1.6 Applications

As you begin reading through the examples in this section, you may find yourself asking why some of these problems seem so contrived. The title of the section is "Applications," but many of the problems here don't seem to have much to do with "real life." You are right about that. Example 3 is what we refer to as an "age problem." But imagine a conversation in which you ask someone how old her children are and she replies, "Bill is 6 years older than Tom. Three years ago the sum of their ages was 21. You figure it out." Although many of the "application" problems in this section are contrived, they are also good for practicing the strategy we will use to solve all application problems.

To begin this section, we list the steps used in solving application problems. We call this strategy the *Blueprint for Problem Solving*. It is an outline that will overlay the solution process we use on all application problems.

BLUEPRINT FOR PROBLEM SOLVING

Step 1: ***Read*** the problem, and then mentally ***list*** the items that are known and the items that are unknown.

Step 2: ***Assign a variable*** to one of the unknown items. (In most cases this will amount to letting $x =$ the item that is asked for in the problem.) Then ***translate*** the other ***information*** in the problem to expressions involving the variable.

Step 3: ***Reread*** the problem, and then ***write an equation***, using the items and variables listed in steps 1 and 2, that describes the situation.

Step 4: ***Solve the equation*** found in step 3.

Step 5: ***Write*** your ***answer*** using a complete sentence.

Step 6: ***Reread*** the problem, and ***check*** your solution with the original words in the problem.

There are a number of substeps within each of the steps in our blueprint. For instance, with steps 1 and 2 it is always a good idea to draw a diagram or picture if it helps visualize the relationship between the items in the problem. In other cases a table helps organize the information. As you gain more experience using the blueprint to solve application problems, you will find additional techniques that expand the blueprint.

To help with problems of the type shown next in Example 1, here are some common English words and phrases and their mathematical translations.

English	Algebra
The sum of a and b	$a + b$
The difference of a and b	$a - b$
The product of a and b	$a \cdot b$
The quotient of a and b	$\frac{a}{b}$
of	$\cdot$ (multiply)
is	$=$ (equals)
A number	x
4 more than x	$x + 4$
4 times x	$4x$
4 less than x	$x - 4$

EXAMPLE 2 One number is three more than twice another; their sum is eighteen. Find the numbers.

SOLUTION

Step 1: **Read and list.**

Known items: Two numbers that add to 18. One is 3 more than twice the other.

Unknown items: The numbers in question.

Step 2: **Assign a variable, and translate information.**

Let x = the first number. The other is $2x + 3$.

Step 3: **Reread, and write an equation.**

Their sum is 18

↓ ↓

$x + (2x + 3) = 18$

Step 4: **Solve the equation.**

$$
\begin{aligned}
x + (2x + 3) &= 18 \\
3x + 3 &= 18 \\
3x + 3 + (-3) &= 18 + (-3) \\
3x &= 15 \\
x &= 5
\end{aligned}
$$

Step 5: **Write the answer.**

The first number is 5. The other is $2 \cdot 5 + 3 = 13$.

Step 6: **Reread, and check.**

The sum of 5 and 13 is 18, and 13 is 3 more than twice 5.

Age Problem

Remember as you read through the steps in the solutions to the examples in this section that step 1 is done mentally. Read the problem, and then mentally list the items that you know and the items that you don't know. The purpose of step 1 is to give you direction as you begin to work application problems. Finding the solution to an application problem is a process; it doesn't happen all at once. The first step is to read the problem with a purpose in mind. That purpose is to mentally note the items that are known and the items that are unknown.

EXAMPLE 3 Bill is 6 years older than Tom. Three years ago Bill's age was four times Tom's age. Find the age of each boy now.

SOLUTION Applying the Blueprint for Problem Solving, we have

Step 1: **Read and list.**

Known items: Bill is 6 years older than Tom. Three years ago Bill's age was four times Tom's age.

Unknown items: Bill's age and Tom's age

Step 2: **Assign a variable, and translate information.**

Let x = Tom's age now. That makes Bill $x + 6$ years old now. A table like the one shown here can help organize the information in an age problem. Notice how we placed the x in the box that corresponds to Tom's age now.

	Three Years Ago	Now
Bill		$x + 6$
Tom		x

If Tom is x years old now, 3 years ago he was $x - 3$ years old. If Bill is $x + 6$ years old now, 3 years ago he was $x + 6 - 3 = x + 3$ years old. We use this information to fill in the remaining squares in the table.

	Three Years Ago	Now
Bill	$x + 3$	$x + 6$
Tom	$x - 3$	x

Step 3: **Reread, and write an equation.**
Reading the problem again, we see that 3 years ago Bill's age was four times Tom's age. Writing this as an equation, we have Bill's age 3 years ago = 4 · (Tom's age 3 years ago):

$$x + 3 = 4(x - 3)$$

Step 4: **Solve the equation.**

$$x + 3 = 4(x - 3)$$
$$x + 3 = 4x - 12$$
$$x + (-x) + 3 = 4x + (-x) - 12$$
$$3 = 3x - 12$$
$$3 + 12 = 3x - 12 + 12$$
$$15 = 3x$$
$$x = 5$$

Step 5: **Write the answer.**
Tom is 5 years old. Bill is 11 years old.

Step 6: **Reread, and check.**
If Tom is 5 and Bill is 11, then Bill is 6 years older than Tom. Three years ago Tom was 2 and Bill was 8. At that time, Bill's age was four times Tom's age. As you can see, the answers check with the original problem. ■

Geometry Problem

To understand Example 4 completely, you need to recall from Chapter 1 that the perimeter of a rectangle is the sum of the lengths of the sides. The formula for the perimeter is $P = 2l + 2w$.

EXAMPLE 4 The length of a rectangle is 5 inches more than twice the width. The perimeter is 34 inches. Find the length and width.

SOLUTION When working problems that involve geometric figures, a sketch of the figure helps organize and visualize the problem.

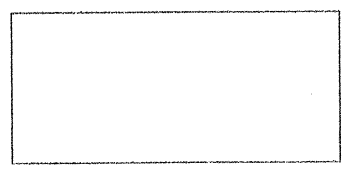
Step 1: **Read and list.**

Known items: The figure is a rectangle. The length is 5 inches more than twice the width. The perimeter is 34 inches.

Unknown items: The length and the width

Step 2: **Assign a variable, and translate information.**

Because the length is given in terms of the width (the length is 5 more than twice the width), we let $x =$ the width of the rectangle. The length is 5 more than twice the width, so it must be $2x + 5$. The diagram below is a visual description of the relationships we have listed so far.



Step 3: **Reread, and write an equation.**

The equation that describes the situation is

Twice the length	+	twice the width	is	the perimeter
$2(2x + 5)$	$+$	$2x$	$=$	34

Step 4: **Solve the equation.**

$$2(2x + 5) + 2x = 34 \quad \text{Original equation}$$
$$4x + 10 + 2x = 34 \quad \text{Distributive property}$$
$$6x + 10 = 34 \quad \text{Add } 4x \text{ and } 2x$$
$$6x = 24 \quad \text{Add } -10 \text{ to each side}$$
$$x = 4 \quad \text{Divide each side by 6}$$

Step 5: **Write the answer.**

The width x is 4 inches. The length is $2x + 5 = 2(4) + 5 = 13$ inches.

Step 6: **Reread, and check.**

If the length is 13 and the width is 4, then the perimeter must be $2(13) + 2(4) = 26 + 8 = 34$, which checks with the original problem.

Coin Problem

EXAMPLE 5 Jennifer has \$2.45 in dimes and nickels. If she has 8 more dimes than nickels, how many of each coin does she have?

SOLUTION

Step 1: **Read and list.**

Known items: The type of coins, the total value of the coins, and that there are 8 more dimes than nickels.

Unknown items: The number of nickels and the number of dimes

Step 2: **Assign a variable, and translate information.**

If we let $x =$ the number of nickels, then $x + 8 =$ the number of dimes. Because the value of each nickel is 5 cents, the amount of money in nickels is $5x$. Similarly, because each dime is worth 10 cents, the amount of money in dimes is $10(x + 8)$. Here is a table that summarizes the information we have so far:

	Nickels	Dimes
Number	x	$x + 8$
Value (in cents)	$5x$	$10(x + 8)$

Step 3: **Reread, and write an equation.**

Because the total value of all the coins is 245 cents, the equation that describes this situation is

Amount of money in nickels	+	Amount of money in dimes	=	Total amount of money
$5x$	+	$10(x + 8)$	=	245

Step 4: **Solve the equation.**

To solve the equation, we apply the distributive property first.

$$5x + 10x + 80 = 245 \quad \text{Distributive property}$$
$$15x + 80 = 245 \quad \text{Add } 5x \text{ and } 10x$$
$$15x = 165 \quad \text{Add } -80 \text{ to each side}$$
$$x = 11 \quad \text{Divide each side by 15}$$

Step 5: **Write the answer.**

The number of nickels is $x = 11$.

The number of dimes is $x + 8 = 11 + 8 = 19$.

Step 6: **Reread, and check.**

To check our results

11 nickels are worth $5(11) =$ 55 cents

19 dimes are worth $10(19) =$ 190 cents

The total value is 245 cents = \$2.45

When you begin working the problems in the problem set that follows, there are a few things to remember. The first is that you may have to read the problems a number of times before you begin to see how to solve them. The second thing to remember is that word problems are not always solved correctly the first time you try them. Sometimes it takes a few attempts and some wrong answers before you can set up and solve these problems correctly.

GETTING READY FOR CLASS

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

A. What is the first step in the Blueprint for Problem Solving?
B. What is the last thing you do when solving an application problem?
C. What good does it do you to solve application problems even when they don't have much to do with real life?
D. Write an application problem whose solution depends on solving the equation $2x + 3 = 7$.

SPOTLIGHT ON SUCCESS *Student Instructor Cynthia*

Each time we face our fear, we gain strength, courage, and confidence in the doing.
—Unknown

I must admit, when it comes to math, it takes me longer to learn the material compared to other students. Because of that, I was afraid to ask questions, especially when it seemed like everyone else understood what was going on. Because I wasn't getting my questions answered, my quiz and exam scores were only getting worse. I realized that I was already paying a lot to go to college and that I couldn't afford to keep doing poorly on my exams. I learned how to overcome my fear of asking questions by studying the material before class, and working on extra problem sets until I was confident enough that at least I understood the main concepts. By preparing myself beforehand, I would often end up answering the question myself. Even when that wasn't the case, the professor knew that I tried to answer the question on my own. If you want to be successful, but you are afraid to ask a question, try putting in a little extra time working on problems before you ask your instructor for help. I think you will find, like I did, that it's not as bad as you imagined it, and you will have overcome an obstacle that was in the way of your success.

