CHAPTER 3

Solving Equations and Inequalities

BEFORE

In previous chapters you've...

- Evaluated expressions
- Solved word problems

Now

In Chapter 3 you'll study...

- Solving one-step equations
- Solving two-step equations
- Writing equations
- Formulas for area and perimeter
- Writing and solving inequalities
- Real life modeling

WHY?

So you can solve real-world problems about...

- sea lions, p. 112
- cartoonists, p. 121
- biplane rides, p. 143
- DJs, p. 149

Internet Preview

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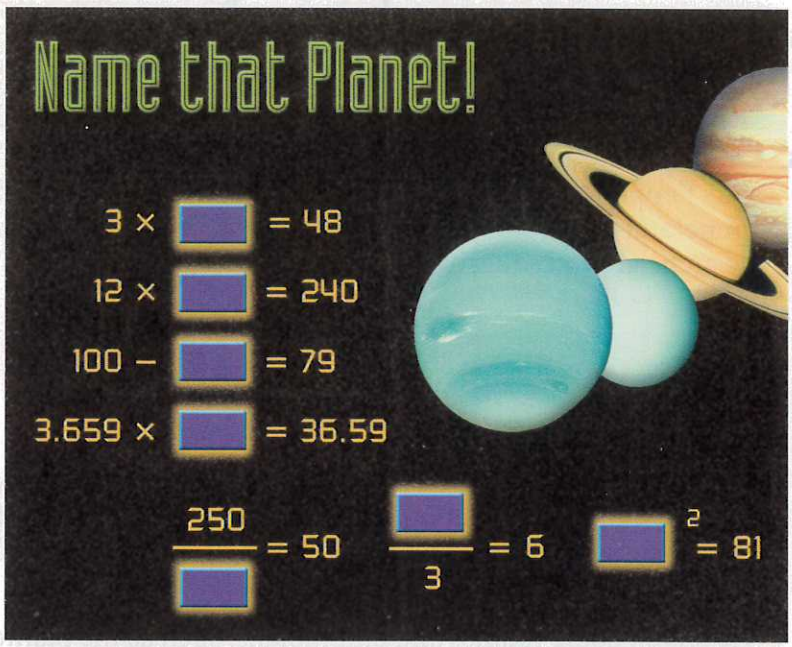
Chapter Warm-Up Games

Review Skills you need for this chapter in these quick games. Work with a partner.



BRAIN GAME

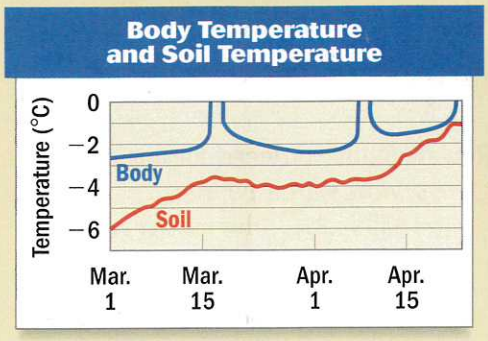
Key Skill:
Solving mental math equations

- Use mental math to find the missing number.
- Match each answer with the corresponding letter of the alphabet. (1 = A, 2 = B, etc.)
- Rearrange the letters to find the name of a planet.

Soil Temperature

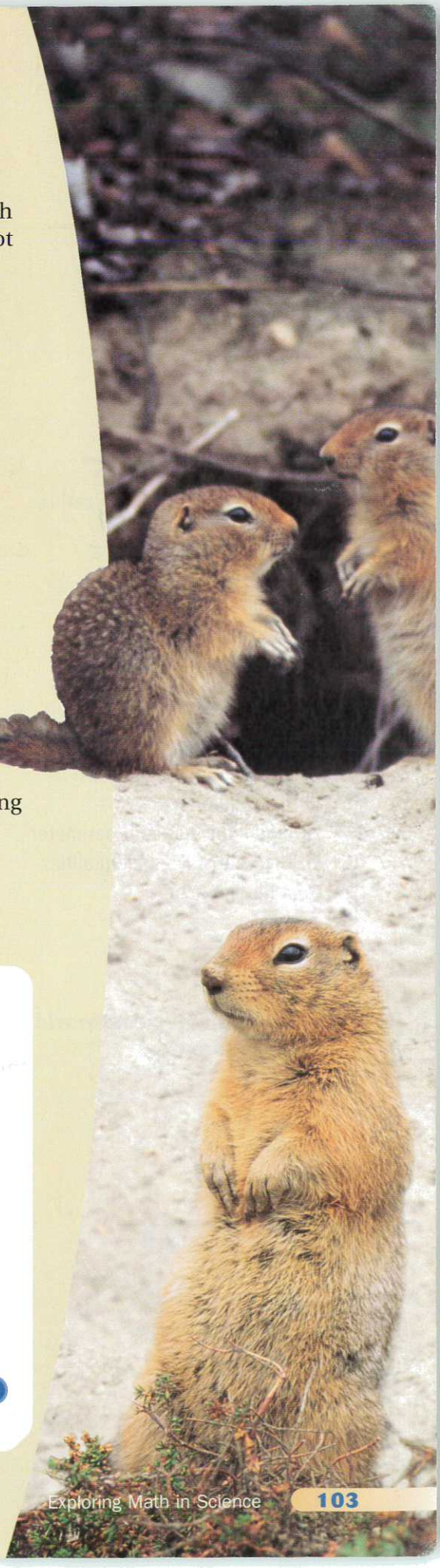
The graph below displays the squirrel body temperature data for March and April. It has a smaller temperature range, so waking periods are not fully displayed in the graph.

It also shows the soil temperature at 1 meter below ground, the depth at which the squirrel usually digs its burrow.



5. What is the difference of body temperature and soil temperature on March 1? What is the difference of these two temperatures on April 15th?

6. **Critical Thinking** A scientist claims that a hibernating animal's body temperature is always within 1 or 2 degrees of the surrounding temperature. Discuss whether this claim seems reasonable for the arctic ground squirrel, based on the data given.



Project IDEAS

- **Report** Find out more about the arctic ground squirrel. In what areas does it live? What foods does it eat? What are its predators? Present your findings to the class.
- **Research** Some reptiles and amphibians, such as the painted turtle and the wood frog, can survive subzero temperatures. Find out more about one of these animals. How low can its body temperature go? What mechanisms does it use to avoid freezing? Present your findings to the class.
- **Career** Find out more about the work that biologists do. What are some topics or areas in which a biologist might specialize? Present your findings to the class.

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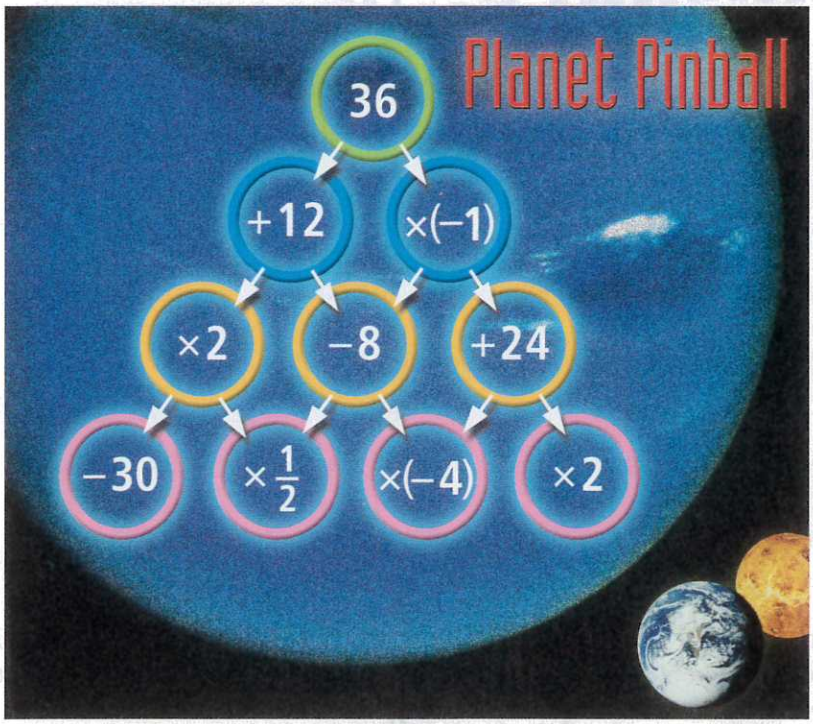
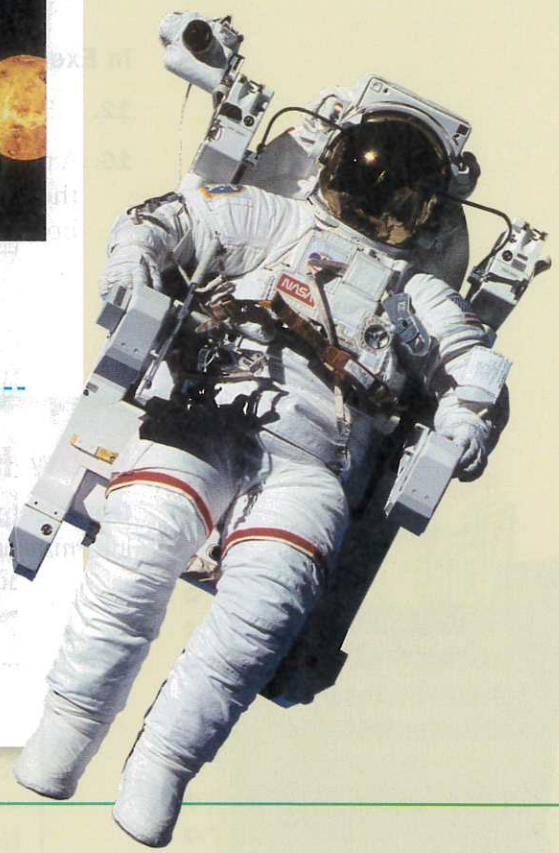


BRAIN GAME

Key Skill: Operations with integers

Materials: penny

- Both players start at the top planet with 36 points.
- On your turn, toss a coin. If you get heads, go to the planet on the left. If you get tails, go to the planet on the right.
- Perform the operation written on the planet. The result is your current score.
- Take turns moving until both players reach the bottom row.
- The player with the higher score wins.



Stop *and* Think

1. **Writing** Without tossing the coin, work with your partner to find the route through the planets in the *Planet Pinball* that gives the highest score. Explain how you know you have found the best route.
2. **Extension** Choose another planet name. Write a puzzle like *Name that Planet!* with that name as the solution.

CHAPTER 3 Getting Ready to Learn

Review What You Need to Know

Using Vocabulary **Copy and complete using a review word.**

1. 5 is the ? of −5.

2. 6 is the ? in the expression $6x$.

3. A(n) ? shows that two expressions are equal.

Solve the equation using mental math. *(p. 28)*

4. $x - 1 = 5$ **5.** $x - 2 = 9$ **6.** $4 + x = 12$ **7.** $10 = x + 3$

8. $5 - x = 2$ **9.** $x - 3 = 1$ **10.** $x + 3 = 4$ **11.** $8 + x = 8$

In Exercises 12–15, evaluate the expression. *(pp. 58, 63, 70)*

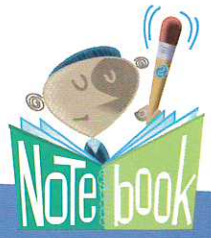
12. $-3 - 2 + 8$ **13.** $3 - 7 + 2 - 1$ **14.** $-2(3 + 1) + 2$ **15.** $8(1 - 4) - 9$

16. A tsunami wave caused by an underwater earthquake travels across the ocean at 500 miles per hour. Write and solve an equation to find how far it travels in 15 minutes. *(p. 33)*

Word Watch

Review Words

variable, p. 15
equation, p. 28
solution, p. 28
opposite, p. 54
like terms, p. 86
coefficient, p. 86



You should include material that appears on a notebook like this in your own notes.

Know How to Take Notes

Organizing Information Sometimes you can organize complicated information in a table to make it easier to understand.

Multiplying Integers

x	Positive	Negative
Positive	+	−
Negative	−	+

In Lesson 3.7, you may want to make a table to help you organize information about solving inequalities.

3.1 Hands-on Activity

GOAL

Solve addition and subtraction equations using algebra tiles.

MATERIALS

- algebra tiles

Modeling One-Step Equations

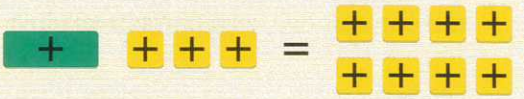
You can use algebra tiles to model and solve one-step addition equations and one-step subtraction equations.

