0 - 1 \\ y &= -1 \end{aligned}$$

When $x = 5$, we have

$$\begin{aligned} y &= 2(5) - 1 \\ y &= 10 - 1 \\ y &= 9 \end{aligned}$$

When $y = 7$, we have

$$\begin{aligned} 7 &= 2x - 1 \\ 8 &= 2x \\ 4 &= x \end{aligned}$$

When $y = 3$, we have

$$\begin{aligned} 3 &= 2x - 1 \\ 4 &= 2x \\ 2 &= x \end{aligned}$$

The completed table is

x	y
0	−1
5	9
4	7
2	3

which means the ordered pairs $(0, -1)$, $(5, 9)$, $(4, 7)$, and $(2, 3)$ are among the solutions to the equation $y = 2x - 1$.

EXAMPLE 4 Which of the ordered pairs $(2, 3)$, $(1, 5)$, and $(-2, -4)$ are solutions to the equation $y = 3x + 2$?

SOLUTION If an ordered pair is a solution to the equation, then it must satisfy the equation; that is, when the coordinates are used in place of the variables in the equation, the equation becomes a true statement.

Try $(2, 3)$ in $y = 3x + 2$:

$$3 \stackrel{?}{=} 3(2) + 2$$
$$3 = 6 + 2$$
$$3 = 8 \qquad \text{A false statement}$$

Try $(1, 5)$ in $y = 3x + 2$:

$$5 \stackrel{?}{=} 3(1) + 2$$
$$5 = 3 + 2$$
$$5 = 5 \qquad \text{A true statement}$$

Try $(-2, -4)$ in $y = 3x + 2$:

$$-4 \stackrel{?}{=} 3(-2) + 2$$
$$-4 = -6 + 2$$
$$-4 = -4 \qquad \text{A true statement}$$

The ordered pairs $(1, 5)$ and $(-2, -4)$ are solutions to the equation $y = 3x + 2$, and $(2, 3)$ is not.

GETTING READY FOR CLASS

After reading through the preceding section, respond in your own words and in complete sentences.

A. How can you tell if an ordered pair is a solution to an equation?
B. How would you find a solution to $y = 3x - 5$?
C. Why is $(3, 2)$ not a solution to $y = 3x - 5$?
D. How many solutions are there to an equation that contains two variables?

Problem Set 2.2

For each equation, complete the given ordered pairs.

1. $2x + y = 6$ $(0,\ ), (\ , 0), (\ , -6)$
2. $3x - y = 5$ $(0,\ ), (1,\ ), (\ , 5)$
3. $3x + 4y = 12$ $(0,\ ), (\ , 0), (-4,\ )$
4. $5x - 5y = 20$ $(0,\ ), (\ , -2), (1,\ )$
5. $y = 4x - 3$ $(1,\ ), (\ , 0), (5,\ )$
6. $y = 3x - 5$ $(\ , 13), (0,\ ), (-2,\ )$
7. $y = 7x - 1$ $(2,\ ), (\ , 6), (0,\ )$
8. $y = 8x + 2$ $(3,\ ), (\ , 0), (\ , -6)$
9. $x = -5$ $(\ , 4), (\ , -3), (\ , 0)$
10. $y = 2$ $(5,\ ), (-8,\ ), \left(\frac{1}{2},\ \right)$

For each of the following equations, complete the given table.

11. $y = 3x$

x	y
1	3
−3	
	12
	18

12. $y = -2x$

x	y
−4	
0	
	10
	12

13. $y = 4x$

x	y
0	
	−2
−3	
	12

14. $y = -5x$

x	y
3	
	0
−2	
	−20

15. $x + y = 5$

x	y
2	
3	
	0
	−4

16. $x - y = 8$

x	y
0	
4	
	−3
	−2

17. $2x - y = 4$

x	y
	0
	2
1	
−3	

18. $3x - y = 9$

x	y
	0
	−9
5	
−4	

19. $y = 6x - 1$

x	y
0	
	−7
−3	
	8

20. $y = 5x + 7$

x	y
0	
−2	
−4	
	−8

For the following equations, tell which of the given ordered pairs are solutions.

21. $2x - 5y = 10$ $(2, 3), (0, -2), \left(\frac{5}{2}, 1\right)$
22. $3x + 7y = 21$ $(0, 3), (7, 0), (1, 2)$
23. $y = 7x - 2$ $(1, 5), (0, -2), (-2, -16)$
24. $y = 8x - 3$ $(0, 3), (5, 16), (1, 5)$
25. $y = 6x$ $(1, 6), (-2, 12), (0, 0)$
26. $y = -4x$ $(0, 0), (2, 4), (-3, 12)$
27. $x + y = 0$ $(1, 1), (2, -2), (3, 3)$
28. $x - y = 1$ $(0, 1), (0, -1), (1, 2)$
29. $x = 3$ $(3, 0), (3, -3), (5, 3)$
30. $y = -4$ $(3, -4), (-4, 4), (0, -4)$

Applying the Concepts

31. **Perimeter** If the perimeter of a rectangle is 30 inches, then the relationship between the length l and the width w is given by the equation

$$2l + 2w = 30$$

What is the length when the width is 3 inches?