Problem Set 1.6

Solve the following word problems. Follow the steps given in the Blueprint for Problem Solving.

Number Problems

1. The sum of a number and five is thirteen. Find the number.
2. The difference of ten and a number is negative eight. Find the number.
3. The sum of twice a number and four is fourteen. Find the number.
4. The difference of four times a number and eight is sixteen. Find the number.
5. Five times the sum of a number and seven is thirty. Find the number.
6. Five times the difference of twice a number and six is negative twenty. Find the number.
7. One number is two more than another. Their sum is eight. Find both numbers.
8. One number is three less than another. Their sum is fifteen. Find the numbers.
9. One number is four less than three times another. If their sum is increased by five, the result is twenty-five. Find the numbers.
10. One number is five more than twice another. If their sum is decreased by ten, the result is twenty-two. Find the numbers.

Age Problems

11. Shelly is 3 years older than Michele. Four years ago the sum of their ages was 67. Find the age of each person now.

	Four Years Ago	Now
Shelly	$x - 1$	$x + 3$
Michele	$x - 4$	x

12. Cary is 9 years older than Dan. In 7 years the sum of their ages will be 93. Find the age of each man now. (Begin by filling in the table.)

	Now	In Seven Years
Cary	$x + 9$	
Dan	x	$x + 7$

13. Cody is twice as old as Evan. Three years ago the sum of their ages was 27. Find the age of each boy now.

	Three Years Ago	Now
Cody		
Evan	$x - 3$	x

14. Justin is 2 years older than Ethan. In 9 years the sum of their ages will be 30. Find the age of each boy now.

	Now	In Nine Years
Justin		
Ethan	x	

15. Fred is 4 years older than Barney. Five years ago the sum of their ages was 48. How old are they now?

	Five Years Ago	Now
Fred		
Barney		x

16. Tim is 5 years older than JoAnn. Six years from now the sum of their ages will be 79. How old are they now?

	Now	Six Years From Now
Tim		
JoAnn	x	

17. Jack is twice as old as Lacy. In 3 years the sum of their ages will be 54. How old are they now?

18. John is 4 times as old as Martha. Five years ago the sum of their ages was 50. How old are they now?

19. Pat is 20 years older than his son Patrick. In 2 years Pat will be twice as old as Patrick. How old are they now?

20. Diane is 23 years older than her daughter Amy. In 6 years Diane will be twice as old as Amy. How old are they now?

Geometry Problems

21. The perimeter of a square is 36 inches. Find the length of one side.

22. The perimeter of a square is 44 centimeters. Find the length of one side.

23. The perimeter of a square is 60 feet. Find the length of one side.

24. The perimeter of a square is 84 meters. Find the length of one side.

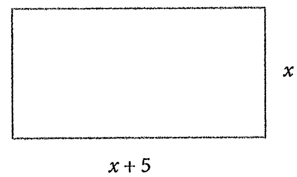
25. One side of a triangle is three times the shortest side. The third side is 7 feet more than the shortest side. The perimeter is 62 feet. Find all three sides.

26. One side of a triangle is half the longest side. The third side is 10 meters less than the longest side. The perimeter is 45 meters. Find all three sides.

27. One side of a triangle is half the longest side. The third side is 12 feet less than the longest side. The perimeter is 53 feet. Find all three sides.

28. One side of a triangle is 6 meters more than twice the shortest side. The third side is 9 meters more than the shortest side. The perimeter is 75 meters. Find all three sides.

29. The length of a rectangle is 5 inches more than the width. The perimeter is 34 inches. Find the length and width.



30. The width of a rectangle is 3 feet less than the length. The perimeter is 10 feet. Find the length and width.

31. The length of a rectangle is 7 inches more than twice the width. The perimeter is 68 inches. Find the length and width.

32. The length of a rectangle is 4 inches more than three times the width. The perimeter is 72 inches. Find the length and width.

33. The length of a rectangle is 6 feet more than three times the width. The perimeter is 36 feet. Find the length and width.

34. The length of a rectangle is 3 feet less than twice the width. The perimeter is 54 feet. Find the length and width.

Coin Problems

35. Marissa has $4.40 in quarters and dimes. If she has 5 more quarters than dimes, how many of each coin does she have?

	Dimes	Quarters
Number	x	$x + 5$
Value (in cents)	$10(x)$	$25(x + 5)$

36. Kendra has $2.75 in dimes and nickels. If she has twice as many dimes as nickels, how many of each coin does she have?

	Nickels	Dimes
Number	x	$2x$
Value (in cents)	$5(x)$	

37. Tanner has $4.35 in nickels and quarters. If he has 15 more nickels than quarters, how many of each coin does he have?

	Nickels	Quarters
Number	$x + 15$	x
Value (in cents)		

38. Connor has $9.00 in dimes and quarters. If he has twice as many quarters as dimes, how many of each coin does he have?

	Dimes	Quarters
Number	x	$2x$
Value (in cents)		

39. Sue has $2.10 in dimes and nickels. If she has 9 more dimes than nickels, how many of each coin does she have? (Completing the table may help you get started.)

40. Mike has $1.55 in dimes and nickels. If he has 7 more nickels than dimes, how many of each coin does he have?

41. Katie has a collection of nickels, dimes, and quarters with a total value of $4.35. There are 3 more dimes than nickels and 5 more quarters than nickels. How many of each coin is in her collection? (*Hint:* Let $x =$ the number of nickels.)

	Nickels	Dimes	Quarters
Number	x		
Value			

42. Mary Jo has $3.90 worth of nickels, dimes, and quarters. The number of nickels is 3 more than the number of dimes. The number of quarters is 7 more than the number of dimes. How many of each coin does she have? (*Hint:* Let $x =$ the number of dimes.)

	Nickels	Dimes	Quarters
Number			
Value			

43. Cory has a collection of nickels, dimes, and quarters with a total value of $2.55. There are 6 more dimes than nickels and twice as many quarters as nickels. How many of each coin is in her collection?

	Nickels	Dimes	Quarters
Number	x		
Value			

44. Kelly has a collection of nickels, dimes, and quarters with a total value of \$7.40. There are four more nickels than dimes and twice as many quarters as nickels. How many of each coin is in her collection?

	Nickels	Dimes	Quarters
Number			
Value			

Getting Ready for the Next Section

To understand all of the explanations and examples in the next section you must be able to work the problems below.

Simplify the following expressions.

45. $x + 2x + 2x$ **46.** $x + 2x + 3x$ **47.** $x + 0.075x$ **48.** $x + 0.065x$

49. $0.09(x + 2{,}000)$ **50.** $0.06(x + 1{,}500)$

51. $0.02x + 0.06(x + 1{,}500) = 570$ **52.** $0.08x + 0.09(x + 2{,}000) = 690$

53. $x + 2x + 3x = 180$ **54.** $2x + 3x + 5x = 180$

More Applications

1.7

Now that you have worked through a number of application problems using our blueprint, you probably have noticed that step 3, in which we write an equation that describes the situation, is the key step. Anyone with experience solving application problems will tell you that there will be times when your first attempt at step 3 results in the wrong equation. Remember, mistakes are part of the process of learning to do things correctly. Many times the correct equation will become obvious after you have written an equation that is partially wrong. In any case it is better to write an equation that is partially wrong and be actively involved with the problem than to write nothing at all. Application problems, like other problems in algebra, are not always solved correctly the first time.

Consecutive Integers

Our first example involves consecutive integers. When we ask for consecutive integers, we mean integers that are next to each other on the number line, like 5 and 6, or 13 and 14, or -4 and -3. In the dictionary, consecutive is defined as following one another in uninterrupted order. If we ask for consecutive odd integers, then we mean odd integers that follow one another on the number line. For example, 3 and 5, 11 and 13, and -9 and -7 are consecutive odd integers. As you can see, to get from one odd integer to the next consecutive odd integer we add 2.

If we are asked to find two consecutive integers and we let x equal the first integer, the next one must be $x + 1$, because consecutive integers always differ by 1. Likewise, if we are asked to find two consecutive odd or even integers, and we let x equal the first integer, then the next one will be $x + 2$ because consecutive even or odd integers always differ by 2. Here is a table that summarizes this information.

In Words	Using Algebra	Example
Two consecutive integers	$x, x + 1$	The sum of two consecutive integers is 15. $x + (x + 1) = 15$ or $7 + 8 = 15$
Three consecutive integers	$x, x + 1, x + 2$	The sum of three consecutive integers is 24. $x + (x + 1) + (x + 2) = 24$ or $7 + 8 + 9 = 24$
Two consecutive odd integers	$x, x + 2$	The sum of two consecutive odd integers is 16. $x + (x + 2) = 16$ or $7 + 9 = 16$
Two consecutive even integers	$x, x + 2$	The sum of two consecutive even integers is 18. $x + (x + 2) = 18$ or $8 + 10 = 18$

EXAMPLE 1 The sum of two consecutive odd integers is 28. Find the two integers.

SOLUTION

Step 1: **Read and list.**

Known items: Two consecutive odd integers. Their sum is equal to 28.

Unknown items: The numbers in question.

Step 2: **Assign a variable, and translate information.**
If we let $x =$ the first of the two consecutive odd integers, then $x + 2$ is the next consecutive one.

Step 3: **Reread, and write an equation.**
Their sum is 28.

$$x + (x + 2) = 28$$

Step 4: **Solve the equation.**

$$2x + 2 = 28 \quad \text{Simplify the left side}$$
$$2x = 26 \quad \text{Add } -2 \text{ to each side}$$
$$x = 13 \quad \text{Multiply each side by } \frac{1}{2}$$

Step 5: **Write the answer.**
The first of the two integers is 13. The second of the two integers will be two more than the first, which is 15.

Step 6: **Reread, and check.**
Suppose the first integer is 13. The next consecutive odd integer is 15. The sum of 15 and 13 is 28.