Represents the variable x	Represents a positive unit, or 1	Represents a negative unit, or -1
x-tile	1-tile	-1-tile

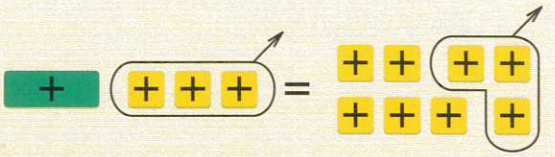
When you combine a 1-tile and a -1-tile, the result is zero. This pair of tiles is called a *zero pair* and may be removed from the model.

Explore 1 Model and solve $x + 3 = 8$.

1 Model $x + 3 = 8$ using algebra tiles.



2 Remove three 1-tiles from each side so the x-tile is by itself.



3 The solution of the equation is 5.

Your turn now

1. Use algebra tiles to model each step below. Draw a picture of each step.

(1 Model the equation $x + 5 = 7$.

(2 Remove five 1-tiles from each side.

(3 Find the solution.

Use algebra tiles to model and solve the equation.

2. $x + 4 = 9$ **3.** $5 + x = 7$ **4.** $6 = x + 2$ **5.** $7 + x = 9$

Explore 2 **Model and solve $x - 5 = -3$. Write the equation at each step.**

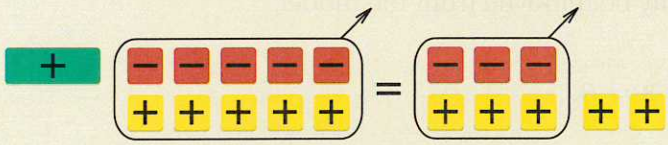
Tile Model **Algebra**

1

$x - 5 = -3$

To get the x-tile by itself, you can add the same number of 1-tiles to each side to create zero pairs. So, add five 1-tiles to each side.

2



$x - 5 + 5 = -3 + 5$

You can remove zero pairs from each side.

3

$x = 2$

The solution is 2.

Your turn now **Use algebra tiles to model and solve the equation. Write the equation at each step.**

6. $x - 3 = 6$ **7.** $x - 5 = 5$ **8.** $x + 6 = 2$ **9.** $8 + x = 1$

10. $x - 4 = -2$ **11.** $x - 7 = -3$ **12.** $x + 8 = 4$ **13.** $x - 3 = -6$

Stop and Think

14. **Writing** Give an example of an equation that requires you to make zero pairs to solve. How do you know that zero pairs are required?

15. **Critical Thinking** Can you model the equation $x + \frac{3}{2} = 5$ using x-tiles and 1-tiles? Explain.

LESSON 3.1

Solving Equations Using Addition or Subtraction

BEFORE

You solved equations using mental math.

NOW

You'll solve equations using addition or subtraction.

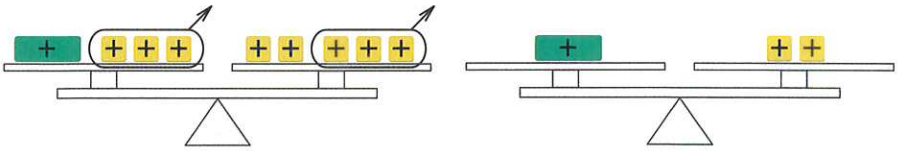
WHY?

So you can find the amount that a sea lion grows, as in Ex. 36.

Word Watch

equivalent equations, p. 109
inverse operation, p. 109

You can model and solve an equation by using a scale as shown.



$x + 3 = 5$ $\qquad$ $x = 2$

In the model above, removing three 1-tiles from each side of the scale keeps the scale in balance.

When you perform the same operation on each side of an equation, the result is a new equation that has the same solution. Equations that have the same solution(s) are **equivalent equations**.

You can solve an equation by using *inverse operations* to write equivalent equations. An **inverse operation** is an operation that "undoes" another operation. Addition and subtraction are inverse operations.

NOTEBOOK

Subtraction Property of Equality

Words Subtracting the same number from each side of an equation makes an equivalent equation.

Numbers If $x + 5 = 7$, then $x + 5 - 5 = 7 - 5$.

Algebra If $a = b$, then $a - c = b - c$.

EXAMPLE 1 Solving an Equation Using Subtraction

$x + 8 = -15$	**Original equation**
$\underline{-8} \quad \underline{-8}$	**Subtract 8 from each side to undo addition.**
$x = -23$	**Simplify. x is by itself.**

ANSWER The solution is -23.

You can also use the addition property of equality to solve an equation.

Addition Property of Equality

Words Adding the same number to each side of an equation makes an equivalent equation.

Numbers If $x - 2 = 6$, then $x - 2 + 2 = 6 + 2$.

Algebra If $a = b$, then $a + c = b + c$.

Watch Out!

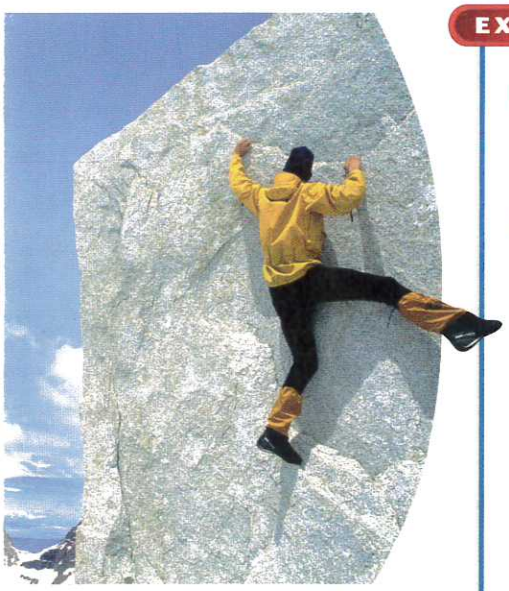
You can add or subtract horizontally or vertically to solve equations, but remember that when solving, you must perform the same operation on *each* side.

EXAMPLE 2 Solving an Equation Using Addition

$c - 4.5 = 13$	Original equation
$c - 4.5 + 4.5 = 13 + 4.5$	Add 4.5 to each side to undo subtraction.
$c = 17.5$	Simplify. c is by itself.
✓Check $17.5 - 4.5 \stackrel{?}{=} 13$	Substitute 17.5 for c in original equation.
$13 = 13$ ✓	

Your turn now **Solve the equation. Check your solution.**

1. $x + 9 = 20$ **2.** $-10 = 3 + y$ **3.** $m - 14 = -15$ **4.** $2 = z - 6.4$



EXAMPLE 3 Using a Verbal Model

Rock Climbing A cliff has a height of about 1500 feet. If you have already climbed 675 feet, how much farther do you have to climb to reach the top?

Solution

Write a verbal model. Let x represent the distance left to climb.

Height of cliff	=	Distance left to climb	+	Distance climbed

$1500 = x + 675$	Write an algebraic model.
$1500 - 675 = x + 675 - 675$	Subtract 675 from each side.
$825 = x$	Simplify. x is by itself.

ANSWER You have about 825 feet left to climb.

3.1 Exercises

More Practice, p. 729

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Getting Ready to Practice

1. Vocabulary Copy and complete: Addition and subtraction are ? operations.

Solve the equation. Check your solution.

2. $x + 10 = 16$ **3.** $12 = x - 8$ **4.** $x + 1.3 = 2.5$

5. Guided Problem Solving You buy new school supplies. The price of the items is \$54.99, but after sales tax is added, they cost \$58.29. How much is the sales tax?

(1 Copy and complete the verbal model.

Price + ? = Total cost

(2 Substitute numbers and variables in the verbal model to write an algebraic model.

(3 Solve the algebraic model. Check your solution.

Practice and Problem Solving

HELP with Homework

Example	Exercises
1	9–20
2	9–20
3	21–24

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Describe an inverse operation that will undo the given operation.

6. Adding 4 **7.** Adding 4.5 **8.** Subtracting 35

Solve the equation.

9. $r + 2 = 7$ **10.** $t - 5 = 2$ **11.** $9 = p - 4$ **12.** $6 + x = 8$

13. $z + 9 = 11$ **14.** $23 = 6 + s$ **15.** $y - 15 = 9$ **16.** $13 = d - 27$

17. $24 = 52 + n$ **18.** $204 = m - 41$ **19.** $43 = a - 21$ **20.** $11 = c + 48$

Tell whether the equation correctly represents the real-life problem. If not, correct the equation.

21. At 62 inches tall, you are 5 inches taller than your sister. How tall is your sister? Equation: $62 = s + 5$.

22. There are 540 freshmen this year. This is 29 more than last year. How many freshmen were there last year? Equation: $f - 29 = 540$.

23. The mean temperature for February 4 in Chicago is 3°F below the mean temperature of 29°F for all of February in Chicago. What is the mean temperature for February 4? Equation: $t - 3 = 29$.

24. An item that usually costs \$2.29 will cost \$1.79 with a coupon. How much is the coupon worth? Equation: $2.29 - c = 1.79$.

25. Writing Write a word problem that can be represented by the equation $s + 13 = 55$.

26. Critical Thinking What inverse operation undoes adding -5 to a number?

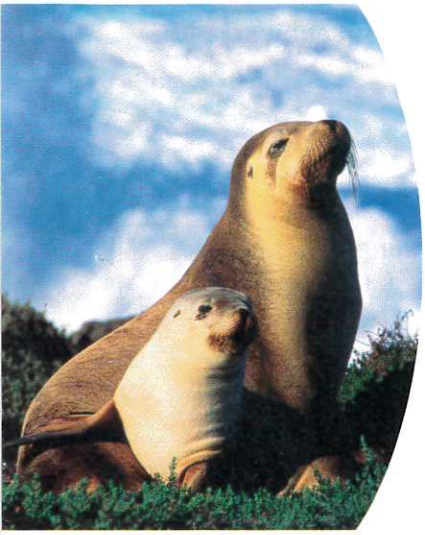
Solve the equation.

27. $x + \frac{1}{2} = \frac{1}{2}$ **28.** $\frac{2}{3} = d + \frac{1}{3}$ **29.** $y - \frac{3}{4} = \frac{1}{4}$

30. $s + 3.4 = 4.4$ **31.** $1.76 = a - 2.94$ **32.** $3.777 + c = 3.977$

33. $m + (-20) = -12$ **34.** $-2 = b + (-4)$ **35.** $r - (-36) = 5$

36. Sea Lions The length of a Steller sea lion at birth is about 45 inches. The average adult female Steller sea lion is 104 inches long. About how many inches do female sea lions grow between birth and adulthood? Write a verbal model. Then write and solve an algebraic model for the problem.



Sea lions

Challenge Solve the equation.

37. $3x - 2x + 8 - 10 = 7$ **38.** $0.2x + 3.4 + 0.8x - 2.1 = 4.2$

39. Cost You spent a total of \$11.09 at the store. You bought two bottles of water for \$1.29 each, a magazine for \$3.50, trail mix for \$1.49, and some markers. How much did the markers cost? (Assume there is no sales tax.)

Mixed Review

Plot the point in a coordinate plane and describe its location. *(Lesson 2.8)*

40. $(-2, 5)$ **41.** $(5, -2)$ **42.** $(-2, -5)$ **43.** $(5, 5)$

Basic Skills Find a low and high estimate for the product.

44. 15×19 **45.** 11×13 **46.** 42×7 **47.** 42×71

Test-Taking Practice

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48. Multiple Choice Five less than the total number of students is twenty-four. Which equation represents this sentence?

A. $5 - x = 24$ **B.** $24 - 5 = x$ **C.** $x + 24 = 5$ **D.** $x - 5 = 24$

49. Multiple Choice Solve $-4 + x = 8$.

F. -12 **G.** -4 **H.** 4 **I.** 12

LESSON 3.2

Solving Equations Using Multiplication or Division

BEFORE

You solved equations using addition or subtraction.

Now

You'll solve equations using multiplication or division.

WHY?

So you can find how much a whole pizza costs, as in Ex. 17.

Word Watch

Review Words

equivalent equations, p. 109
inverse operation, p. 109

Activity **You can use multiplication to solve equations.**

$\frac{x}{2} = 5$ → Multiply each side by 2. $\frac{x}{2} \cdot 2 = 5 \cdot 2$ → Simplify. $x = 10$

Solve the equations.

1. $\frac{y}{5} = 4$ **2.** $\frac{h}{6} = 9$ **3.** $\frac{m}{6} = -3$

4. What operation did you use to solve each division equation? How did you use that operation? Write a rule for solving division equations.

In the activity, you used multiplication to solve equations involving division. Multiplication and division are inverse operations.

Notebook

Multiplication Property of Equality

Words Multiplying each side of an equation by the same nonzero number makes an equivalent equation.

Numbers If $\frac{x}{3} = 4$, then $\frac{x}{3} \cdot 3 = 4 \cdot 3$.

Algebra If $a = b$ and $c \neq 0$, then $ac = bc$.

HELP with Solving

Remember to check your answer by substituting it in the original equation.