32. **Perimeter** The relationship between the perimeter P of a square and the length of its side s is given by the formula $P = 4s$. If each side of a square is 5 inches, what is the perimeter? If the perimeter of a square is 28 inches, how long is a side?

33. Janai earns \$12 per hour working as a math tutor. We can express the amount she earns each week, y, for working x hours with the equation $y = 12x$. Indicate with a yes or no, which of the following could be one of Janai's paychecks. If you answer no, explain your answer.
   - **a.** \$60 for working five hours.
   - **b.** \$100 for working nine hours
   - **c.** \$80 for working seven hours.
   - **d.** \$168 for working 14 hours

34. Erin earns \$15 per hour working as a graphic designer. We can express the amount she earns each week, y, for working x hours with the equation $y = 15x$. Indicate with a yes or no which of the following could be one of Erin's paychecks. If you answer no, explain your answer.
   - **a.** \$75 for working five hours.
   - **b.** \$125 for working nine hours
   - **c.** \$90 for working six hours.
   - **d.** \$500 for working 35 hours

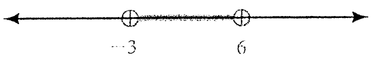
35. The equation $V = -45{,}000t + 600{,}000$, can be used to find the value, V, of a small crane at the end of t years.
   - **a.** What is the value of the crane at the end of five years?
   - **b.** When is the crane worth \$330,000?
   - **c.** Is it true that the crane with be worth \$150,000 after nine years?
   - **d.** How much did the crane cost?

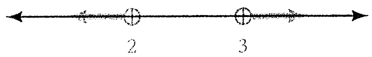
36. The equation $P = -400t + 2{,}500$, can be used to find the price, P, of a notebook computer at the end of t years.
   - **a.** What is the value of the notebook computer at the end of four years?
   - **b.** When is the notebook computer worth \$1,700?
   - **c.** Is it true that the notebook computer with be worth \$100 after five years?
   - **d.** How much did the notebook computer cost?

Getting Ready for the Next Section

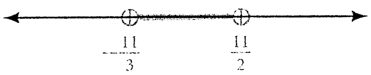
37. Find y when x is 4 in the formula $3x + 2y = 6$.
38. Find y when x is 0 in the formula $3x + 2y = 6$.
39. Find y when x is 0 in $y = -\frac{1}{3}x + 2$.
40. Find y when x is 3 in $y = -\frac{1}{3}x + 2$.
41. Find y when x is 2 in $y = \frac{3}{2}x - 3$.
42. Find y when x is 4 in $y = \frac{3}{2}x - 3$.
43. Solve $5x + y = 4$ for y.
44. Solve $-3x + y = 5$ for y.
45. Solve $3x - 2y = 6$ for y.
46. Solve $2x - 3y = 6$ for y.

Answers to Odd-Numbered Problems

19. 

21. 

23. 

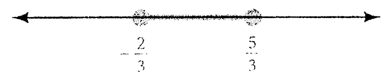
25. 

27. 

29. 

31. 

33. 

35. 

37. 

39. 

41. $-2 < x < 3$ **43.** $x \le -2$ or $x \ge 3$ **45.** **a.** $2x + x > 10$; $x + 10 > 2x$; $2x + 10 > x$ **b.** $\frac{10}{3} < x < 10$

47. 

49. $4 < x < 5$ **51.** **a.** $20 < P < 30$ **b.** $3 < w < \frac{11}{2}$ **c.** $7 < l \le \frac{19}{2}$

53. 8 **55.** 24 **57.** 25% **59.** 10% **61.** 80 **63.** 400 **65.** −5 **67.** 5 **69.** 7 **71.** 9 **73.** 6 **75.** $2x - 3$ **77.** $-3, 0, 2$

CHAPTER 1 TEST

1. $-y + 1$ **2.** $4x - 1$ **3.** $4 - 2y$ **4.** $x - 22$ **5.** −3 **6.** −4 **7.** **a.**

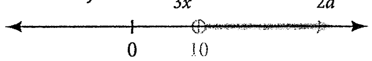
n	$(n+2)^2$
1	9
2	16
3	25
4	36

b.

n	$n^2 + 2$
1	3
2	6
3	11
4	18

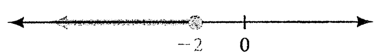
8. $x = 3$ **9.** $y = -5$ **10.** $x = -3$ **11.** $x = 4$ **12.** $x = 1$ **13.** 55 **14.** $t = -3$ **15.** $x = \frac{10}{4}$ **16.** $x = (.40)(56)$

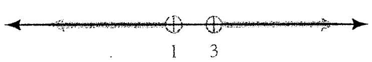
17. $720 = 0.24x$ **18.** −1 **19.** 8 **20.** $y = 2 - \frac{1}{3x}$ **21.** $a = \frac{x^2 - v^2}{2d}$ **22.** 18, 36 **23.** 20 cm, 55 cm **24.** 6 nickles, 14 dimes