Interest

EXAMPLE 2 Suppose you invest a certain amount of money in an account that earns 8% in annual interest. At the same time, you invest $2,000 more than that in an account that pays 9% in annual interest. If the total interest from both accounts at the end of the year is $690, how much is invested in each account?

SOLUTION

Step 1: **Read and list.**
Known items: The interest rates, the total interest earned, and how much more is invested at 9%
Unknown items: The amounts invested in each account

Step 2: **Assign a variable, and translate information.**
Let $x =$ the amount of money invested at 8%. From this, $x + 2{,}000 =$ the amount of money invested at 9%. The interest earned on x dollars invested at 8% is $0.08x$. The interest earned on $x + 2{,}000$ dollars invested at 9% is $0.09(x + 2{,}000)$.

Here is a table that summarizes this information:

	Dollars Invested at 8%	Dollars Invested at 9%
Number of	x	$x + 2{,}000$
Interest on	$0.08x$	$0.09(x + 2{,}000)$

Step 3: **Reread, and write an equation.**
Because the total amount of interest earned from both accounts is $690, the equation that describes the situation is

Interest earned at 8%	+	Interest earned at 9%	=	Total interest earned
$0.08x$	+	$0.09(x + 2{,}000)$	=	690

Step 4: **Solve the equation.**

$$0.08x + 0.09(x + 2{,}000) = 690$$

$$0.08x + 0.09x + 180 = 690 \quad \text{Distributive property}$$

$$0.17x + 180 = 690 \quad \text{Add } 0.08x \text{ and } 0.09x$$

$$0.17x = 510 \quad \text{Add } -180 \text{ to each side}$$

$$x = 3{,}000 \quad \text{Divide each side by } 0.17$$

Step 5: **Write the answer:**
The amount of money invested at 8% is \$3,000, whereas the amount of money invested at 9% is $x + 2{,}000 = 3{,}000 + 2{,}000 = \$5{,}000$.

Step 6: **Reread, and check.**

The interest at 8% is 8% of 3,000 = 0.08(3,000) = \$240
The interest at 9% is 9% of 5,000 = 0.09(5,000) = \$450
The total interest is \$690

FACTS FROM GEOMETRY ***Labeling Triangles and the Sum of the Angles in a Triangle***

One way to label the important parts of a triangle is to label the vertices with capital letters and the sides with small letters, as shown in Figure 1.

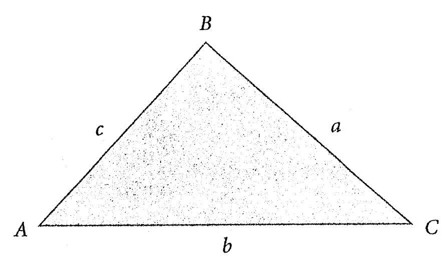


FIGURE 1

In Figure 1, notice that side a is opposite vertex A, side b is opposite vertex B, and side c is opposite vertex C. Also, because each vertex is the vertex of one of the angles of the triangle, we refer to the three interior angles as A, B, and C.

In any triangle, the sum of the interior angles is 180°. For the triangle shown in Figure 1, the relationship is written

$$A + B + C = 180°$$

EXAMPLE 3 The angles in a triangle are such that one angle is twice the smallest angle, whereas the third angle is three times as large as the smallest angle. Find the measure of all three angles.

SOLUTION

Step 1: **Read and list.**
Known items: The sum of all three angles is 180°, one angle is twice the smallest angle, the largest angle is three times the smallest angle.
Unknown items: The measure of each angle

Step 2: **Assign a variable, and translate information.**
Let x be the smallest angle, then $2x$ will be the measure of another angle and $3x$ will be the measure of the largest angle.

Step 3: **Reread, and write an equation.**
When working with geometric objects, drawing a generic diagram sometimes will help us visualize what it is that we are asked to find. In Figure 2, we draw a triangle with angles A, B, and C.

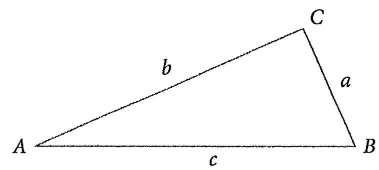


FIGURE 2

We can let the value of $A = x$, the value of $B = 2x$, and the value of $C = 3x$. We know that the sum of angles A, B, and C will be 180°, so our equation becomes

$$x + 2x + 3x = 180°$$

Step 4: **Solve the equation.**

$$x + 2x + 3x = 180°$$
$$6x = 180°$$
$$x = 30°$$

Step 5: **Write the answer.**
The smallest angle A measures 30°
Angle B measures $2x$, or $2(30°) = 60°$
Angle C measures $3x$, or $3(30°) = 90°$

Step 6: **Reread, and check.**
The angles must add to 180°:

$$A + B + C = 180°$$
$$30° + 60° + 90° \stackrel{?}{=} 180°$$
$$180° = 180° \quad \textit{Our answers check}$$

GETTING READY FOR CLASS

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

A. How do we label triangles?
B. What rule is always true about the three angles in a triangle?
C. Write an application problem whose solution depends on solving the equation $x + 0.075x = 500$.
D. Write an application problem whose solution depends on solving the equation $0.05x + 0.06(x + 200) = 67$.

Problem Set 1.7

Consecutive Integer Problems

1. The sum of two consecutive integers is 11. Find the numbers.
2. The sum of two consecutive integers is 15. Find the numbers.
3. The sum of two consecutive integers is −9. Find the numbers.
4. The sum of two consecutive integers is −21. Find the numbers.
5. The sum of two consecutive odd integers is 28. Find the numbers.
6. The sum of two consecutive odd integers is 44. Find the numbers.
7. The sum of two consecutive even integers is 106. Find the numbers.
8. The sum of two consecutive even integers is 66. Find the numbers.
9. The sum of two consecutive even integers is −30. Find the numbers.
10. The sum of two consecutive odd integers is −76. Find the numbers.
11. The sum of three consecutive odd integers is 57. Find the numbers.
12. The sum of three consecutive odd integers is −51. Find the numbers.
13. The sum of three consecutive even integers is 132. Find the numbers.
14. The sum of three consecutive even integers is −108. Find the numbers.

Interest Problems

15. Suppose you invest money in two accounts. One of the accounts pays 8% annual interest, whereas the other pays 9% annual interest. If you have $2,000 more invested at 9% than you have invested at 8%, how much do you have invested in each account if the total amount of interest you earn in a year is $860? (Begin by completing the following table.)

	Dollars Invested at 8%	Dollars Invested at 9%
Number of	x	
Interest on		

16. Suppose you invest a certain amount of money in an account that pays 11% interest annually, and $4,000 more than that in an account that pays 12% annually. How much money do you have in each account if the total interest for a year is $940?

	Dollars Invested at 11%	Dollars Invested at 12%
Number of	x	
Interest on		

17. Tyler has two savings accounts that his grandparents opened for him. The two accounts pay 10% and 12% in annual interest; there is $500 more in the account that pays 12% than there is in the other account. If the total interest for a year is $214, how much money does he have in each account?

Problem Set 1.7

Consecutive Integer Problems

1. The sum of two consecutive integers is 11. Find the numbers.
2. The sum of two consecutive integers is 15. Find the numbers.
3. The sum of two consecutive integers is -9. Find the numbers.
4. The sum of two consecutive integers is -21. Find the numbers.
5. The sum of two consecutive odd integers is 28. Find the numbers.
6. The sum of two consecutive odd integers is 44. Find the numbers.
7. The sum of two consecutive even integers is 106. Find the numbers.
8. The sum of two consecutive even integers is 66. Find the numbers.
9. The sum of two consecutive even integers is -30. Find the numbers.
10. The sum of two consecutive odd integers is -76. Find the numbers.
11. The sum of three consecutive odd integers is 57. Find the numbers.
12. The sum of three consecutive odd integers is -51. Find the numbers.
13. The sum of three consecutive even integers is 132. Find the numbers.
14. The sum of three consecutive even integers is -108. Find the numbers.

Interest Problems

15. Suppose you invest money in two accounts. One of the accounts pays 8% annual interest, whereas the other pays 9% annual interest. If you have $2,000 more invested at 9% than you have invested at 8%, how much do you have invested in each account if the total amount of interest you earn in a year is $860? (Begin by completing the following table.)

	Dollars Invested at 8%	Dollars Invested at 9%
Number of	x	
Interest on		

16. Suppose you invest a certain amount of money in an account that pays 11% interest annually, and $4,000 more than that in an account that pays 12% annually. How much money do you have in each account if the total interest for a year is $940?

	Dollars Invested at 11%	Dollars Invested at 12%
Number of	x	
Interest on		

17. Tyler has two savings accounts that his grandparents opened for him. The two accounts pay 10% and 12% in annual interest; there is $500 more in the account that pays 12% than there is in the other account. If the total interest for a year is $214, how much money does he have in each account?

18. Travis has a savings account that his parents opened for him. It pays 6% annual interest. His uncle also opened an account for him, but it pays 8% annual interest. If there is \$800 more in the account that pays 6%, and the total interest from both accounts is \$104, how much money is in each of the accounts?

19. A stockbroker has money in three accounts. The interest rates on the three accounts are 8%, 9%, and 10%. If she has twice as much money invested at 9% as she has invested at 8%, three times as much at 10% as she has at 8%, and the total interest for the year is \$280, how much is invested at each rate? (*Hint:* Let $x =$ the amount invested at 8%.)

20. An accountant has money in three accounts that pay 9%, 10%, and 11% in annual interest. He has twice as much invested at 9% as he does at 10% and three times as much invested at 11% as he does at 10%. If the total interest from the three accounts is \$610 for the year, how much is invested at each rate? (*Hint:* Let $x =$ the amount invested at 10%.)

Triangle Problems

21. Two angles in a triangle are equal and their sum is equal to the third angle in the triangle. What are the measures of each of the three interior angles?

22. One angle in a triangle measures twice the smallest angle, whereas the largest angle is six times the smallest angle. Find the measures of all three angles.

23. The smallest angle in a triangle is $\frac{1}{5}$ as large as the largest angle. The third angle is twice the smallest angle. Find the three angles.

24. One angle in a triangle is half the largest angle but three times the smallest. Find all three angles.

25. A right triangle has one 37° angle. Find the other two angles.

26. In a right triangle, one of the acute angles is twice as large as the other acute angle. Find the measure of the two acute angles.