EXAMPLE 1 **Solving an Equation Using Multiplication**

	$\frac{y}{3} = 5$	Original equation
	$\frac{y}{3} \cdot 3 = 5 \cdot 3$	Multiply each side by 3 to undo division.
	$y = 15$	Simplify. y is by itself.
✓ Check	$\frac{15}{3} = 5$ ✓	Substitute 15 for y in original equation.

You can use division to solve equations involving multiplication.

Division Property of Equality

Words Dividing each side of an equation by the same nonzero number makes an equivalent equation.

Numbers If $2x = 24$, then $\frac{2x}{2} = \frac{24}{2}$.

Algebra If $a = b$ and $c \neq 0$, then $\frac{a}{c} = \frac{b}{c}$.

Watch Out!

When solving an equation, remember to perform the same operation on each side.

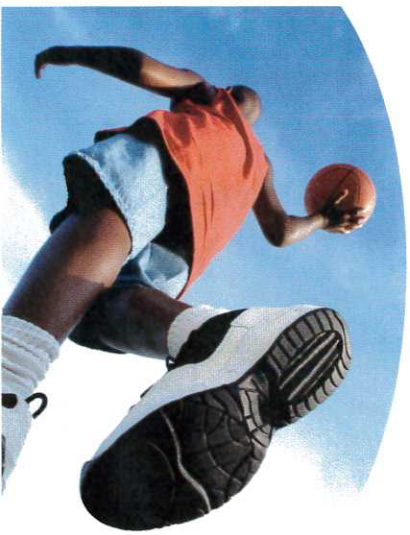
EXAMPLE 2 Solving an Equation Using Division

$-2.5x = 20$	**Original equation**
$\frac{-2.5x}{-2.5} = \frac{20}{-2.5}$	**Divide each side by −2.5 to undo multiplication.**
$x = -8$	**Simplify. *x* is by itself.**

Your turn now **Solve the equation. Check your solution.**

1. $21 = \frac{x}{9}$ **2.** $\frac{x}{3.5} = 14$ **3.** $9x = 54$ **4.** $45 = -9x$

EXAMPLE 3 Writing and Solving an Equation



Sports Fifty-four people show up for a basketball tournament. Write and solve an equation to find how many 3 person teams can be formed.

Solution

Let t be the number of 3 person teams that can be formed.

Total number of people	=	Number per team	·	Number of teams

$54 = 3t$	**Write an algebraic model.**
$\frac{54}{3} = \frac{3t}{3}$	**Divide each side by 3.**
$18 = t$	**Simplify.**

ANSWER Eighteen 3 person teams can be formed.

3.2 Exercises

More Practice, p. 729

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Getting Ready to Practice

1. Vocabulary Copy and complete: To solve $6x = 36$, ? each side of the equation by 6.

Copy and complete the solution. Justify each step.

2. $6x = 72$

$\frac{6x}{?} = \frac{72}{?}$

$x = ?$

3. $\frac{y}{9} = -3$

$\frac{y}{9} \cdot ? = -3 \cdot ?$

$y = ?$

4. Concert You are at a sold-out concert. There are 1950 people at the concert, and the arena has 30 seats in each row.

People at concert = Seats per row · Number of rows

Write and solve an equation to find how many rows of seats there are.

Practice and Problem Solving

HELP with Homework

Example	Exercises
1	5–16
2	5–16
3	17–18

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Solve the equation. Check your solution.

5. $\frac{p}{2} = 9$ **6.** $\frac{t}{8} = 6$ **7.** $14 = \frac{x}{5}$

8. $4x = 32$ **9.** $18 = 6g$ **10.** $3b = 39$

11. $7 = \frac{k}{15}$ **12.** $25 = \frac{h}{14}$ **13.** $\frac{r}{18} = 12$

14. $17y = 51$ **15.** $14h = 35$ **16.** $48 = 96z$

17. Pizza A pizza shop cuts a pizza into 8 slices. One slice costs \$1.10. Which equation can you use to find the cost of the whole pizza?

A. $1.10x = 8$ **B.** $8x = 1.10$ **C.** $\frac{x}{8} = 1.10$ **D.** $x = \frac{1.10}{8}$

18. Mowing Lawns You charged your neighbors \$56 for mowing their lawn 7 times. How much do you charge for mowing the lawn once?

Describe an inverse operation that will undo the given operation.

19. Multiplying by 5 **20.** Dividing by -9 **21.** Adding -6

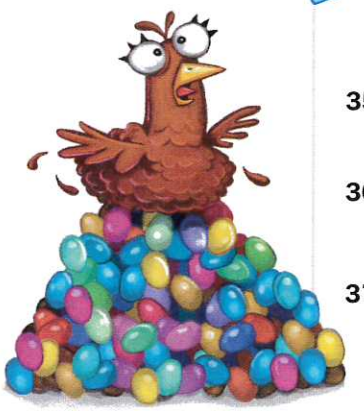
Solve the equation. Check your solution.

22. $12 = -2z$ **23.** $\frac{h}{6} = -36$ **24.** $-3x = -57$

25. $44 = 4.4p$ **26.** $\frac{z}{1.8} = 5$ **27.** $13 = \frac{w}{2.3}$

28. $-2.4k = 48$ **29.** $-21 = -0.7p$ **30.** $\frac{y}{-1.5} = 21$

31. $1368 = 456x$ **32.** $8 = \frac{-b}{5.5}$ **33.** $12m = -25.2$



34. Real Estate A real estate agent receives \$6 for every \$100 of a house's selling price. The agent receives \$10,725 for selling a house. What is the house's selling price?

35. Critical Thinking Write a multiplication equation and a division equation that have the same solution.

36. Challenge Solve the equation.

$$3(6n) + 5(3n) - 2^2n = 261$$

37. Hens About 240 million laying hens produce about 50 billion eggs each year in the United States. About how many eggs does each hen lay in a month? in a week?

Mixed Review

Copy and complete the statement with < or >. *(Lesson 2.1)*

38. $3 \underline{?} -6$ **39.** $-21 \underline{?} -17$ **40.** $-12 \underline{?} -5$ **41.** $0 \underline{?} -3$

Basic Skills **Write the number in words.**

42. 12,448 **43.** 16.02 **44.** 5.107 **45.** 7,540,688

Test-Taking Practice

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46. Multiple Choice Which operation should you perform to solve the equation represented by the verbal sentence?

The quotient of a number and four is the opposite of two.

A. Divide each side by 4. **B.** Multiply each side by 4.

C. Divide each side by −4. **D.** Multiply each side by −4.

47. Short Response Joanne drove for three hours traveling at a constant speed throughout her trip. She traveled a total of 204 miles. Write an equation that represents the situation. Let r represent Joanne's speed. Solve the equation to find her speed. Show all the steps you used to solve the equation.

3.3 Hands-on Activity

GOAL

Use algebra tiles to solve two-step equations.

MATERIALS

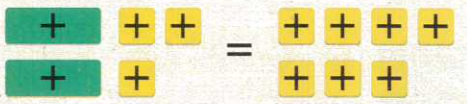
- algebra tiles

Modeling Two-Step Equations

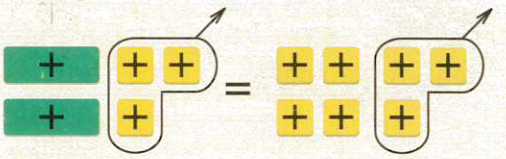
A *two-step equation* is an equation you solve using two operations. You can use algebra tiles to model and solve two-step equations.

Explore 1 **Model and solve $2x + 3 = 7$.**

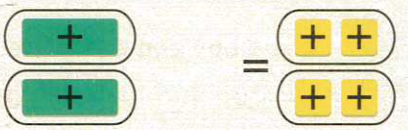
1. Model the equation $2x + 3 = 7$.



2. Remove three 1-tiles from each side.



3. The coefficient of x is 2, so divide the remaining tiles on each side into 2 identical groups.



4. Keep one of these groups. One x-tile is equal to two 1-tiles. So, the solution is 2.

Your turn now **Use algebra tiles to model and solve the equation.**

1. Model each step described below. Draw a picture of each step.

(1 Use algebra tiles to model the equation $3x + 1 = 10$.

(2 Remove one 1-tile from each side.

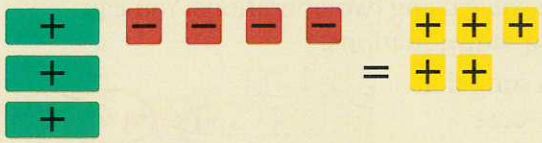
(3 Divide the remaining tiles into three identical groups.

(4 Solve the equation. Then check your solution by substituting in the original equation.

Explore 2 **Model and solve $3x - 4 = 5$. Write the equation at each step.**

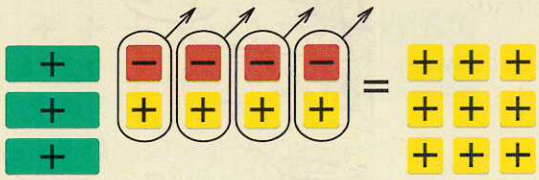
Tile Model **Algebra**

1



$3x - 4 = 5$

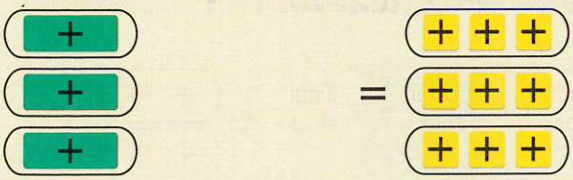
2



$3x - 4 + 4 = 5 + 4$

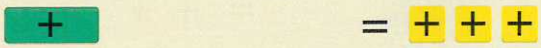
Remove zero pairs.

3



$\frac{3x}{3} = \frac{9}{3}$

4



$x = 3$

Your turn now **Use algebra tiles to model and solve the equation. Write the equation at each step.**

2. $3x + 1 = 7$ **3.** $2x - 3 = 7$ **4.** $4x + 2 = -10$ **5.** $2x - 5 = -9$

Stop and Think

6. Writing Explain what kinds of equations are difficult or impossible to solve using algebra tiles. Give an example.

7. Work Backward Use algebra tiles to write a two-step equation whose solution is 1.

LESSON 3.3

Solving Two-Step Equations

BEFORE You solved one-step equations.

Now You'll solve two-step equations.

WHY? So you can make a plan to earn money, as in Ex. 36.

In the Real World

Word Watch

Review Words

equation, p. 28
solution, p. 28

Music Club You pay $7 to join an Internet music club. You pay $2 for each song that you download. Your cost for joining and downloading some songs is $23. How many songs did you download?

In Example 1, you will answer this question by solving the two-step equation $7 + 2x = 23$. The value of x is the number of songs you downloaded.

EXAMPLE 1 Solving a Real-World Problem

Cost to join	+	Cost per song	•	Number of songs	=	Total Cost

$7 + 2x = 23$	**Write an algebraic model.**
$-7 \qquad -7$	**Subtract 7 from each side to undo addition.**
$2x = 16$	**Simplify.**
$\frac{2x}{2} = \frac{16}{2}$	**Divide each side by 2 to undo multiplication.**
$x = 8$	**Simplify. x is by itself.**

ANSWER You downloaded 8 songs.

Your turn now **Use the equation in Example 1.**

1. Substitute 8 for x in the original equation in Example 1 to check the solution.
2. What is the cost to join the club and download 5 songs?
3. Suppose the cost to join and download songs is $27. How does this change the equation you solve to find the number of songs?

Solving a Two-Step Equation

Some equations require two inverse operations to solve.

$2x + 1 = 5$	**Original equation**
$2x + 1 - 1 = 5 - 1$	**Undo addition or subtraction.**
$2x = 4$	**Simplify.**
$\frac{2x}{2} = \frac{4}{2}$	**Undo multiplication or division.**
$x = 2$	**Simplify.**

HELP with Solving

Another way to undo operations is to add the opposite to undo addition or subtraction. Then multiply by the reciprocal to undo multiplication or division.

EXAMPLE 2 Solving with a Variable in the Numerator

$\frac{x}{2} - 14 = 8$	**Original equation**
$+14 \quad +14$	**Add 14 to each side to undo subtraction.**
$\frac{x}{2} = 22$	**Simplify.**
$\frac{x}{2} \cdot 2 = 22 \cdot 2$	**Multiply each side by 2 to undo division.**
$x = 44$	**Simplify.**
✓ **Check** $\frac{44}{2} - 14 \stackrel{?}{=} 8$	**Substitute 44 for *x* in original equation.**
$22 - 14 = 8$ ✓	

HELP with Review

Remember that you can solve an equation vertically or horizontally. See p. 110.