25. \$700, \$1,200 **26.** $x > 10$ 

27. $y \ge -4$ 

28. $x > -4$ 

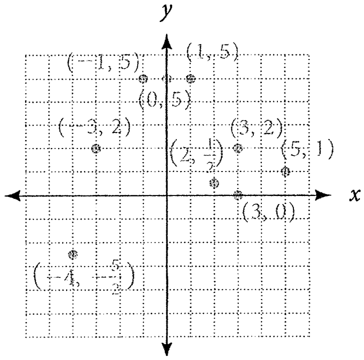
29. $n \le -2$ 

30. $1 > x$ or $x > 3$ 

31. $2 \le x \le 8$ 

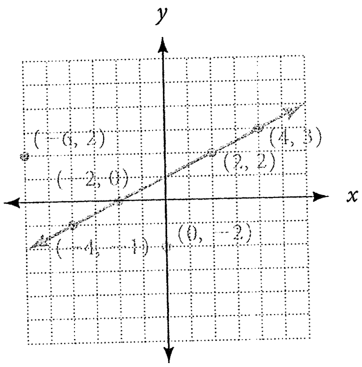
Chapter 2

PROBLEM SET 2.1

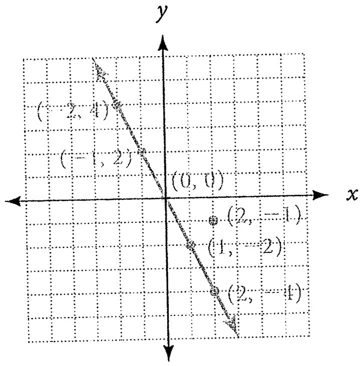
1–17. 

19. $(-4, 4)$ **21.** $(-4, 2)$ **23.** $(-3, 0)$ **25.** $(2, -2)$ **27.** $(-5, -5)$

29. Yes

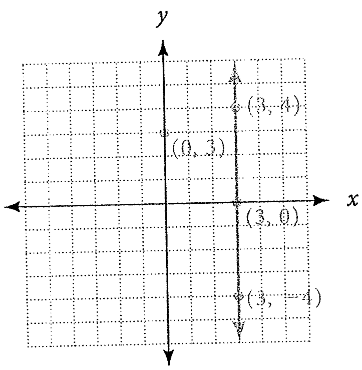


31. No **33.** Yes

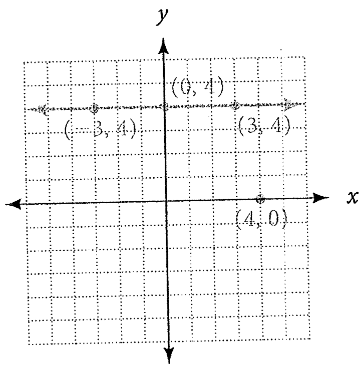


35. No

37. Yes



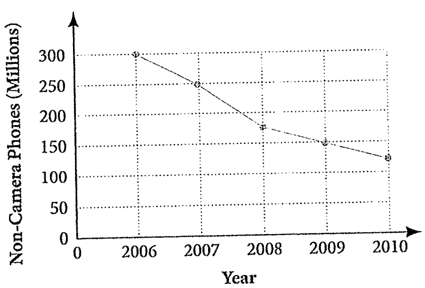
39. No **41.** No



43. No

45. **a.** (5, 40), (10, 80), (20, 160), Answers may vary **b.** \$320 **c.** 30 hours **d.** No, if she works 35 hours, she should be paid \$280.

47.



49. (1985, 20.2), (1990, 34.4), (1995, 44.8), (2000, 65.4), (2005, 104)

51. $A = (1, 2), B = (6, 7)$ **53.** $A = (2, 2), B = (2, 5), C = (7, 5)$

55. **a.** −3 **b.** 6 **c.** 0 **d.** −4 **57.** **a.** 4 **b.** 2 **c.** −1 **d.** 9

PROBLEM SET 2.2

1. (0, 6), (3,0), (6, −6) **3.** (0, 3), (4, 0), (−4, 6) **5.** (1, 1), $\left(\frac{3}{4}, 0\right)$, (5, 17) **7.** (2, 13), (1, 6), (0, −1) **9.** (−5, 4), (−5, −3), (−5, 0)

11.

x	y
1	3
−3	−9
4	12
6	18

13.

x	y
0	0
$-\frac{1}{2}$	−2
−3	−12
3	12

15.

x	y
2	3
3	2
5	0
9	−4

17.

x	y
2	0
3	2
1	−2
−3	−10

19.

x	y
0	−1
−1	−7
−3	−19
$\frac{3}{2}$	8

21. (0, −2)

23. (1, 5), (0, −2), and (−2, −16) **25.** (1, 6), and (0, 0) **27.** (2, −2) **29.** (3, 0) and (3, −3) **31.** 12 inches

33. **a.** Yes **b.** No, she should earn \$108 for working 9 hours. **c.** No, she should earn \$84 for working 7 hours. **d.** Yes

35. **a.** \$375,000 **b.** At the end of 6 years. **c.** No, the crane will be worth \$195,000 after 9 years. **d.** \$600,000

37. −3 **39.** 2 **41.** 0 **43.** $y = -5x + 4$ **45.** $y = \frac{3}{2}x - 3$