27. One angle of a triangle measures 20° more than the smallest, while a third angle is twice the smallest. Find the measure of each angle.

28. One angle of a triangle measures 50° more than the smallest, while a third angle is three times the smallest. Find the measure of each angle.

Miscellaneous Problems

29. Ticket Prices Miguel is selling tickets to a barbecue. Adult tickets cost \$6.00 and children's tickets cost \$4.00. He sells six more children's tickets than adult tickets. The total amount of money he collects is \$184. How many adult tickets and how many children's tickets did he sell?

	Adult	Child
Number	x	$x + 6$
Income	$6(x)$	$4(x + 6)$

30. **Working Two Jobs** Maggie has a job working in an office for $10 an hour and another job driving a tractor for $12 an hour. One week she works in the office twice as long as she drives the tractor. Her total income for that week is $416. How many hours did she spend at each job?

Job	Office	Tractor
Hours Worked	$2x$	x
Wages Earned	$10(2x)$	$12x$

31. **Phone Bill** The cost of a long-distance phone call is $0.41 for the first minute and $0.32 for each additional minute. If the total charge for a long-distance call is $5.21, how many minutes was the call?

32. **Phone Bill** Danny, who is 1 year old, is playing with the telephone when he accidentally presses one of the buttons his mother has programmed to dial her friend Sue's number. Sue answers the phone and realizes Danny is on the other end. She talks to Danny, trying to get him to hang up. The cost for a call is $0.23 for the first minute and $0.14 for every minute after that. If the total charge for the call is $3.73, how long did it take Sue to convince Danny to hang up the phone?

33. **Hourly Wages** JoAnn works in the publicity office at the state university. She is paid $12 an hour for the first 35 hours she works each week and $18 an hour for every hour after that. If she makes $492 one week, how many hours did she work?

34. **Hourly Wages** Diane has a part-time job that pays her $6.50 an hour. During one week she works 26 hours and is paid $178.10. She realizes when she sees her check that she has been given a raise. How much per hour is that raise?

35. **Office Numbers** Professors Wong and Gil have offices in the mathematics building at Miami Dade College. Their office numbers are consecutive odd integers with a sum of 14,660. What are the office numbers of these two professors?

36. **Cell Phone Numbers** Diana and Tom buy two cell phones. The phone numbers assigned to each are consecutive integers with a sum of 11,109,295. If the smaller number is Diana's, what are their phone numbers?

37. **Age** Marissa and Kendra are 2 years apart in age. Their ages are two consecutive even integers. Kendra is the younger of the two. If Marissa's age is added to twice Kendra's age, the result is 26. How old is each girl?

38. **Age** Justin's and Ethan's ages form two consecutive odd integers. What is the difference of their ages?

39. **Arrival Time** Jeff and Carla Cole are driving separately from San Luis Obispo, California, to the north shore of Lake Tahoe, a distance of 425 miles. Jeff leaves San Luis Obispo at 11:00 AM and averages 55 miles per hour on the drive, Carla leaves later, at 1:00 PM but averages 65 miles per hour. Which person arrives in Lake Tahoe first?

40. **Piano Lessons** Tyler is taking piano lessons. Because he doesn't practice as often as his parents would like him to, he has to pay for part of the lessons himself. His parents pay him $0.50 to do the laundry and $1.25 to mow the lawn. In one month, he does the laundry 6 more times than he mows the lawn. If his parents pay him $13.50 that month, how many times did he mow the lawn?

At one time, the Texas Junior College Teachers Association annual conference was held in Austin. At that time a taxi ride in Austin was \$1.25 for the first $\frac{1}{5}$ of a mile and \$0.25 for each additional $\frac{1}{5}$ of a mile. Use this information for Problems 41 and 42.

41. Cost of a Taxi Ride If the distance from one of the convention hotels to the airport is 7.5 miles, how much will it cost to take a taxi from that hotel to the airport?

42. Cost of a Taxi Ride Suppose the distance from one of the hotels to one of the western dance clubs in Austin is 12.4 miles. If the fare meter in the taxi gives the charge for that trip as \$16.50, is the meter working correctly?

43. Geometry The length and width of a rectangle are consecutive even integers. The perimeter is 44 meters. Find the length and width.

44. Geometry The length and width of a rectangle are consecutive odd integers. The perimeter is 128 meters. Find the length and width.

45. Geometry The angles of a triangle are three consecutive integers. Find the measure of each angle.

46. Geometry The angles of a triangle are three consecutive even integers. Find the measure of each angle.

Ike and Nancy Lara give western dance lessons at the Elk's Lodge on Sunday nights. The lessons cost \$3.00 for members of the lodge and \$5.00 for nonmembers. Half of the money collected for the lesson is paid to Ike and Nancy. The Elk's Lodge keeps the other half. One Sunday night Ike counts 36 people in the dance lesson. Use this information to work Problems 47 through 50.

47. Dance Lessons What is the least amount of money Ike and Nancy will make?

48. Dance Lessons What is the largest amount of money Ike and Nancy will make?

49. Dance Lessons At the end of the evening, the Elk's Lodge gives Ike and Nancy a check for \$80 to cover half of the receipts. Can this amount be correct?

50. Dance Lessons Besides the number of people in the dance lesson, what additional information does Ike need to know to always be sure he is being paid the correct amount?

Getting Ready for the Next Section

To understand all the explanations and examples in the next section you must be able to work the problems below.

Solve the following equations.

51. **a.** $x - 3 = 6$ **b.** $x + 3 = 6$ **c.** $-x - 3 = 6$ **d.** $-x + 3 = 6$

52. **a.** $x - 7 = 16$ **b.** $x + 7 = 16$ **c.** $-x - 7 = 16$ **d.** $-x + 7 = 16$

53. **a.** $\frac{x}{4} = -2$ **b.** $-\frac{x}{4} = -2$ **c.** $\frac{x}{4} = 2$ **d.** $-\frac{x}{4} = 2$

54. **a.** $3a = 15$ **b.** $3a = -15$ **c.** $-3a = 15$ **d.** $-3a = -15$

55. $2.5x - 3.48 = 4.9x + 2.07$

56. $2(1 - 3x) + 4 = 4x - 14$

57. $3(x - 4) = -2$

58. Solve for y: $2x - 3y = 6$

1.8 Linear Inequalities

Linear inequalities are solved by a method similar to the one used in solving linear equations. The only real differences between the methods are in the multiplication property for inequalities and in graphing the solution set.

An inequality differs from an equation only with respect to the comparison symbol between the two quantities being compared. In place of the equal sign, we use $<$ (less than), $\leq$ (less than or equal to), $>$ (greater than), or $\geq$ (greater than or equal to). The addition property for inequalities is almost identical to the addition property for equality.

PROPERTY *Addition Property for Inequalities*

For any three algebraic expressions A, B, and C,

if $\quad A < B$

then $\quad A + C < B + C$

In words: Adding the same quantity to both sides of an inequality will not change the solution set.

It makes no difference which inequality symbol we use to state the property. Adding the same amount to both sides always produces an inequality equivalent to the original inequality. Also, because subtraction can be thought of as addition of the opposite, this property holds for subtraction as well as addition.

EXAMPLE 1 Solve the inequality $x + 5 < 7$.

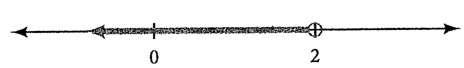
SOLUTION To isolate x, we add -5 to both sides of the inequality:

$$x + 5 < 7$$

$$x + 5 + (-5) < 7 + (-5) \qquad \text{Addition property for inequalities}$$

$$x < 2$$

We can go one step further here and graph the solution set. The solution set is all real numbers less than 2. To graph this set, we simply draw a straight line and label the center 0 (zero) for reference. Then we label the 2 on the right side of zero and extend an arrow beginning at 2 and pointing to the left. We use an open circle at 2 because it is not included in the solution set. Here is the graph.



EXAMPLE 2 Solve $x - 6 \leq -3$.

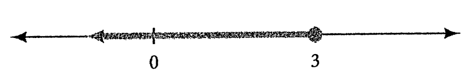
SOLUTION Adding 6 to each side will isolate x on the left side:

$$x - 6 \leq -3$$

$$x - 6 + 6 \leq -3 + 6 \qquad \text{Add 6 to both sides}$$

$$x \leq 3$$

The graph of the solution set is



Notice that the dot at the 3 is darkened because 3 is included in the solution set. We always will use open circles on the graphs of solution sets with $<$ or $>$ and closed (darkened) circles on the graphs of solution sets with $\leq$ or $\geq$.

To see the idea behind the multiplication property for inequalities, we will consider three true inequality statements and explore what happens when we multiply both sides by a positive number and then what happens when we multiply by a negative number.

Consider the following three true statements:

$$3 < 5 \qquad -3 < 5 \qquad -5 < -3$$

Now multiply both sides by the positive number 4:

$$4(3) < 4(5) \qquad 4(-3) < 4(5) \qquad 4(-5) < 4(-3)$$
$$12 < 20 \qquad -12 < 20 \qquad -20 < -12$$

In each case, the inequality symbol in the result points in the same direction it did in the original inequality. We say the "sense" of the inequality doesn't change when we multiply both sides by a positive quantity.

Notice what happens when we go through the same process but multiply both sides by -4 instead of 4:

$$3 < 5 \qquad -3 < 5 \qquad -5 < -3$$
$$-4(3) > -4(5) \qquad -4(-3) > -4(5) \qquad -4(-5) > -4(-3)$$
$$-12 > -20 \qquad 12 > -20 \qquad 20 > 12$$

Note: This discussion is intended to show why the multiplication property for inequalities is written the way it is. You may want to look ahead to the property itself and then come back to this discussion if you are having trouble making sense out of it.

In each case, we have to change the direction in which the inequality symbol points to keep each statement true. Multiplying both sides of an inequality by a negative quantity always reverses the sense of the inequality. Our results are summarized in the multiplication property for inequalities.

[Δ≠Σ PROPERTY] ***Multiplication Property for Inequalities***

For any three algebraic expressions A, B, and C,

if	$A < B$	
then	$AC < BC$	when C is positive
and	$AC > BC$	when C is negative

In words: Multiplying both sides of an inequality by a positive number does not change the solution set. When multiplying both sides of an inequality by a negative number, it is necessary to reverse the inequality symbol to produce an equivalent inequality.