EXAMPLE 3 Solving with a Negative Coefficient

$8 = 12 - 2x$	**Original equation**
$8 - 12 = 12 - 2x - 12$	**Subtract 12 from each side to undo addition.**
$-4 = -2x$	**Simplify.**
$\frac{-4}{-2} = \frac{-2x}{-2}$	**Divide each side by −2 to undo multiplication.**
$2 = x$	**Simplify.**

Your turn now **Solve the equation. Check your answer.**

4. $13 = 11 + \frac{y}{3}$ **5.** $\frac{z}{5} - 3 = 4$ **6.** $-6x + 5 = 23$ **7.** $6 = 16 - a$

3.3 Exercises

More Practice, p. 729

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Getting Ready to Practice

1. Write the two operations, in order, that you would use to solve the equation $3w - 2 = 7$. Then solve the equation.

2. Find the Error Describe and correct the error in the solution.

$$3x - 9 = 18$$
$$3x = 9$$
$$x = 3$$

Solve the equation. Check your answer.

3. $2x + 1 = 7$ **4.** $3y - 4 = 2$ **5.** $10 - 7z = 3$

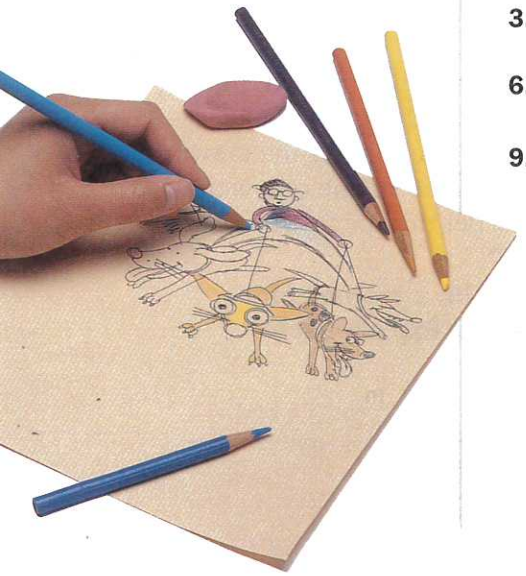
6. $15 = 4p + 7$ **7.** $1 = 2k + 9$ **8.** $11 = \frac{h}{6} + 8$

9. Guided Problem Solving You draw illustrations. You charge \$50 per illustration and \$12 per hour to make changes. You get a check for \$198 to pay for 3 illustrations and changes. How many hours did you spend making changes to the illustrations?

(1 Read the problem. What is the main idea? What do you know and what do you need to find?

(2 You can use the equation $3(50) + 12n = 198$ to find the number of hours you spent making changes to the illustrations. Why is the value of n the number of hours you spent making changes?

(3 Solve the equation and check your answer.



Practice and Problem Solving

HELP with Homework

Example	Exercises
1	10–23
2	24–35
3	10–21, 24–35

Online Resources CLASSZONE.COM
- More Examples
- eTutorial Plus

Solve the equation. Check your answer.

10. $4z + 8 = 12$ **11.** $18 = 4h + 2$ **12.** $29 = 5a + 4$

13. $40 = 8p - 16$ **14.** $100 - 7r = 44$ **15.** $8q - 9 = -7$

16. $6 + 2c = 15$ **17.** $3g + 4 = 13$ **18.** $-9 + 2k = -25$

19. $-36 = 18 - 6x$ **20.** $7 + 5b = -23$ **21.** $10 = 2d + 11$

22. Measurement To find the number of inches in 5 feet 4 inches, you can evaluate the expression $5(12) + 4$. The diameter of the largest cookie ever made was 81 feet 8 inches. Write and evaluate an expression that will give the diameter of the cookie in inches.

23. Hiking Trails Students are cleaning up 11 miles of trails in a local park. After an hour, they have cleaned about 3 miles of trails. Solve the two-step equation $3h + 3 = 11$. Explain why the value of h is an estimate of the number of hours it will take to finish.

Solve the equation. Check your answer.

24. $3 = 12 - 3x$

25. $-7 = 7 - 2r$

26. $20 - 6w = 14$

27. $9p + 8 = -7$

28. $\frac{x}{9} - 4 = 5$

29. $-7 + \frac{z}{4} = 3$

30. $8 = 5 + \frac{m}{2}$

31. $3 + \frac{t}{5} = 14$

32. $32 = 17 + \frac{d}{2}$

33. $2 - z = 9$

34. $11 - b = 34$

35. $\frac{c}{3} - 7 = 1$

36. Walking Dogs You earn money by walking dogs in your neighborhood. One neighbor pays you \$20 each week, and other neighbors pay you \$5 per walk. If your goal is to earn \$50 per week, how many walks do you need to do at \$5 each? To answer this question, solve the equation $20 + 5w = 50$.

37. Phone Card You have \$2.10 remaining on your phone card. You pay 7 cents for each minute of a call and a 75 cent charge for using a pay phone. If you make a call from a pay phone, what is the maximum whole number of minutes that you can talk? (*Hint:* The cost is the sum of the pay phone charge and 7 cents per minute for your call.)

Compare and Contrast In Exercises 38 and 39, a method for solving the equation $2(m + 3) = 18$ is shown. Explain each step of the solution.

38.

$$2(m + 3) = 18$$
$$2m + 6 = 18$$
$$2m + 6 - 6 = 18 - 6$$
$$2m = 12$$
$$\frac{2m}{2} = \frac{12}{2}$$
$$m = 6$$

39.

$$2(m + 3) = 18$$
$$\frac{2(m + 3)}{2} = \frac{18}{2}$$
$$m + 3 = 9$$
$$m + 3 - 3 = 9 - 3$$
$$m = 6$$

Choose a Method In Exercises 40–42, use one of the methods in Exercises 38 and 39 to solve the equation.

40. $3(r + 1) = 9$

41. $4 = -1(z + 11)$

42. $6\left(\frac{1}{3} + h\right) = 20$

Challenge Solve the equation.

43. $2(10 + x) + 4(12 - x) = 34$

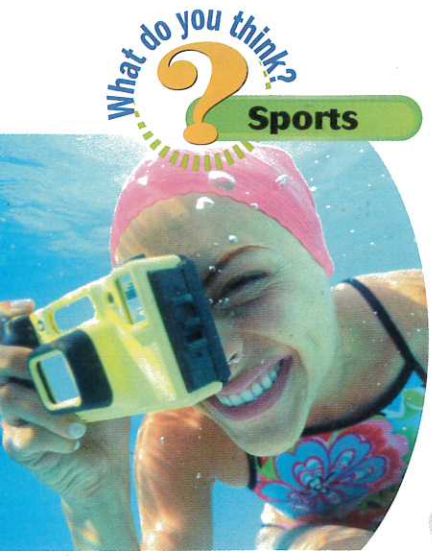
44. $-5(3 - z) + 1(z - 9) = 0$

Extended Problem Solving **In Exercises 45–47, use the given information about the cost of using the city pool.**

45. **Evaluate and Explain** Evaluate the expression $3(40) + 12$. What does the answer tell you about the payment plans?

46. **Interpret** Solve the two-step equation $3x + 12 = 100$. What does the answer tell you about the payment plans?

47. **Compare and Contrast** For each payment plan, give one reason why you might choose it.



Swimming

About 8% of adults in the United States say that swimming is one of their three favorite leisure activities. About how many students would be 8% of your class? of your school?

Mixed Review

Solve the equation. Check your answer. *(Lessons 3.1, 3.2)*

48. $p + 9 = 19$ **49.** $13 = n - 6$ **50.** $-20 = 4x$ **51.** $\frac{1}{2}y = 24$

Choose a Strategy **Use a strategy from the list to solve the following problem. Explain your choice of strategy.**

52. A running club has six members. The instructor wants each member to race one-on-one against every other member. How many times will each member race? How many races will there be altogether?

Problem Solving Strategies
- Guess, Check, and Revise
- Draw a Diagram
- Look for a Pattern

Basic Skills **Write the number as a percent.**

53. $\frac{1}{2}$ **54.** 0.75 **55.** $\frac{20}{100}$ **56.** 0.35

Test-Taking Practice

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57. **Multiple Choice** Solve the equation $21 = 3x + 9$.

A. -2 **B.** 4 **C.** 10 **D.** 16

58. **Short Response** Jamie is a certified youth soccer referee. After completing a course that cost \$24, she earned \$16 per game. Her profit in the first season was \$280. Which equation should you use to find g, the number of games Jamie refereed? Explain.

A. $16g + 24 = 280$ **B.** $16g - 24 = 280$

LESSON 3.4

Writing Two-Step Equations

BEFORE	Now	WHY?
You solved two-step equations.	You'll solve problems by writing two-step equations.	So you can calculate sandwich sales, as in Ex. 9.

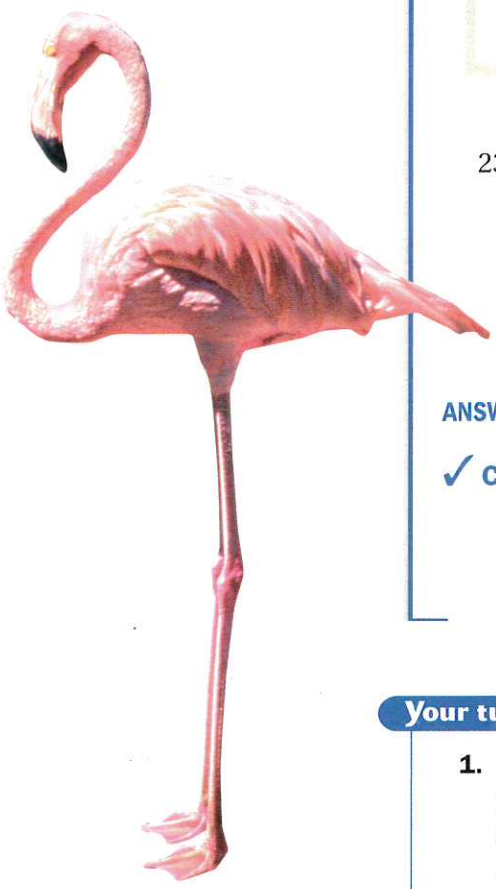
Word Watch

Review Words

equation, p. 28
solution, p. 28

In the Real World

American Flamingos This year, a zoo spent $1580 to feed its American flamingos. Next year, its budget for feeding the flamingos is $2370. Next year it will cost $395 to feed each additional flamingo. How many additional flamingos can the zoo buy? You can use a verbal model to help you write a two-step equation.



EXAMPLE 1 Writing and Solving a Two-Step Equation

You can write and solve a two-step equation to find how many additional flamingos the zoo can buy. Write a verbal model. Let n be the number of additional flamingos.

Budget available	=	Cost of each new flamingo	•	Number of new flamingos	+	Cost of existing flamingos

$2370 = 395n + 1580$	**Write an algebraic model.**
$2370 - 1580 = 395n + 1580 - 1580$	**Subtract 1580 from each side.**
$790 = 395n$	**Simplify.**
$\frac{790}{395} = \frac{395n}{395}$	**Divide each side by 395.**
$2 = n$	**Simplify.**

ANSWER The zoo can buy 2 additional flamingos next year.

✓ **Check** $2370 \stackrel{?}{=} 395(2) + 1580$ **Substitute 2 for n in original equation.**

$2370 \stackrel{?}{=} 790 + 1580$

$2370 = 2370$ ✓

Your turn now **Write a two-step equation to solve the problem.**

1. It costs a zoo $1150 per year to feed its Aldabra tortoises. Each additional tortoise will cost $575 per year to feed. The zoo's budget for the tortoises' food next year is $2875. Write and solve an equation to find how many new tortoises the zoo can buy next year.

EXAMPLE 2 Writing and Solving a Two-Step Equation

The sum of 4 times a number and -6 is 14. What is the number?

Solution

4 times **a number** and -6 is 14.	**Write a verbal model.**
$4 \cdot n + (-6) = 14$	**Translate.**
$4n - 6 = 14$	**Write equation.**
$4n - 6 + 6 = 14 + 6$	**Add 6 to each side.**
$4n = 20$	**Simplify.**
$\frac{4n}{4} = \frac{20}{4}$	**Divide each side by 4.**
$n = 5$	**Simplify.**

HELP with Solving

Remember that adding -6 is the same as subtracting 6.

Your turn now **Write a two-step equation to find the number.**

2. The difference of six times a number and 9 is -3. What is the number?

3. The sum of a number divided by 6 and -5 is -2. What is the number?

EXAMPLE 3 Writing and Solving a Two-Step Equation

Reading You have to read several books for a class. You want to find how many pages you need to read per week in order to finish by the time the term is over. There are a total of 1244 pages. You have already read 500 pages. If there are six weeks left in the term, how many pages do you have to read per week?

Solution

Let p be the number of pages to read per week.

Total pages	=	Weeks left	•	Pages per week	+	Pages I've read

$1244 = 6p + 500$	**Write an algebraic model.**
$1244 - 500 = 6p + 500 - 500$	**Subtract 500 from each side.**
$744 = 6p$	**Simplify.**
$\frac{744}{6} = \frac{6p}{6}$	**Divide each side by 6.**
$124 = p$	**Simplify.**

ANSWER You have to read 124 pages per week.

3.4 Exercises

More Practice, p. 729

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Getting Ready to Practice

Match the statement with the correct equation.

1. The sum of 3 and a number is 16. **A.** $3n - 2 = 16$
2. The product of 3 and a number is 16. **B.** $3(2n) = 16$
3. The difference of three times a number and 2 is 16. **C.** $3n = 16$
4. The product of 3 and twice a number is 16. **D.** $3 + n = 16$
5. **Bicycle Rental** A bicycle rental shop charges \$5 per hour plus a fee of \$10 each time you rent a bicycle. Which equation can you use to find the number of hours you can rent a bicycle if you have \$45?

   A. $5h + 10 = 45$ **B.** $10h + 5 = 45$ **C.** $5 + h + 10 = 45$

6. **Guided Problem Solving** You and your friends decide to have a car wash as a fundraiser. You spend \$15 on supplies and charge \$6 per car. At the end of the day your profit is \$93. How many cars did you and your friends wash?

   (1 Write a verbal model.

   (2 Translate your verbal model into an algebraic model.

   (3 Solve the equation.

   (4 Check that your answer is reasonable.

Practice and Problem Solving

HELP with Homework

Example	Exercises
1	9–13
2	7–8
3	9–13

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- More Examples
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In Exercises 7 and 8, translate the statement into an equation. Then solve the equation.

7. The sum of 5 times a number and 4 is 9.
8. Seven subtracted from the quotient of a number and 2 is -6.
9. **Restaurant** At a restaurant one day, 60 sandwiches are sold in total, some on rye bread and some on white bread. The number of sandwiches sold on rye bread is twice the number sold the day before. The number of sandwiches on white bread is 28. How many sandwiches on rye bread were sold yesterday?
10. **Hourly Wage** You had \$20 at the beginning of the week. You worked 10 hours during the week and ended the week having \$70. How much do you earn each hour?

11. **Writing** Write a word problem that can be modeled by the equation $5x - 6 = 9$.

12. **Party Supplies** You need 124 plastic forks for a party. At one store you buy 5 boxes that contain 8 forks each. At another store you find boxes that contain 12 forks each. How many of these boxes do you need to buy?

13. **Magazine Subscription** You subscribe to a magazine that costs \$26 yearly. You make an initial payment of \$5 and then make three equal payments. How much is each payment?

14. **Critical Thinking** Write a one-step equation and a two-step equation that both have 8 as a solution.

In Exercises 15–18, translate the statement into an equation. Then solve the equation.

15. The sum of 2 times a number and 5 is 12.

16. The difference of the product of 3 and a number and $-\frac{1}{2}$ is $-\frac{5}{2}$.

17. The sum of -2 times a number and 3.5 is 7.5.

18. Three less than the quotient of a number and 2 is 8.

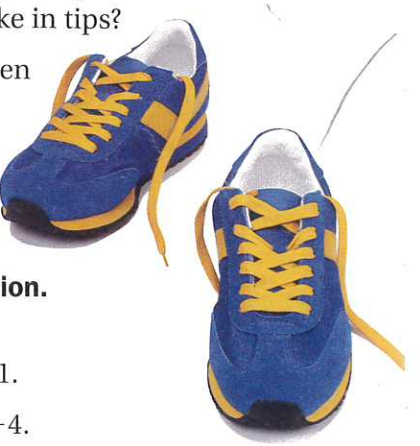
19. **School Fair** The senior class at your school made a \$300 profit at the school fair by having a dunk tank. The dunk tank cost \$125 to rent, and the senior class charged \$5 for each person to play. How many people played?

20. **Taxicab** A taxicab charges a \$2 fee plus an additional \$1.50 for every mile driven. Your cab ride cost \$17. How many miles did you travel?

Critical Thinking Exercises 21 and 22 are missing information. Tell what information is needed in order to solve the problem.

21. You have a job in which you make \$6 per hour plus tips. You made a total of \$34 yesterday. How much did you make in tips?

22. To train for a race, you jog for 5 minutes and then you run for 20 minutes. For each week after, you jog for 5 minutes, but increase the time that you run. After how many weeks will you be training for a total of 85 minutes?



Challenge Translate the statement into an equation. Then solve the equation.

23. The product of a number divided by 5 and 2 is 1.

24. The sum of 2 and 3, plus 3 times a number, is -4.

25. The quotient of -36 and 9, subtracted from 4 times a number, is -8.

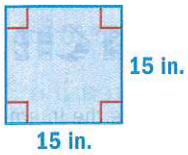
26. The product of 8 squared divided by 16 and a number is 24.

Mixed Review

Find the perimeter and area of the rectangle or square. *(Lesson 1.6)*

27.

28.



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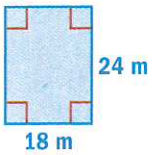

Solve the equation. *(Lessons 2.7, 3.3)*

30. $2(x + 5) = 30$ **31.** $2x + 8(-2) = 54$ **32.** $3(t - 6) = 9$

Test-Taking Practice

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33. Multiple Choice Which equation has the solution -2?

A. $2x + 7 = 11$ **B.** $2x - 7 = -3$ **C.** $2x + 7 = 8$ **D.** $2x - 7 = -11$

34. Extended Response Mr. Andreas has a video rental business. The table shows how much he charges to rent videos. Write an equation that could be used to find the cost of renting x videos. Explain how you found your equation. Use your equation to find the cost of renting 10 videos.

Videos	Price
1	$4.00
2	$6.00
3	$8.00
4	$10.00
5	$12.00
6	$14.00

BRAIN GAME

Behind the Magic

- Choose any number.
- Multiply the number by 2.
- Add 14. Divide by 2.
- Subtract the number you started with.
- Multiply by 3. Your answer is 21.

To figure out why the answer is always 21, let x be the number you choose and write an algebraic expression that shows all of the steps. Then simplify the expression. What is your answer?

3.4 Technology Activity

INTERNET

Searching for Information

GOAL Use the Internet to search for information necessary to write an equation.

Example **A class is planning a trip to the Naismith Memorial Basketball Hall of Fame in Springfield, Massachusetts. The class has $190 to spend on admission. There are 35 students in the class. How many adults can they afford to bring?**

Solution

Follow these steps to perform a search on the Internet:

1. Pick a search engine.
2. Type keywords that cover the topic you would like to search. Then select Search.
3. Of the results the search engine finds, pick a site that is likely to have the information you need.

Use the steps described above to find the prices for students and adults. (*Hint:* There are over 35 people going, so the group rates would apply.)

Amount to spend	=	Number of students	•	Price per student	+	Number of adults	•	Price per adult

Your turn now **Use the results of your search.**

1. Write and solve an equation to solve the problem in the example.
2. Your class is planning a trip to a museum. Use the Internet to research prices for student and adult tickets at a nearby museum. If your class has $200 to spend on admission, how many adults can you afford to bring?

LESSONS 3.1 TO 3.4

Notebook Review

Notebook

Review the vocabulary definitions in your notebook.

Copy the review examples in your notebook. Then complete the exercises.

Check Your Definitions

equivalent equations, p. 109 *inverse operation*, p. 109

Use Your Vocabulary

1. Name two pairs of inverse operations.

3.1 Can you solve addition and subtraction equations?

Review

EXAMPLE Solve the equation.

$x - 23 = 9$	**Original equation**	$y + 17.3 = 68.8$	**Original equation**
$\underline{+23} \quad \underline{+23}$	**Add 23 to each side.**	$\underline{-17.3} \quad \underline{-17.3}$	**Subtract 17.3 from each side.**
$x = 32$	**Simplify.**	$y = 51.5$	**Simplify.**

Solve the equation.

2. $c + 14 = 3$ **3.** $y - 31 = 11$ **4.** $7.7 = s - 4.3$

5. $2 = r - 45$ **6.** $29 = 40 + p$ **7.** $b + 3.09 = -5.91$

3.2 Can you solve multiplication and division equations?

Review

EXAMPLE Solve the equation.

$\frac{y}{4} = -8$	**Original equation**	$-7x = -56$	**Original equation**
$\frac{y}{4} \cdot 4 = -8 \cdot 4$	**Multiply each side by 4.**	$\frac{-7x}{-7} = \frac{-56}{-7}$	**Divide each side by −7.**
$y = -32$	**Simplify.**	$x = 8$	**Simplify.**

Solve the equation.

8. $\frac{m}{3} = 9$ **9.** $\frac{h}{5} = -8$ **10.** $-5 = \frac{w}{-11}$

11. $-15n = 60$ **12.** $-25x = 0$ **13.** $7 = 3.5t$

3.3–3.4 Can you write and solve two-step equations?

Review

EXAMPLE A catering company charges \$100 for setup plus \$15 per guest. How many guests can be served within a \$1000 budget?

Solution

Setup	+	Cost per guest	•	Number of guests	=	Budget

$100 + 15n = 1000$ **Write an algebraic model.**

$15n = 900$ **Subtract 100 from each side.**

$n = 60$ **Divide each side by 15.**

ANSWER Sixty guests can be served within a \$1000 budget.

14. You are stuffing 560 envelopes for a school event. By 1:00 P.M., you have stuffed 140 envelopes. How many envelopes an hour do you need to stuff to finish by 5:00 P.M.?

Stop and Think about Lessons 3.1–3.4

15. **Critical Thinking** How is the order of the steps you use to solve a two-step equation related to the order of operations for evaluating expressions?

Review Quiz 1

Solve the equation.

1. $x - 16 = 8$ **2.** $-330 = -10x$ **3.** $42 = \frac{1}{6}x$ **4.** $5x - 12 = 23$

5. **Field Trip** Your class is going to a museum. Your teacher buys 32 tickets that are all the same price. The total charge for all the tickets is \$256. Write and solve an equation to find the price of one museum ticket.

Translate the statement into an equation. Then solve.

6. The sum of 10 times a number and 5 is -15.

7. The difference of 4 times a number and -7 is 39.

8. **Bicycle** Mary wants to buy a bicycle that costs \$280. Her parents agree to pay half. Mary will save \$20 a week. Write and solve an equation to find how long it will take her to save enough money.

3.5 Problem Solving Strategies

- Guess, Check, and Revise
- Look for a Pattern
- Act It Out
- Work Backward
- Draw a Diagram
- Solve a Simpler Problem
- Draw a Graph

Draw a Diagram

Problem Your class is hosting a science fair. Your classroom is 30 feet by 20 feet. You need to keep a 10 foot by 10 foot space empty for a demonstration. How much space do you have left for exhibits?

1 Read and Understand

Read the problem carefully.

- You need to find the area of the room after the demonstration space is identified.

2 Make a Plan

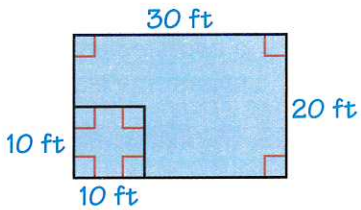
Decide on a strategy to use.

One way to see the situation is to draw a diagram. To solve this problem, you can draw a diagram of the classroom.

3 Solve the Problem

Reread the problem and draw a diagram.

First, draw and label a diagram of the classroom.



Next, draw a space to save for the demonstration. The problem doesn't specify where the space needs to be, so you might choose to put it in one corner.

The space available for exhibits is the total area of the classroom minus the area kept for the demonstration.

Total Area $= 30 \times 20$ **Demonstration Area** $= 10 \times 10$

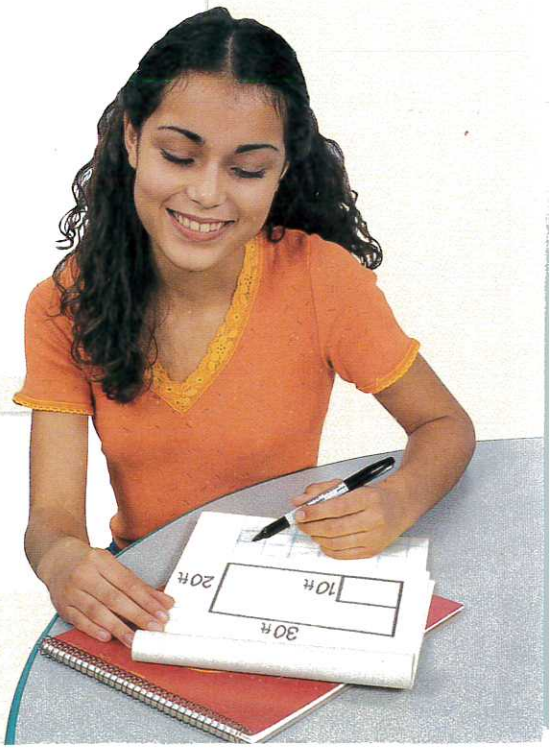
Area for Exhibits = Total Area − Demonstration Area

$= 30 \times 20 - 10 \times 10$ **Write an algebraic model.**

$= 600 - 100$ **Multiply.**

$= 500$ **Subtract.**

Area is measured in square units, so the area for exhibits is 500 square feet.