Note: Because division is defined in terms of multiplication, this property is also true for division. We can divide both sides of an inequality by any nonzero number we choose. If that number happens to be negative, we must also reverse the direction of the inequality symbol.

We can multiply both sides of an inequality by any nonzero number we choose. If that number happens to be negative, we must also reverse the sense of the inequality.

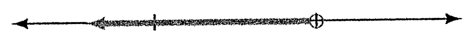
EXAMPLE 3 Solve $3a < 15$ and graph the solution.

SOLUTION We begin by multiplying each side by $\frac{1}{3}$. Because $\frac{1}{3}$ is a positive number, we do not reverse the direction of the inequality symbol:

$$3a < 15$$

$$\frac{1}{3}(3a) < \frac{1}{3}(15) \qquad \text{Multiply each side by } \frac{1}{3}$$

$$a < 5$$



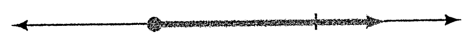
EXAMPLE 4 Solve $-3a \leq 18$, and graph the solution.

SOLUTION We begin by multiplying both sides by $-\frac{1}{3}$. Because $-\frac{1}{3}$ is a negative number, we must reverse the direction of the inequality symbol at the same time that we multiply by $-\frac{1}{3}$.

$$-3a \leq 18$$

$$-\frac{1}{3}(-3a) \geq -\frac{1}{3}(18) \qquad \text{Multiply both sides by } -\frac{1}{3} \text{ and reverse the direction of the inequality symbol}$$

$$a \geq -6$$



EXAMPLE 5 Solve $-\frac{x}{4} > 2$ and graph the solution.

SOLUTION To isolate x, we multiply each side by -4. Because -4 is a negative number, we also must reverse the direction of the inequality symbol:

$$-\frac{x}{4} > 2$$

$$-4\left(-\frac{x}{4}\right) < -4(2) \qquad \text{Multiply each side by } -4\text{, and reverse the direction of the inequality symbol}$$

$$x < -8$$

To solve more complicated inequalities, we use the following steps.

HOW TO *Solving Linear Inequalities in One Variable*

Step 1a: Use the distributive property to separate terms, if necessary.
1b: If fractions are present, consider multiplying both sides by the LCD to eliminate the fractions. If decimals are present, consider multiplying both sides by a power of 10 to clear the inequality of decimals.
1c: Combine similar terms on each side of the inequality.
Step 2: Use the addition property for inequalities to get all variable terms on one side of the inequality and all constant terms on the other side.
Step 3: Use the multiplication property for inequalities to get x by itself on one side of the inequality.
Step 4: Graph the solution set.

EXAMPLE 6 Solve $2.5x - 3.48 < -4.9x + 2.07$.

SOLUTION We have two methods we can use to solve this inequality. We can simply apply our properties to the inequality the way it is currently written and work with the decimal numbers, or we can eliminate the decimals to begin with and solve the resulting inequality.

Method 1 Working with the decimals.

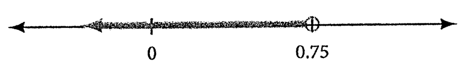
$2.5x - 3.48 < -4.9x + 2.07$	Original inequality
$2.5x + 4.9x - 3.48 < -4.9x + 4.9x + 2.07$	Add 4.9x to each side
$7.4x - 3.48 < 2.07$	
$7.4x - 3.48 + 3.48 < 2.07 + 3.48$	Add 3.48 to each side
$7.4x < 5.55$	
$\frac{7.4x}{7.4} < \frac{5.55}{7.4}$	Divide each side by 7.4
$x < 0.75$	

Method 2 Eliminating the decimals in the beginning.

Because the greatest number of places to the right of the decimal point in any of the numbers is 2, we can multiply each side of the inequality by 100 and we will be left with an equivalent inequality that contains only whole numbers.

$2.5x - 3.48 < -4.9x + 2.07$	Original inequality
$100(2.5x - 3.48) < 100(-4.9x + 2.07)$	Multiply each side by 100
$100(2.5x) - 100(3.48) < 100(-4.9x) + 100(2.07)$	Distributive property
$250x - 348 < -490x + 207$	Multiplication
$740x - 348 < 207$	Add 490x to each side
$740x < 555$	Add 348 to each side
$\frac{740x}{740} < \frac{555}{740}$	Divide each side by 740
$x < 0.75$	

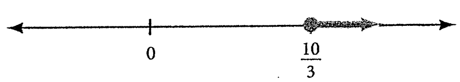
The solution by either method is $x < 0.75$. Here is the graph:



EXAMPLE 7 Solve $3(x - 4) \geq -2$.

SOLUTION

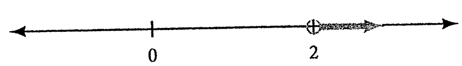
$3x - 12 \geq -2$	Distributive property
$3x - 12 + 12 \geq -2 + 12$	Add 12 to both sides
$3x \geq 10$	
$\frac{1}{3}(3x) \geq \frac{1}{3}(10)$	Multiply both sides by $\frac{1}{3}$
$x \geq \frac{10}{3}$	



EXAMPLE 8 Solve and graph $2(1 - 3x) + 4 < 4x - 14$.

SOLUTION

$2 - 6x + 4 < 4x - 14$	Distributive property
$-6x + 6 < 4x - 14$	Simplify
$-6x + 6 + (-6) < 4x - 14 + (-6)$	Add -6 to both sides
$-6x < 4x - 20$	
$-6x + (-4x) < 4x + (-4x) - 20$	Add $-4x$ to both sides
$-10x < -20$	
$\left(-\frac{1}{10}\right)(-10x) > \left(-\frac{1}{10}\right)(-20)$	Multiply by $-\frac{1}{10}$, reverse the direction of the inequality
$x > 2$	



EXAMPLE 9 Solve $2x - 3y < 6$ for y.

SOLUTION We can solve this formula for y by first adding $-2x$ to each side and then multiplying each side by $-\frac{1}{3}$. When we multiply by $-\frac{1}{3}$ we must reverse the direction of the inequality symbol. Because this is a formula, we will not graph the solution.

$2x - 3y < 6$	Original formula
$2x + (-2x) - 3y < (-2x) + 6$	Add $-2x$ to each side
$-3y < -2x + 6$	
$-\frac{1}{3}(-3y) > -\frac{1}{3}(-2x + 6)$	Multiply each side by $-\frac{1}{3}$
$y > \frac{2}{3}x - 2$	Distributive property

When working application problems that involve inequalities, the phrases "at least" and "at most" translate as follows:

In Words	*In Symbols*
x is at least 30	$x \geq 30$
x is at most 20	$x \leq 20$

Our next example is similar to an example done earlier in this chapter. This time it involves an inequality instead of an equation.

We can modify our Blueprint for Problem Solving to solve application problems whose solutions depend on writing and then solving inequalities.

EXAMPLE 10 The sum of two consecutive odd integers is at most 28. What are the possibilities for the first of the two integers?

SOLUTION When we use the phrase "their sum is at most 28," we mean that their sum is less than or equal to 28.

Step 1: **Read and list.**
Known items: Two consecutive odd integers. Their sum is less than or equal to 28.
Unknown items: The numbers in question.

Step 2: **Assign a variable, and translate information.**
If we let $x =$ the first of the two consecutive odd integers, then $x + 2$ is the next consecutive one.

Step 3: **Reread, and write an inequality.**
Their sum is at most 28.

$$x + (x + 2) \le 28$$

Step 4: **Solve the inequality.**

$$2x + 2 \le 28 \quad \text{Simplify the left side}$$
$$2x \le 26 \quad \text{Add } -2 \text{ to each side}$$
$$x \le 13 \quad \text{Multiply each side by } \tfrac{1}{2}$$

Step 5: **Write the answer.**
The first of the two integers must be an odd integer that is less than or equal to 13. The second of the two integers will be two more than whatever the first one is.

Step 6: **Reread, and check.**
Suppose the first integer is 13. The next consecutive odd integer is 15. The sum of 15 and 13 is 28. If the first odd integer is less than 13, the sum of it and the next consecutive odd integer will be less than 28.

GETTING READY FOR CLASS

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

A. State the addition property for inequalities.
B. How is the multiplication property for inequalities different from the multiplication property of equality?
C. When do we reverse the direction of an inequality symbol?
D. Under what conditions do we not change the direction of the inequality symbol when we multiply both sides of an inequality by a number?

Problem Set 1.8

Solve the following inequalities using the addition property of inequalities. Graph each solution set.

1. $x - 5 < 7$ **2.** $x + 3 < -5$ **3.** $a - 4 \leq 8$ **4.** $a + 3 \leq 10$

5. $x - 4.3 > 8.7$ **6.** $x - 2.6 > 10.4$ **7.** $y + 6 \geq 10$ **8.** $y + 3 \geq 12$

9. $2 < x - 7$ **10.** $3 < x + 8$

Solve the following inequalities using the multiplication property of inequalities. If you multiply both sides by a negative number, be sure to reverse the direction of the inequality symbol. Graph the solution set.

11. $3x < 6$ **12.** $2x < 14$ **13.** $5a \leq 25$ **14.** $4a \leq 16$

15. $\frac{x}{3} > 5$ **16.** $\frac{x}{7} > 1$ **17.** $-2x > 6$ **18.** $-3x \geq 9$

19. $-3x \geq -18$ **20.** $-8x \geq -24$ **21.** $-\frac{x}{5} \leq 10$ **22.** $-\frac{x}{9} \geq -1$

23. $-\frac{2}{3}y > 4$ **24.** $-\frac{3}{4}y > 6$

Solve the following inequalities. Graph the solution set in each case.