4 Look Back

When the question involves measurements, check to be sure your answer includes the appropriate units.

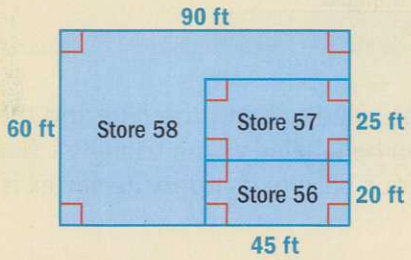
Practice the Strategy

Use the strategy *draw a diagram.*

1. **Restaurant Space** Your favorite pizza place has a new addition. The original building was 30 feet by 16 feet. The addition is 12 feet by 16 feet. What is the total area of the building with the addition?

2. **Cafeteria** Mark, Kristine, Todd, and Alia are in line for lunch at the cafeteria in that order. Kristine lets Alia cut in front of her. Mark lets Todd cut in back of him. Todd then lets Kristine cut in front of him. In what order are they now?

3. **Mall Stores** Stores rent space in a mall. If the cost to rent Store 58 is $35 per square foot, what is the total rent for the store?



4. **School Gym** A gym is 100 feet by 70 feet. Bleachers are along both 100 foot sides of the gym. The bleachers are 4 feet deep when closed. When open, they are 9 feet deep. Compare the available area in the gym when the bleachers are closed to when they are open.

5. **Classrooms** Two classrooms are the same size. Each has seating for 28 students. In one room, each student has a desk and chair that take up 9 square feet. In the other room, each group of 4 students shares a table and chairs that take up 35 square feet. Each room also has one large table that takes up 15 square feet. Which room has more walking space?

Mixed Problem Solving

Use any strategy to solve the problem.

6. **Internet Sales** In May 2001, spending on online auctions was $556 million, about $\frac{2}{3}$ of which was through one auction site. What was the total spending on auctions at that site in May 2001?

7. **Survey** A group of 1238 students in grades 7–12 were asked to name the reasons for community involvement. How do you know that some students gave more than one answer? Graph the data.

Reason	Number
Makes me feel good	842
Fun to do	829
Right thing to do	805

8. **Video Games** In a video game, when you reach 50 points, you reach Level 2. You need 70 more points to reach Level 3, and then you need 90 more points to reach Level 4. How many points do you need to reach Level 7 without skipping any levels?

9. **Creating a Maze** You are painting a 10 foot by 10 foot maze at your school. Inside the maze will be a 2 foot by 2 foot area that is the goal. What is the longest path you can create if the path, including lines, is one foot wide? Draw one solution. Explain how you know you have found the longest path.

LESSON 3.5

Applying Geometric Formulas

BEFORE You measured rectangles.

Now You'll use formulas for perimeter and area.

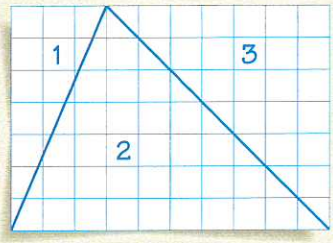
WHY? So you can evaluate advertising claims, as in Ex. 26.

Word Watch

base, p. 134
height, p. 134

Activity **You can use a model to find the area of a triangle.**

1. Copy the diagram on graph paper.
2. Cut out the three pieces.
3. Arrange the pieces to make two equal-sized triangles.



4. Compare the height of triangle 2 to the height of the original rectangle. What is the area of the rectangle? of triangle 2?
5. Draw your own triangle on graph paper so that its longest side is a side of the rectangle and the vertex touches the opposite side. Find its area by following the steps above.
6. Write a formula for the area of a triangle.

To find the area of a triangle, you need to know the *base* and the *height*. Any side of a triangle can be labeled as the triangle's **base**. The perpendicular distance from a base to its opposite vertex is the **height** of a triangle.

Notebook

Area and Perimeter of a Triangle

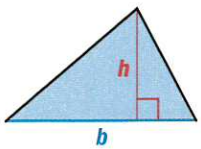
Words The *area* of a triangle is one half the product of its base b and height h.

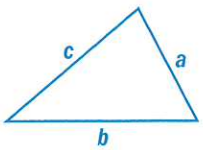
The *perimeter* of a triangle is the sum of the lengths of all three sides a, b, and c.

Algebra $A = \frac{1}{2}bh$

$P = a + b + c$

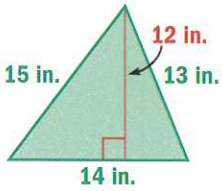
Diagram





EXAMPLE 1 Finding Area and Perimeter of a Triangle

Find the area and perimeter of the triangle.



$A = \frac{1}{2}bh$

$= \frac{1}{2}(14)(12)$

$= 84 \text{ in.}^2$

$P = a + b + c$

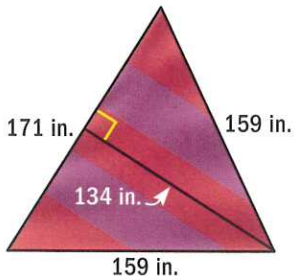
$= 13 + 14 + 15$

$= 42 \text{ in.}$

EXAMPLE 2 Finding the Area of a Triangle

Sailboats Find the area of the sail.

Solution



$A = \frac{1}{2}bh$	**Write area formula.**
$= \frac{1}{2}(171)(134)$	**Substitute values.**
$= 11{,}457$	**Multiply.**

ANSWER The area of the sail is 11,457 square inches.

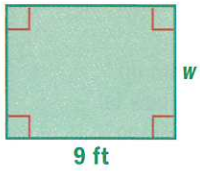
Your turn now **Use the given information about the triangle.**

1. Its height is 9 inches and its base is 10 inches. Find its area.
2. Its side lengths are 4 feet, 6 feet, and 2.5 feet. Find its perimeter.

Now that you can solve equations, you can use area and perimeter formulas to find missing dimensions of geometric shapes.

EXAMPLE 3 Finding a Missing Width

Find the width of the rectangle shown if the area is 63 square feet.



$A = lw$	**Write area formula.**
$63 = 9w$	**Substitute values.**
$\frac{63}{9} = \frac{9w}{9}$	**Divide each side by 9.**
$7 = w$	**Simplify.**

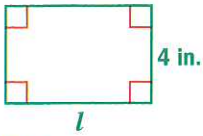
ANSWER The width of the rectangle is 7 feet.

HELP with Review

If you need help with area and perimeter of squares and rectangles, see p. 33.

EXAMPLE 4 Finding a Missing Length

The rectangle has a perimeter of 20 inches. Find the length of the rectangle.

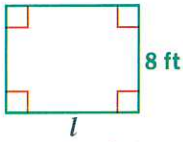


$P = 2l + 2w$	**Write perimeter formula.**
$20 = 2l + 2(4)$	**Substitute 20 for P and 4 for w.**
$20 = 2l + 8$	**Multiply.**
$20 - 8 = 2l + 8 - 8$	**Subtract 8 from each side.**
$12 = 2l$	**Simplify.**
$\frac{12}{2} = \frac{2l}{2}$	**Divide each side by 2.**
$6 = l$	**Simplify.**

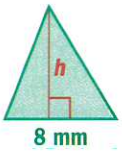
ANSWER The length of the rectangle is 6 inches.

Your turn now **Find the unknown dimension.**

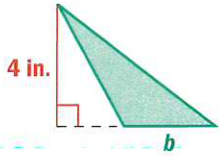
3. Perimeter = 36 ft



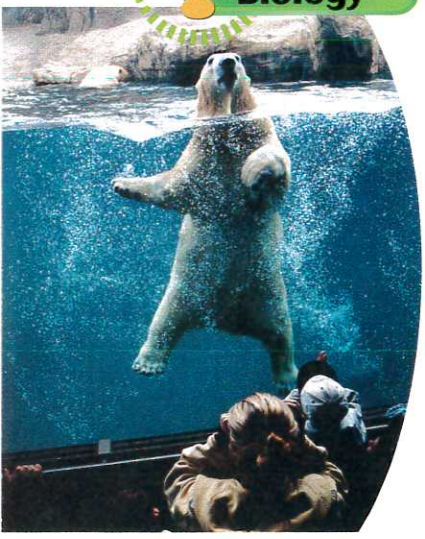
4. Area = 32 mm^2



5. Area = 6 $in.^2$



What do you think? Biology

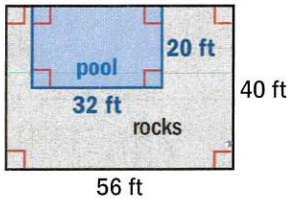


Polar Bears

Polar bears can swim up to 6.2 mi/h. About how far can a polar bear swim in 6 minutes?

EXAMPLE 5 Using an Area Formula

Zoo A polar bear exhibit includes a pool and a region with rocks for climbing. Find the area of the region with rocks.



Solution

Let r be the area of the region with rocks.

Total area	=	Area of pool	+	Area of rock region

$40 \cdot 56 = 20 \cdot 32 + r$	
$2240 = 640 + r$	**Write an algebraic model.**
$2240 - 640 = 640 - 640 + r$	**Subtract 640 from each side.**
$1600 = r$	**Simplify.**

ANSWER The area of the region with rocks is 1600 square feet.

3.5 Exercises

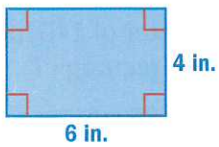
More Practice, p. 729

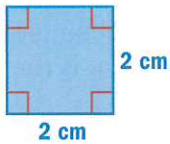
INTERNET eWorkbook Plus CLASSZONE.COM

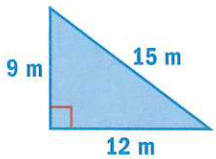
Getting Ready to Practice

1. **Vocabulary** Copy and complete: In order to find the area of a triangle, you need to know the length of a(n) ? and the ?.

Find the area and perimeter of the figure.

2. 

3. 

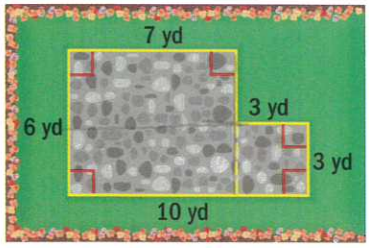
4. 

5. **Guided Problem Solving** Find the area of the patio shown at the right.

(1) Find the area of the rectangle.

(2) Find the area of the square.

(3) Add the two areas.



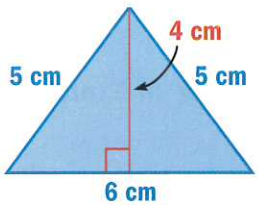
Practice and Problem Solving

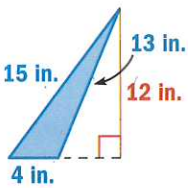
HELP with Homework

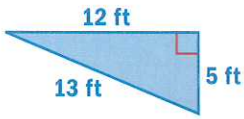
Example	Exercises
1	6–8
2	6–8
3	9–11
4	12–14, 17
5	21–23

Online Resources CLASSZONE.COM
- More Examples
- eTutorial Plus

Find the area and perimeter of the triangle.

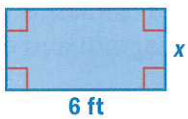
6. 

7. 

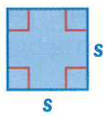
8. 

Find the unknown dimension.

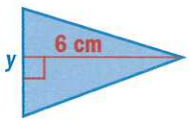
9. $A = 18\ \text{ft}^2$



10. $A = 49\ \text{in.}^2$

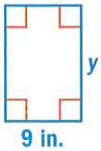


11. $A = 12\ \text{cm}^2$

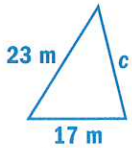


Find the unknown dimension.

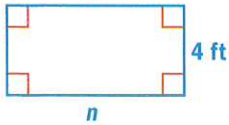
12. $P = 44$ in.



13. $P = 60$ m



14. $P = 24$ ft



15. Find the Error Describe and correct the error in the solution.

$$A = \frac{1}{2}(5 \text{ in.})(4 \text{ in.})$$
$$A = \frac{1}{2}(20 \text{ in.})$$
$$A = 10 \text{ in.}$$

16. Critical Thinking Explain how the formulas for the perimeter and area of a rectangle can be used to find the perimeter and area of a square.