25. $2x - 3 < 9$ **26.** $3x - 4 < 17$ **27.** $-\frac{1}{5}y - \frac{1}{3} \leq \frac{2}{3}$

28. $-\frac{1}{6}y - \frac{1}{2} \leq \frac{2}{3}$ **29.** $-7.2x + 1.8 > -19.8$ **30.** $-7.8x - 1.3 > 22.1$

31. $\frac{2}{3}x - 5 \leq 7$ **32.** $\frac{3}{4}x - 8 \leq 1$ **33.** $-\frac{2}{5}a - 3 > 5$

34. $-\frac{4}{5}a - 2 > 10$ **35.** $5 - \frac{3}{5}y > -10$ **36.** $4 - \frac{5}{6}y > -11$

37. $0.3(a + 1) \leq 1.2$ **38.** $0.4(a - 2) \leq 0.4$ **39.** $2(5 - 2x) \leq -20$

40. $7(8 - 2x) > 28$ **41.** $3x - 5 > 8x$ **42.** $8x - 4 > 6x$

43. $\frac{1}{3}y - \frac{1}{2} \leq \frac{5}{6}y + \frac{1}{2}$ **44.** $\frac{7}{6}y + \frac{4}{3} \leq \frac{11}{6}y - \frac{7}{6}$

45. $-2.8x + 8.4 < -14x - 2.8$ **46.** $-7.2x - 2.4 < -2.4x + 12$

47. $3(m - 2) - 4 \geq 7m + 14$ **48.** $2(3m - 1) + 5 \geq 8m - 7$

49. $3 - 4(x - 2) \leq -5x + 6$ **50.** $8 - 6(x - 3) \leq -4x + 12$

Solve each of the following formulas for y.

51. $3x + 2y < 6$ **52.** $-3x + 2y < 6$ **53.** $2x - 5y > 10$

54. $-2x - 5y > 5$ **55.** $-3x + 7y \leq 21$ **56.** $-7x + 3y \leq 21$

57. $2x - 4y \geq -4$ **58.** $4x - 2y \geq -8$

The next two problems are intended to give you practice reading, and paying attention to, the instructions that accompany the problems you are working.

59. Work each problem according to the instructions given.

a. Evaluate when $x = 0$: $-5x + 3$ **b.** Solve: $-5x + 3 = -7$

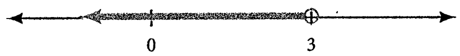
c. Is 0 a solution to $-5x + 3 < -7$ **d.** Solve: $-5x + 3 < -7$

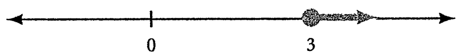
60. Work each problem according to the instructions given.

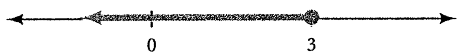
a. Evaluate when $x = 0$: $-2x - 5$ **b.** Solve: $-2x - 5 = 1$

c. Is 0 a solution to $-2x - 5 > 1$ **d.** Solve: $-2x - 5 > 1$

For each graph below, write an inequality whose solution is the graph.

61. 

62. 

63. 

64. 

Applying the Concepts

65. Consecutive Integers The sum of two consecutive integers is at least 583. What are the possibilities for the first of the two integers?

66. Consecutive Integers The sum of two consecutive integers is at most 583. What are the possibilities for the first of the two integers?

67. Number Problems The sum of twice a number and six is less than ten. Find all solutions.

68. Number Problems Twice the difference of a number and three is greater than or equal to the number increased by five. Find all solutions.

69. Number Problems The product of a number and four is greater than the number minus eight. Find the solution set.

70. Number Problems The quotient of a number and five is less than the sum of seven and two. Find the solution set.

71. Geometry Problems The length of a rectangle is 3 times the width. If the perimeter is to be at least 48 meters, what are the possible values for the width? (If the perimeter is at least 48 meters, then it is greater than or equal to 48 meters.)

72. Geometry Problems The length of a rectangle is 3 more than twice the width. If the perimeter is to be at least 51 meters, what are the possible values for the width? (If the perimeter is at least 51 meters, then it is greater than or equal to 51 meters.)

73. Geometry Problems The numerical values of the three sides of a triangle are given by three consecutive even integers. If the perimeter is greater than 24 inches, what are the possibilities for the shortest side?

74. Geometry Problems The numerical values of the three sides of a triangle are given by three consecutive odd integers. If the perimeter is greater than 27 inches, what are the possibilities for the shortest side?

Getting Ready for the Next Section

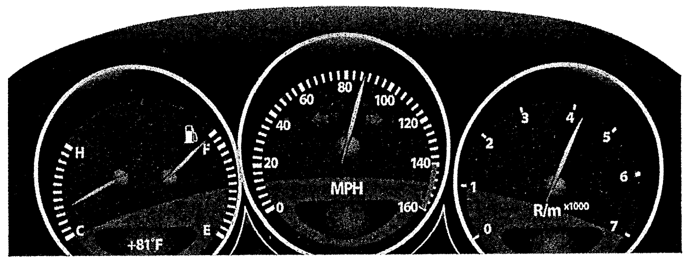
Solve each inequality. Do not graph.

75. $2x - 1 \geq 3$ **76.** $3x + 1 \geq 7$ **77.** $-2x > -8$ **78.** $-3x > -12$

79. $-3 > 4x + 1$ **80.** $4x + 1 \leq 9$

1.9 Compound Inequalities

The instrument panel on most cars includes a temperature gauge. The one shown below indicates that the normal operating temperature for the engine is from 50°F to 270°F.



We can represent the same situation with an inequality by writing $50 \le F \le 270$, where F is the temperature in degrees Fahrenheit. This inequality is a *compound inequality*. In this section we present the notation and definitions associated with compound inequalities.

The *union* of two sets A and B is the set of all elements that are in A or in B. The word *or* is the key word in the definition. The *intersection* of two sets A and B is the set of elements contained in both A and B. The key word in this definition is *and*. We can put the words *and* and *or* together with our methods of graphing inequalities to find the solution sets for compound inequalities.

DEFINITION *compound inequality*

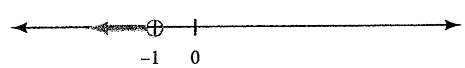
A ***compound inequality*** is two or more inequalities connected by the word *and* or *or*.

EXAMPLE 1 Graph the solution set for the compound inequality

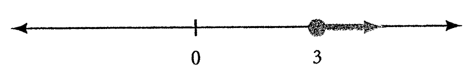
$$x < -1 \quad \text{or} \quad x \ge 3$$

SOLUTION Graphing each inequality separately, we have

$x < -1$

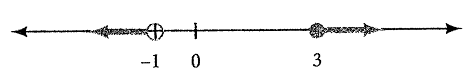


$x \ge 3$



Because the two inequalities are connected by *or*, we want to graph their union; that is, we graph all points that are on either the first graph or the second graph. Essentially, we put the two graphs together on the same number line.

$$x < -1 \quad \text{or} \quad x \ge 3$$

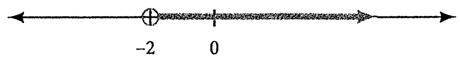


EXAMPLE 2 Graph the solution set for the compound inequality

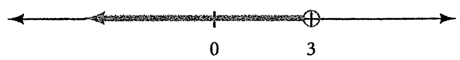
$$x > -2 \quad \text{and} \quad x < 3$$

SOLUTION Graphing each inequality separately, we have

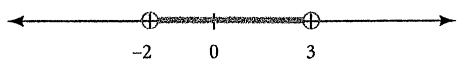
$x > -2$



$x < 3$



Because the two inequalities are connected by the word *and,* we will graph their intersection, which consists of all points that are common to both graphs; that is, we graph the region where the two graphs overlap.



EXAMPLE 3 Solve and graph the solution set for

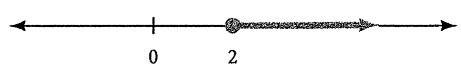
$$2x - 1 \geq 3 \quad \text{and} \quad -3x > -12$$

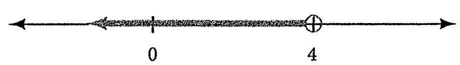
SOLUTION Solving the two inequalities separately, we have

$$2x - 1 \geq 3 \quad \text{and} \quad -3x > -12$$

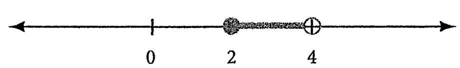
$$2x \geq 4 \qquad -\frac{1}{3}(-3x) < -\frac{1}{3}(-12)$$

$$x \geq 2 \quad \text{and} \quad x < 4$$

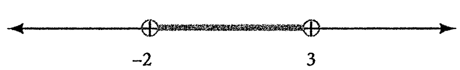




Because the word *and* connects the two graphs, we will graph their intersection—the points they have in common:



Notation Sometimes compound inequalities that use the word *and* can be written in a shorter form. For example, the compound inequality $-2 < x$ and $x < 3$ can be written as $-2 < x < 3$. The word *and* does not appear when an inequality is written in this form; it is implied. The solution set for $-2 < x$ and $x < 3$ is



It is all the numbers between -2 and 3 on the number line. It seems reasonable then, that this graph should be the graph of

$$-2 < x < 3$$

In both the graph and the inequality, x is said to be between -2 and 3.

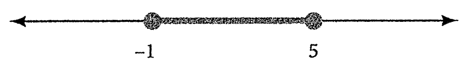
EXAMPLE 4 Solve and graph $-3 \le 2x - 1 \le 9$.

SOLUTION To solve for x, we must add 1 to the center expression and then divide the result by 2. Whatever we do to the center expression, we also must do to the two expressions on the ends. In this way we can be sure we are producing equivalent inequalities. The solution set will not be affected.

$$-3 \le 2x - 1 \le 9$$

$$-2 \le 2x \le 10 \quad \text{Add 1 to each expression}$$

$$-1 \le x \le 5 \quad \text{Multiply each expression by } \tfrac{1}{2}$$



GETTING READY FOR CLASS

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

A. What is a compound inequality?
B. Explain the shorthand notation that can be used to write two inequalities connected by the word *and*.
C. Write two inequalities connected by the word *and* that together are equivalent to $-1 < x < 2$.
D. Explain in words how you would graph the compound inequality $x < 2$ or $x > -3$.

Problem Set 1.9

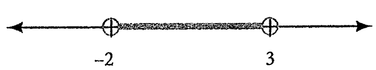
Graph the following compound inequalities.

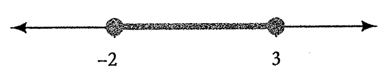
1. $x < -1$ or $x > 5$
2. $x \le -2$ or $x \ge -1$
3. $x < -3$ or $x \ge 0$
4. $x < 5$ and $x > 1$
5. $x \le 6$ and $x > -1$
6. $x \le 7$ and $x > 0$
7. $x > 2$ and $x < 4$
8. $x < 2$ or $x > 4$
9. $x \ge -2$ and $x \le 4$
10. $x \le 2$ or $x \ge 4$
11. $x < 5$ and $x > -1$
12. $x > 5$ or $x < -1$
13. $-1 < x < 3$
14. $-1 \le x \le 3$
15. $-3 < x \le -2$
16. $-5 \le x \le 0$

Solve the following compound inequalities. Graph the solution set in each case.