Find the dimension.

17. A rectangle has a perimeter of 146 inches and a length of 49 inches. What is the width of the rectangle?

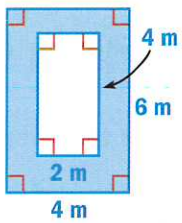
18. A triangle has an area of 36 square meters and a height of 8 meters. What is the length of its base?

19. A triangle has an area of 5 square meters and a base of $2x$. What is the height of the triangle in terms of x?

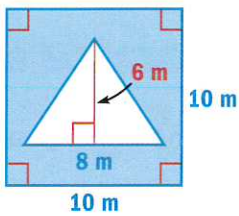
20. A rectangle has an area of 70 square inches and a width of $3.5w$. What is the length of the rectangle in terms of w?

Find the area of the shaded region in the figure.

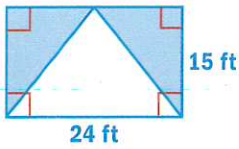
21.



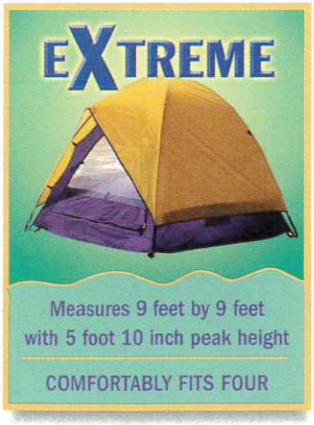
22.



23.



Extended Problem Solving In Exercises 24–26, use the tent advertisement shown.



24. Calculate Find the area of the tent floor.

25. Estimate Estimate the dimensions of a rectangular sleeping bag and find its area.

26. Critical Thinking Do you think this tent will comfortably fit four sleeping bags? Draw a diagram and explain your answer.

Critical Thinking Explain how the area of a triangle changes if you change the triangle as described.

27. Double the height.

28. Double the base.

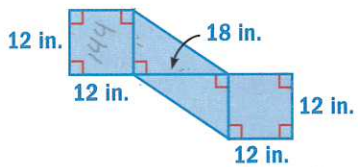
29. Double both the height and the base.

30. Change its shape, but not its base or height.

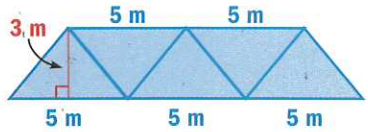
31. Sharing Space Michelle and her sister Kate share a bedroom that is 18 feet by 14 feet. They want to divide the room so that each sister has half the area. Kate marks out her space. It is a square with sides 11 feet long in the center of the room. Does Kate have half the area of the room? Explain.

Find the area of the figure.

32.



33.



34. Challenge A roll of weather stripping for windows is about 6 feet long. How many rolls are needed to go around three square windows that measure 3 feet on each side, and one rectangular window that measures 3 feet by 5 feet?

Mixed Review

Find the sum or difference. *(Lessons 2.2, 2.3)*

35. $-18 - 42$ **36.** $-21 - (-14)$ **37.** $8 - (-10) - (-3)$

38. $15 + (-10)$ **39.** $-20 + (-12)$ **40.** $11 + (-5) + (-8)$

In Exercises 41–43, evaluate the expression when $a = 2$, $b = -5$, and $c = -7$. *(Lessons 2.3, 2.4)*

41. $a - b$ **42.** $c + b^2$ **43.** $abc - bc$

44. You have \$80 today. If you save \$40 a week, how many weeks will it take to save enough to buy a camera that costs \$320? How many weeks will it take if you save \$35 a week? *(Lesson 3.4)*

Basic Skills Copy and complete the statement with <, >, or =.

45. $3 \underline{?} -3$ **46.** $-5 \underline{?} -6$ **47.** $-17 \underline{?} -13$ **48.** $13 \underline{?} |13|$

Test-Taking Practice

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49. Multiple Choice A rectangular garden has an area of 64 square feet. Its length is 16 feet. Which equation can you use to find the width?

A. $64 - x = 16$ **B.** $x + 16 = 32$ **C.** $64x = 16$ **D.** $16x = 64$

50. Multiple Choice What is the length of a rectangular room that is 22 feet wide with a perimeter of 114 feet?

F. 20 feet **G.** 25 feet **H.** 30 feet **I.** 35 feet

LESSON 3.6

Solving Inequalities Using Addition or Subtraction

BEFORE	Now	WHY?
You solved equations using addition or subtraction.	You'll solve inequalities using addition or subtraction.	So you can find how much to improve your distance, as in Ex. 40.

Word Watch

inequality, p. 140
solution of an inequality, p. 140
equivalent inequalities, p. 141

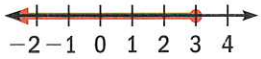
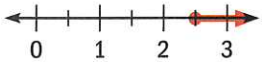
In the Real World

Disc Golf In a game of disc golf, the target is beyond a pond the far end of which is 300 feet away. Your first throw travels 134 feet. How far does your second throw have to go in order to clear the pond? You will use an inequality to answer this question in Example 3.

Inequalities An **inequality** is a statement formed by placing an inequality symbol between two expressions, such as $x \le 6$. The **solution of an inequality** is the set of numbers that you can substitute for the variable to make the inequality true.

You can graph the solution of an inequality using a number line. When graphing inequalities with > or <, use an open circle. When graphing inequalities with ≥ or ≤, use a closed circle.

EXAMPLE 1 Graphing Inequalities

Inequality	Graph	Verbal Phrase
a. $y < 7$		All numbers less than 7
b. $q \le 3$		All numbers less than or equal to 3
c. $x > -5$		All numbers greater than −5
d. $h \ge 2\frac{1}{2}$		All numbers greater than or equal to $2\frac{1}{2}$

Your turn now Graph the inequality.

1. $z \ge -1$ **2.** $4 > p$ **3.** $k \le -3.5$ **4.** $m > \frac{1}{2}$

When you solve an inequality, you find all solutions of the inequality. Inequalities that have the same solutions are **equivalent inequalities**.

Notebook: Addition and Subtraction Properties of Inequality

Words Adding or subtracting the same number on each side of an inequality produces an equivalent inequality.

Algebra If $a > b$, then $a + c > b + c$.

If $a > b$, then $a - c > b - c$.

HELP with Solving

Remember that the inequality symbols can be read as follows.
> "greater than"
< "less than"
≥ "greater than or equal to"
≤ "less than or equal to"

EXAMPLE 2 Solving Inequalities

Solve the inequality. Then graph its solution.

a. $x - 5 < 8$ **Original inequality**

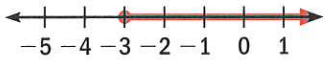
$x - 5 + 5 < 8 + 5$ **Add 5 to each side.**

$x < 13$ **Simplify.**

b. $y - 7 \geq -10$ **Original inequality**

$y - 7 + 7 \geq -10 + 7$ **Add 7 to each side.**

$y \geq -3$ **Simplify.**



c. $8 + m > 15$ **Original inequality**

$8 - 8 + m > 15 - 8$ **Subtract 8 from each side.**

$m > 7$ **Simplify.**

Your turn now **Solve the inequality. Then graph its solution.**

5. $x - 3 > -2$ **6.** $6 > t - 1$ **7.** $12 \geq p + 14$

EXAMPLE 3 Writing and Solving an Inequality

Disc Golf Using an inequality, you can find the distance needed to clear the pond described on page 140.

Let d be the distance needed to clear the pond on your second throw.

Distance of 2nd throw	+	Distance of 1st throw	>	Distance to far end of pond

$d + 134 > 300$	**Write an algebraic model.**
$d + 134 - 134 > 300 - 134$	**Subtract 134 from each side.**
$d > 166$	**Simplify.**

ANSWER Your second throw needs to travel more than 166 feet.

3.6 Exercises

More Practice, p. 729

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Getting Ready to Practice

1. Vocabulary Copy and complete: $-4 + x < -6$ and $x < -2$ are ? .

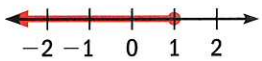
Matching Match the inequality with its graph.

2. $x < -1$

3. $x \leq 1$

4. $x \geq 1$

5. $x > -1$

A.


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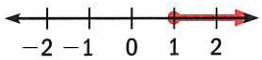
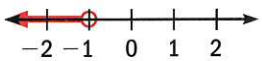
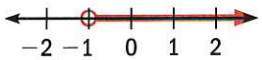


C.


D.


Solve the inequality. Then graph its solution.

6. $x - 5 < 5$ **7.** $8 > t + 10$ **8.** $12 + p > 7$

9. Guided Problem Solving On four tests you scored 90, 85, 98, and 87. To earn a B in math class, you need at least 425 points on 5 tests. Write and solve an inequality that represents the possible test scores you could get on your fifth test and still get at least a B in the class.

(1 Add your current scores.

(2 Let x represent the fifth score. Write and solve the inequality.

(3 Graph the possible test scores.

Practice and Problem Solving

HELP with Homework

Example	Exercises
1	10–21
2	22–30
3	31, 33

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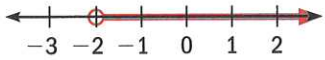
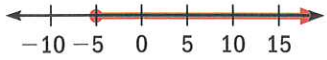
Write the inequality represented by the graph.

10. 

11. 

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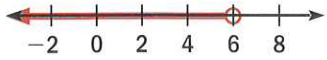
13. 

In Exercises 14–17, tell whether the number is a solution of the inequality graphed below.

14. -4.5 **15.** -4 **16.** $2\frac{1}{2}$ **17.** 0

Write a verbal phrase to describe the inequality.

18. $z \le 8$ **19.** $j > -4$ **20.** $w \ge -15$ **21.** $n < 0$

Solve the inequality. Then graph its solution.

22. $k + 4 \le 11$ **23.** $5 < 8 + t$ **24.** $n - 6 > 3$

25. $17 + r \ge 25$ **26.** $m + 6 \ge -10$ **27.** $p - 12 > -5$

28. $-9 < d - 21$ **29.** $-8 \ge m - 19$ **30.** $-42 + x > -59$

31. Banking You have \$33.96 in a savings account. At your bank, you must have a minimum balance of \$50 in your account to avoid a fee. Write and solve an inequality to represent the amount of money you must deposit in order to reach or exceed the minimum balance.

32. Critical Thinking Write an equivalent inequality that you would use addition to solve and whose solution is $p < 6$.

33. Biplane Ride Your family bought your grandmother a biplane ride for her 80th birthday. The flight can last up to one hour and 15 minutes. If she does 10 minutes of corkscrew rolls, 15 minutes of hammerheads, and 30 minutes of over-water flying, how much time can she use for scenic low-altitude flying without going over the time limit?

Solve the inequality. Then graph its solution.

34. $5.45 + b < -3.55$ **35.** $r - 3.1 < 4.4$ **36.** $-3.5 < w - 9$

37. $\frac{2}{3} \le p - 2\frac{1}{3}$ **38.** $-\frac{1}{2} \le k + 2$ **39.** $t + \frac{1}{4} > 5$

40. Ski Jumping In a ski jumping competition, the top four jumpers perform as shown. How much farther does the fourth place jumper need to jump in order to place first? Write and solve an inequality that describes the situation.

Name	Distance
Cara	238.2 m
Jason	233.6 m
Marisa	250.2 m
Mitchell	236.3 m

41. Writing Explain why $x - 3 \geq 10$ and $x \geq 13$ are equivalent inequalities.

What do you think? Music

Vocal Range

In an octave, the frequency doubles from the lowest to the highest note. Aretha Franklin's voice can range over about 3 octaves, but she is an exception. A typical person's singing voice can range over about 2 octaves. If your vocal range is 2 octaves and begins at 220 hertz, predict your full vocal range.

Tell whether −6 is a solution of the inequality.

42. $8 + x \geq -2$ **43.** $x - 15 > -20$ **44.** $-10 - x \leq -4$

45. Vocal Range The frequency range of the human singing voice is between about 81 hertz and about 1100 hertz. Write two inequalities that describe this range.

46. Careers You are investigating a job that pays a maximum of \$34,000 and a minimum of \$25,000. Write two inequalities that describe this range.

EXAMPLE

Write a compound inequality that represents the set of all numbers greater than or equal to 0 and less than 4.

The set can be represented by two inequalities.

$0 \leq x$ and $x < 4$

The two inequalities can then be combined in a single inequality:

$0 \leq x < 4$

The compound inequality may be read in these two ways:

x is greater than or equal to 0 and x is less than 4.

x is greater than or equal to 0 and less than 4.

In Exercises 47–49, refer to the above example. Write a verbal sentence that describes the *compound inequality*.