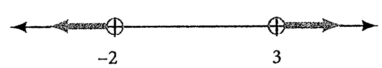
17. $3x - 1 < 5$ or $5x - 5 > 10$
18. $x + 1 < -3$ or $x - 2 > 6$
19. $x - 2 > -5$ and $x + 7 < 13$
20. $3x + 2 \le 11$ and $2x + 2 \ge 0$
21. $11x < 22$ or $12x > 36$
22. $-5x < 25$ and $-2x \ge -12$
23. $3x - 5 < 10$ and $2x + 1 > -5$
24. $5x + 8 < -7$ or $3x - 8 > 10$
25. $2x - 3 < 8$ and $3x + 1 > -10$
26. $11x - 8 > 3$ or $12x + 7 < -5$
27. $2x - 1 < 3$ and $3x - 2 > 1$
28. $3x + 9 < 7$ or $2x - 7 > 11$
29. $-1 \le x - 5 \le 2$
30. $0 \le x + 2 \le 3$
31. $-4 \le 2x \le 6$
32. $-5 < 5x < 10$
33. $-3 < 2x + 1 < 5$
34. $-7 \le 2x - 3 \le 7$
35. $0 \le 3x + 2 \le 7$
36. $2 \le 5x - 3 \le 12$
37. $-7 < 2x + 3 < 11$
38. $-5 < 6x - 2 < 8$
39. $-1 \le 4x + 5 \le 9$
40. $-8 \le 7x - 1 \le 13$

For each graph below, write an inequality whose solution is the graph.

41. 

42. 

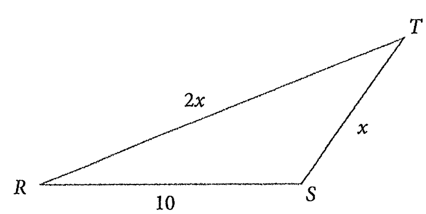
43. 

44. 

Applying the Concepts

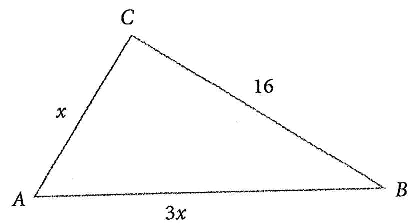
Triangle Inequality The triangle inequality states that the sum of any two sides of a triangle must be greater than the third side.

45. The following triangle RST has sides of length x, $2x$, and 10 as shown.



a. Find the three inequalities, which must be true based on the sides of the triangle.
b. Write a compound inequality based on your results above.

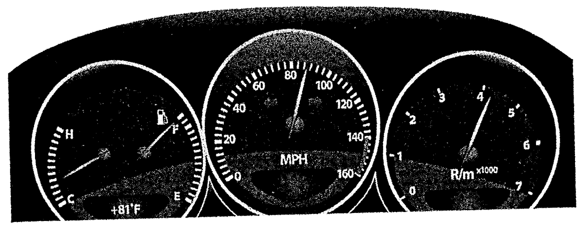
46. The following triangle ABC has sides of length x, $3x$, and 16 as shown.



a. Find the three inequalities, which must be true based on the sides of the triangle.

b. Write a compound inequality based on your results above.

47. Engine Temperature The engine in a car gives off a lot of heat due to the combustion in the cylinders. The water used to cool the engine keeps the temperature within the range $50 \le F \le 266$ where F is in degrees Fahrenheit. Graph this inequality on the number line.



48. Engine Temperature To find the engine temperature range from Problem 47 in degrees Celsius, we use the fact that $F = \frac{9}{5}C + 32$ to rewrite the inequality as

$$50 \le \frac{9}{5}C + 32 \le 266$$

Solve this inequality and graph the solution set.

49. Number Problem The difference of twice a number and 3 is between 5 and 7. Find the number.

50. Number Problem The sum of twice a number and 5 is between 7 and 13. Find the number.

51. Perimeter The length of a rectangle is 4 inches longer than the width. The perimeter is between 20 inches and 30 inches.

a. Write the perimeter as a compound inequality. ____ $< P <$ ____

b. Write the width as a compound inequality. ____ $< w <$ ____

c. Write the length as a compound inequality. ____ $< l <$ ____

52. Perimeter The length of a rectangle is 6 feet longer than the width. The perimeter is between 24 feet and 36 feet.

a. Write the perimeter as a compound inequality. ____ $< P <$ ____

b. Write the width as a compound inequality. ____ $< w <$ ____

c. Write the length as a compound inequality. ____ $< l <$ ____

Maintaining Your Skills

The problems that follow review some of the more important skills you have learned in previous sections and chapters. You can consider the time you spend working these problems as time spent studying for exams.

Answer the following percent problems.

53. What number is 25% of 32?

54. What number is 15% of 75?

55. What number is 20% of 120?

56. What number is 125% of 300?

57. What percent of 36 is 9?

58. What percent of 16 is 9?

59. What percent of 50 is 5?

60. What percent of 140 is 35?

61. 16 is 20% of what number?

62. 6 is 3% of what number?

63. 8 is 2% of what number?

64. 70 is 175% of what number?

Simplify each expression.

65. $-|-5|$

66. $\left(-\frac{2}{3}\right)^3$

67. $-3 - 4(-2)$

68. $2^4 + 3^3 \div 9 - 4^2$

69. $5|3 - 8| - 6|2 - 5|$

70. $7 - 3(2 - 6)$

71. $5 - 2[-3(5 - 7) - 8]$

72. $\dfrac{5 + 3(7 - 2)}{2(-3) - 4}$

73. Find the difference of -3 and -9.

74. If you add -4 to the product of -3 and 5, what number results?

75. Apply the distributive property to $\frac{1}{2}(4x - 6)$.

76. Use the associative property to simplify $-6\left(\frac{1}{3}x\right)$.

For the set $\left\{-3, -\frac{4}{5}, 0, \frac{5}{8}, 2, \sqrt{5}\right\}$, which numbers are

77. Integers

78. Rational numbers

Answers to Odd-Numbered Problems

Chapter 1

PROBLEM SET 1.1

1. $-3x$ **3.** $-a$ **5.** $12x$ **7.** $6a$ **9.** $6x - 3$ **11.** $7a + 5$ **13.** $5x - 5$ **15.** $4a + 2$ **17.** $-9x - 2$ **19.** $12a + 3$ **21.** $10x - 1$
23. $21y + 6$ **25.** $-6x + 8$ **27.** $-2a + 3$ **29.** $-4x + 26$ **31.** $4y - 16$ **33.** $-6x - 1$ **35.** $2x - 12$ **37.** $10a + 33$
39. $4x - 9$ **41.** $7y - 39$ **43.** $-19x - 14$ **45.** 5 **47.** -9 **49.** 4 **51.** 4 **53.** -37 **55.** -41 **57.** 64 **59.** 64 **61.** 144
63. 144 **65.** 3 **67.** 0 **69.** 15 **71.** 6 **73.** **a.**

n	1	2	3	4
$3n$	3	6	9	12

b.

n	1	2	3	4
n^3	1	8	27	64

75. 1, 4, 7, 10, . . . an arithmetic sequence **77.** 0, 1, 4, 9, . . . a sequence of squares **79.** $-6y + 4$ **81.** $0.17x$ **83.** $2x$
85. $5x - 4$ **87.** $7x - 5$ **89.** $-2x - 9$ **91.** $7x + 2$ **93.** $-7x + 6$ **95.** $7x$ **97.** $-y$ **99.** $10y$ **101.** $0.17x + 180$
103. $0.22x + 60$ **105.** 49 **107.** 40 **109.** **a.** 42°F **b.** 28°F **c.** -14°F **111.** **a.** \$37.50 **b.** \$40.00 **c.** \$42.50 **113.** 12
115. -3 **117.** -9.7 **119.** $-\frac{5}{4}$ **121.** 53 **123.** $a - 12$ **125.** 7

PROBLEM SET 1.2

1. 11 **3.** 4 **5.** $-\frac{3}{4}$ **7.** -5.8 **9.** -17 **11.** $-\frac{1}{8}$ **13.** -4 **15.** -3.6 **17.** 1 **19.** $-\frac{7}{45}$ **21.** 3 **23.** $\frac{11}{8}$ **25.** 21 **27.** 7
29. 3.5 **31.** 22 **33.** -2 **35.** -16 **37.** -3 **39.** 10 **41.** -12 **43.** 4 **45.** 2 **47.** -5 **49.** -1 **51.** -3 **53.** 8 **55.** -8
57. 2 **59.** 11 **61.** -5.8 **63.** **a.** 6% **b.** 5% **c.** 2% **d.** 75% **65.** y **67.** x **69.** 6 **71.** 6 **73.** -9 **75.** $-\frac{15}{8}$ **77.** 8
79. $-\frac{5}{4}$ **81.** $3x$

PROBLEM SET 1.3

1. 2 **3.** 4 **5.** $-\frac{1}{2}$ **7.** -2 **9.** 3 **11.** 4 **13.** 0 **15.** 0 **17.** 6 **19.** -50 **21.** $\frac{3}{2}$ **23.** 12 **25.** -3 **27.** 32 **29.** -8 **31.** $\frac{1}{2}$
33. 4 **35.** 8 **37.** -4 **39.** 4 **41.** -15 **43.** $-\frac{1}{2}$ **45.** 3 **47.** 1 **49.** $\frac{1}{4}$ **51.** -3 **53.** 3 **55.** 2 **57.** $-\frac{3}{2}$ **59.** $-\frac{3}{2}$ **61.** 1
63. 1 **65.** -2 **67.** **a.** $\frac{3}{2}$ **b.** 1 **c.** $-\frac{3}{2}$ **d.** -4 **e.** $\frac{8}{5}$ **69.** 200 tickets **71.** \$1,390.85 per month **73.** 2 **75.** 6 **77.** 3,000
79. $3x - 11$ **81.** $0.09x + 180$ **83.** $-6y + 4$ **85.** $4x - 11$ **87.** $5x$ **89.** $0.17x$

PROBLEM SET 1.4

1. 3 **3.** -2 **5.** -1 **7.** 2 **9.** -4 **11.** -2 **13.** 0 **15.** 1 **17.** $\frac{1}{2}$ **19.** 7 **21.** 8 **23.** $-\frac{1}{3}$ **25.** $\frac{3}{4}$ **27.** 75 **29.** 2 **31.** 6
33. 8 **35.** 0 **37.** $\frac{3}{7}$ **39.** 1 **41.** 1 **43.** -1 **45.** 6 **47.** $\frac{3}{4}$ **49.** 3 **51.** $\frac{3}{4}$ **53.** 8 **55.** 6 **57.** -2 **59.** -2 **61.** 2 **63.** -6
65. 2 **67.** 20 **69.** 4,000 **71.** 700 **73.** 11 **75.** 7 **77.** **a.** $\frac{5}{4} = 1.25$ **b.** $\frac{15}{2} = 7.5$ **c.** $6x + 20$ **d.** 15 **e.** $4x - 20$ **f.** $\frac{45}{2} = 22.5$
79. 14 **81.** -3 **83.** $\frac{1}{4}$ **85.** $\frac{1}{3}$ **87.** $-\frac{3}{2}x + 3$

PROBLEM SET 1.5

1. 100 feet **3.** 0 **5.** 2 **7.** 15 **9.** 10 **11.** -2 **13.** 1 **15.** **a.** 2 **b.** 4 **17.** **a.** 5 **b.** 18 **19.** $l = \frac{A}{w}$ **21.** $h = \frac{V}{lw}$
23. $a = P - b - c$ **25.** $x = 3y - 1$ **27.** $y = 3x + 6$ **29.** $y = -\frac{2}{3}x + 2$ **31.** $y = -2x - 5$ **33.** $y = -\frac{2}{3}x + 1$
35. $w = \frac{P - 2l}{2}$ **37.** $v = \frac{h - 16t^2}{t}$ **39.** $h = \frac{A - \pi r^2}{2\pi r}$ **41.** **a.** $y = \frac{3}{5}x + 1$ **b.** $y = \frac{1}{2}x + 2$ **c.** $y = 4x + 3$
43. $y = \frac{3}{7}x - 3$ **45.** $y = 2x + 8$ **47.** 60°; 150° **49.** 45°; 135° **51.** 10 **53.** 240 **55.** 25% **57.** 35% **59.** 64 **61.** 2,000
63. 100°C; yes **65.** 20°C; yes **67.** $C = \frac{5}{9}(F - 32)$ **69.** 4°F over **71.** 7 meters **73.** $\frac{3}{2}$ or 1.5 inches **75.** 132 feet
77. $\frac{2}{9}$ centimeters **79.** 60% **81.** 26.5% **83.** The sum of 4 and 1 is 5. **85.** The difference of 6 and 2 is 4.
87. The difference of a number and 5 is -12. **89.** The sum of a number and 3 is four times the difference of that number and 3.
91. $2(6 + 3) = 18$ **93.** $2(5) + 3 = 13$ **95.** $x + 5 = 13$ **97.** $5(x + 7) = 30$

PROBLEM SET 1.6

1. 8 **3.** 5 **5.** -1 **7.** 3 and 5 **9.** 6 and 14 **11.** Shelly is 39; Michele is 36 **13.** Evan is 11; Cody is 22
15. Barney is 27; Fred is 31 **17.** Lacy is 16; Jack is 32 **19.** Patrick is 18; Pat is 38 **21.** $s = 9$ inches **23.** $s = 15$ feet
25. 11 feet, 18 feet, 33 feet **27.** 26 feet, 13 feet, 14 feet **29.** $l = 11$ inches; $w = 6$ inches **31.** $l = 25$ inches; $w = 9$ inches

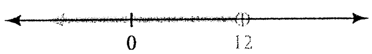
Answers to Odd-Numbered Problems

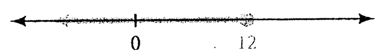
33. $l = 15$ feet; $w = 3$ feet **35.** 9 dimes; 14 quarters **37.** 12 quarters; 27 nickels **39.** 8 nickels; 17 dimes **41.** 7 nickels; 10 dimes; 12 quarters **43.** 3 nickels; 9 dimes; 6 quarters **45.** $5x$ **47.** $1.075x$ **49.** $0.09x + 180$ **51.** 6,000 **53.** 30

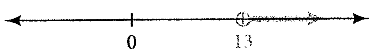
PROBLEM SET 1.7

1. 5 and 6 **3.** −4 and −5 **5.** 13 and 15 **7.** 52 and 54 **9.** −14 and −16 **11.** 17, 19, and 21 **13.** 42, 44, and 46 **15.** \$4,000 invested at 8%, \$6,000 invested at 9% **17.** \$700 invested at 10%, \$1,200 invested at 12% **19.** \$500 at 8%, \$1,000 at 9%, \$1,500 at 10% **21.** 45°, 45°, 90° **23.** 22.5°, 45°, 112.5° **25.** 53°, 90° **27.** 80°, 60°, 40° **29.** 16 adult and 22 children's tickets **31.** 16 minutes **33.** 39 hours **35.** They are in offices 7329 and 7331. **37.** Kendra is 8 years old and Marissa is 10 years old. **39.** Jeff **41.** \$10.38 **43.** $l = 12$ meters; $w = 10$ meters **45.** 59°, 60°, 61° **47.** \$54.00 **49.** Yes **51.** **a.** 9 **b.** 3 **c.** −9 **d.** −3 **53.** **a.** −8 **b.** 8 **c.** 8 **d.** −8 **55.** −2.3125 **57.** $\frac{10}{3}$

PROBLEM SET 1.8

1. $x < 12$ 

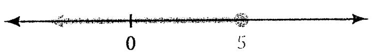
3. $a \le 12$ 

5. $x > 13$ 

7. $y \ge 4$ 

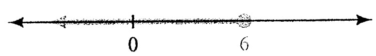
9. $x > 9$ 

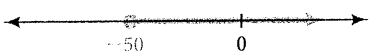
11. $x < 2$ 

13. $a \le 5$ 

15. $x > 15$ 

17. $x < -3$ 

19. $x \le 6$ 

21. $x \ge -50$ 

23. $y < -6$ 

25. $x < 6$ 

27. $y \ge -5$ 

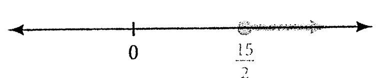
29. $x < 3$ 

31. $x \le 18$ 

33. $a < -20$ 

35. $y < 25$ 

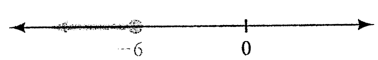
37. $a \le 3$ 

39. $x \ge \frac{15}{2}$ 

41. $x < -1$ 

43. $y \ge -2$ 

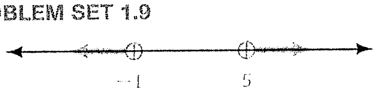
45. $x < -1$ 

47. $m \le -6$ 

49. $x \le -5$ 

51. $y < -\frac{3}{2}x + 3$ **53.** $y < \frac{2}{5}x - 2$ **55.** $y \le \frac{3}{7}x + 3$ **57.** $y \le \frac{1}{2}x + 1$ **59.** **a.** 3 **b.** 2 **c.** No **d.** $x > 2$ **61.** $x < 3$ **63.** $x \le 3$ **65.** At least 291 **67.** $x < 2$ **69.** $x > -\frac{8}{3}$ **71.** $x \ge 6$; the width is at least 6 meters. **73.** $x > 6$; the shortest side is even and greater than 6 inches. **75.** $x \ge 2$ **77.** $x < 4$ **79.** $-1 > x$

PROBLEM SET 1.9

1. 

3. 

5. 

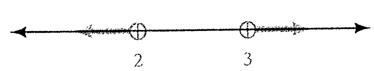
7. 

9. 

11. 

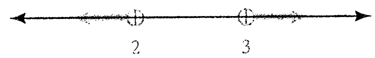
13. 

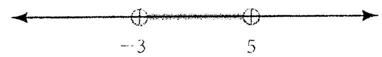
15. 

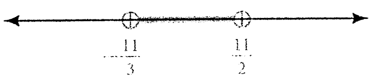
17. 

Answers to Odd-Numbered Problems

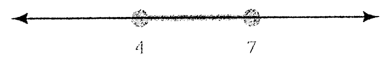
19. 

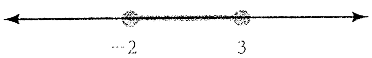
21. 

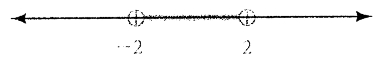
23. 

25. 

27. 

29. 

31. 

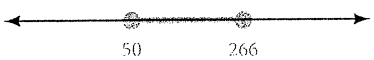
33. 

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.**

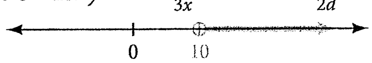
n	$(n + 2)^2$
1	9
2	16
3	25
4	36

b.

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

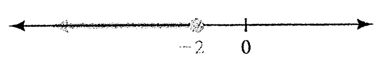
8. $x = 3$ **9.** $y = -5$ **10.** $x = -3$ **11.** $x = 4$ **12.** $x = 1$ **13.** 55 **14.** $t = -3$ **15.** $x = \frac{10}{4}$ **16.** $x = (.40)(56)$

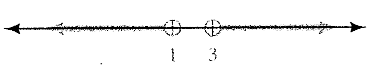
17. $720 = 0.24x$ **18.** −1 **19.** 8 **20.** $y = 2 - \frac{1}{3x}$ **21.** $a = \frac{x^2 - v^2}{2d}$ **22.** 18, 36 **23.** 20 cm, 55 cm **24.** 6 nickles, 14 dimes

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

27. $y \ge -4$ 

28. $x > -4$ 

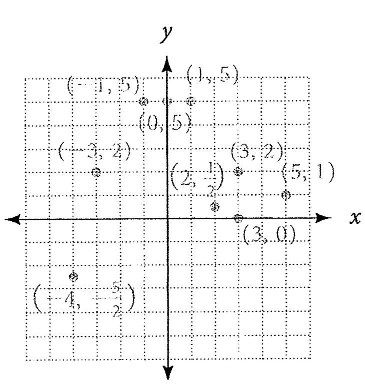
29. $n \le -2$ 

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)