47. $-2 < y < 1$ **48.** $7 \leq t < 9$ **49.** $4 \leq m \leq 11$

50. Tigers Until 1900, the tiger population in India was approximately 40,000. Beginning in 1960, the population dropped dramatically until 1972, when the population fell below 2000. Now the tiger population is rising again. The current population can be described by the inequality $2000 \leq x \leq 4556$. Explain what this says about the current population.

51. Challenge Find the values of x that will make the following statement true: $4x - 10 < 8x + 4 - 3x$.

52. Advertising During the first Super Bowl in 1967, a 30 second television commercial cost about $42,000. In 2001, advertisers paid about $2.4 million for a 30 second commercial. Assuming those were the least and greatest costs during that period, write an inequality that describes the cost c of 30 seconds of commercial time during the Super Bowl from 1967 through 2001.

Mixed Review

Evaluate the expression. *(Lessons 2.2–2.5)*

53. $(-24) \div 3 + 5 \times (-9)$

54. $(-12) \div (-33 + 45) - 19$

55. $(-13 - 44) + 100 \div 2$

56. $(-3) \times (15 - 7) \div 2 + 4$

Basic Skills **Write the number in standard form.**

57. Nine and fifty-three thousandths **58.** Sixty-four and seven tenths

Test-Taking Practice

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59. Multiple Choice What value of x makes $x - 3 \geq 20$ true?

A. 17 **B.** 20 **C.** 22 **D.** 24

60. Short Response Lauren can spend at most $60 at the mall. She buys a birthday gift that costs $35. She also wants to buy a backpack for herself. Let x represent the cost of a backpack. Write and solve an inequality to find how much Lauren can spend on the backpack. Explain what the solution of the inequality means.

BRAIN GAME

Prized Positions

The student council is holding a raffle to raise money. The officers must decide how many prizes to award, but each officer has a different opinion.

- The president thinks there should be more than 1 prize.
- The vice president wants to give no more than 10 prizes.
- The treasurer believes at least 4 prizes should be awarded.
- The secretary says there should be fewer than 5.

How many prizes should the student council award? Find a number that will make everyone happy.

LESSON 3.7

Solving Inequalities Using Multiplication or Division

BEFORE

You solved equations using multiplication or division.

Now

You'll solve inequalities using multiplication or division.

WHY?

So you can find how many students must attend a dance, as in Ex. 26.

In the Real World

Bats About 15,000 fruit-eating bats live on Panama's Barro Colorado Island. Every year they consume up to 61,440,000 grams of fruit. About how many grams of fruit does each bat consume in a year? You will use an inequality to solve this in Example 3.

There is one important difference between solving inequalities and solving equations. When multiplying or dividing each side of an inequality by a negative number, you must *reverse the direction of the inequality symbol.*

Word Watch

Review Words

inequality, p. 140
solution of an inequality, p. 140
equivalent inequalities, p. 141

Notebook: Multiplication Property of Inequality

Words	Algebra
Multiplying each side of an inequality by a *positive* number makes an equivalent inequality.	If $4x < 10$, then $\left(\frac{1}{4}\right)(4x) < \left(\frac{1}{4}\right)(10)$.
Multiplying each side of an inequality by a *negative* number and *reversing the direction of the inequality symbol* makes an equivalent inequality.	If $-5x < 10$, then $\left(-\frac{1}{5}\right)(-5x) > \left(-\frac{1}{5}\right)(10)$.

HELP with Notetaking

You might want to use a table to organize this information about reversing the inequality symbol.

EXAMPLE 1 Solving an Inequality Using Multiplication

$-\frac{1}{8}n \geq 2$	Original inequality
$-8 \cdot \left(-\frac{1}{8}\right)n \leq -8 \cdot 2$	Multiply each side by -8. Reverse inequality symbol.
$n \leq -16$	Simplify.

Division Property of Inequality

Words	Algebra
Dividing each side of an inequality by a *positive* number makes an equivalent inequality.	If $2x < 10$, then $\frac{2x}{2} < \frac{10}{2}$.
Dividing each side of an inequality by a *negative* number and *reversing the direction of the inequality symbol* makes an equivalent inequality.	If $-5x < 15$, then $\frac{-5x}{-5} > \frac{15}{-5}$.

EXAMPLE 2 Solving an Inequality Using Division

$15 > -3m$	Original inequality
$\frac{15}{-3} < \frac{-3m}{-3}$	Divide each side by -3. Reverse inequality symbol.
$-5 < m$	Simplify.

Your turn now Solve the inequality.

1. $\frac{t}{6} > 4$ **2.** $-\frac{1}{2}x \le 10$ **3.** $27 > -3t$ **4.** $9n < 63$

EXAMPLE 3 Using the Division Property of Inequality

Bats You can find how much each fruit-eating bat eats annually as described on the previous page as follows.

Solution

Write a verbal model. Let g represent the number of grams one bat eats in a year.

Number of bats • Grams each bat eats ≤ Maximum amount eaten annually

$15{,}000g \le 61{,}440{,}000$	Write an algebraic model.
$\frac{15{,}000g}{15{,}000} \le \frac{61{,}440{,}000}{15{,}000}$	Divide each side by 15,000.
$g \le 4096$	Simplify.

ANSWER Each bat eats as much as 4096 grams of fruit in a year.

What do you think? Bats

Fruit Bats

Fruit bats help forests regrow by spreading the seeds from the figs that they eat each night. One kind of fruit bat is about 25 grams and can eat 2.5 times its body mass in figs in one night. How many grams of figs can one of these bats eat?

3.7 Exercises

More Practice, p. 729

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Getting Ready to Practice

1. **Vocabulary** Copy and complete: When you multiply both sides of an inequality by a negative number, you need to _?_ the inequality symbol.

Decide whether the solution strategy will require reversing the inequality symbol.

2. $\frac{1}{3}x < 18$ Multiply each side by 3.

3. $-6x \geq 24$ Divide each side by -6.

Solve the inequality. Then graph its solution.

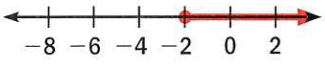
4. $\frac{1}{2}x < 4$ 5. $\frac{m}{-7} \geq 6$ 6. $9 \leq -3z$ 7. $30 > -6p$

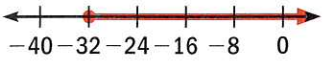
8. **Fundraising** The diving club is selling lessons to raise money. The profit is \$15 per lesson. The diving club wants to raise at least \$300. How many lessons must be sold?

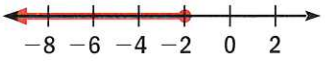
Practice and Problem Solving

Solve the inequality. Match the inequality with the graph of its solution.

9. $\frac{1}{4}x \leq 8$ 10. $-4x \geq 8$ 11. $4x \geq -8$ 12. $-\frac{1}{4}x \leq 8$

A. 

B. 

C. 

D.

Solve the inequality. Then graph its solution.

13. $\frac{1}{4}x > 1$ 14. $-\frac{1}{7}t \geq 3$ 15. $-\frac{1}{5}b \geq 72$ 16. $\frac{1}{3}d < -33$

17. $4g < 24$ 18. $12 \geq -3s$ 19. $-9c \leq 54$ 20. $5z < -15$

21. $7 > -\frac{1}{8}r$ 22. $-6t \geq 36$ 23. $-39 \leq -13k$ 24. $-\frac{1}{7}a < 54$

25. **Critical Thinking** Is it possible to list every number in the solution set of an inequality? Explain your answer.

HELP with Homework

Example	Exercises
1	9–24
2	9–24
3	26

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26. Dance The student council must pay a DJ \$275 to work at a dance. A ticket to the dance costs \$5.50. The amount of money received from ticket sales must at least cover the cost of the DJ. Write and solve an inequality that gives the number of students that must attend the dance in order to pay the \$275 for the DJ.

Solve the inequality. Then graph its solution.

27. $12 > 6 - 2x$ **28.** $3y - 4 < 2y + 5$ **29.** $4p - 9 \geq -1$

30. $5(1 - t) \leq 4(3 - t)$ **31.** $4d < -2(33 + d)$ **32.** $7z + 3 \leq 5z - 1$

33. Writing How is solving an inequality like solving an equation? How is solving an inequality different from solving an equation?

34. Borrowing Money You borrow \$200 from your aunt to buy a new surfboard. If you pay her back at a rate of \$12 per week, when will you owe her less than \$60?

Solve the inequality.

35. $5(x - 20) \geq 3x + 60$ **36.** $4(12 - 5x) \geq -4$ **37.** $2(3 - x) \leq 10x$

Challenge Solve the compound inequality.

38. $-6 < 2x < 10$ **39.** $-35 \leq 7x \leq -14$ **40.** $10 < 5x < 100$

41. Monitor The height of a rectangular computer screen is 20 centimeters less than twice the width. The perimeter is at least 53 centimeters. Find the minimum dimensions of the screen if each dimension is an integer.

Mixed Review

Use mental math to solve the equation. *(Lessons 2.2, 2.4)*

42. $-4x = 0$ **43.** $11a = 11$ **44.** $z + (-12) = -12$

Solve the inequality. Then graph its solution. *(Lesson 3.6)*

45. $c + 7 \leq 11$ **46.** $3 < 12 + s$ **47.** $x - 12 > 17$

Basic Skills Find the missing number.

48. 7 hours = ? minutes **49.** 3 days = ? hours

Test-Taking Practice

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50. Short Response An elevator can hold a maximum of 2000 pounds. Using 150 pounds as the average weight per person, write an inequality that models the situation. What does the variable represent? If you solve the inequality, what does the answer tell you in terms of the number of people who can ride in the elevator?

LESSONS 3.5 TO 3.7

Notebook Review

Notebook

Review the vocabulary definitions in your notebook.

Copy the review examples in your notebook. Then complete the exercises.

Check Your Definitions

base, p. 134
height, p. 134
inequality, p. 140
solution of an inequality, p. 140
equivalent inequalities, p. 141

Use Your Vocabulary

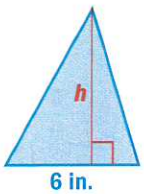
1. Draw a triangle. Label the base and the height.

3.5 Can you use formulas for perimeter and area?

Review

EXAMPLE Find the height of the triangle. Its area is 21 square inches.

$A = \frac{1}{2}bh$	**Write area formula.**
$21 = \frac{1}{2}(6)(h)$	**Substitute known values.**
$21 = 3h$	**Multiply.**
$7 = h$	**Divide each side by 3.**



ANSWER The height of the triangle is 7 inches.

Find the unknown dimension of the triangle.

2. $A = 50\ \text{cm}^2$, $b = 10$ cm, $h =$? **3.** $A = 45\ \text{ft}^2$, $h = 10$ ft, $b =$?

3.6 Can you solve addition or subtraction inequalities?

Review

EXAMPLE Solve $x - 9 < -4$.

$x - 9 < -4$	**Write original inequality.**
$x - 9 + 9 < -4 + 9$	**Add 9 to each side.**
$x < 5$	**Simplify.**

Solve the inequality. Then graph its solution.

4. $h - 12 > 12$ **5.** $-4 + k \le 6$ **6.** $7 < 15 + p$ **7.** $d + 11 \ge 5$

3.7 Can you solve multiplication or division inequalities?

Review

EXAMPLE

$\frac{t}{7} > 2$	**Original inequality**	$-12k \le 60$	**Original inequality**
$7 \cdot \frac{t}{7} > 7 \cdot 2$	**Multiply each side by 7.**	$\frac{-12k}{-12} \ge \frac{60}{-12}$	**Divide each side by −12. Reverse inequality symbol.**
$t > 14$	**Simplify.**	$k \ge -5$	**Simplify.**

Solve the inequality.

8. $\frac{d}{6} \le 34$ **9.** $-\frac{1}{5}x \ge 20$ **10.** $5c > 25$ **11.** $-15b < 60$

Stop *and* Think about Lessons 3.5–3.7

12. Writing Mary claims that she has at least 50 CDs at home and she just got 4 more for her birthday. Write an inequality for the number of CDs she has now.

13. Critical Thinking What is the greatest integer solution of $-7x > -56$? Justify your answer.

Review Quiz 2

Find the length of each side.

1. A rectangle has a perimeter of 30 millimeters and a width of 6 millimeters. Find the length.

2. A triangle has an area of 26 square yards and a height of 4 yards. Find the base.

Solve the inequality. Then graph its solution.

3. $a + 9 \ge -1$ **4.** $-16 > y - 12$ **5.** $\frac{x}{3} < -3$ **6.** $-x > 5$

7. Apples An empty basket weighs 2 pounds. When filled with apples, the basket weighs more than 13 pounds. Write and solve an inequality that represents this situation. What does the variable stand for?

8. Calling Card You have \$9.50 with which to recharge your phone card. Write and solve an inequality to find how many minutes you can add to your phone card if each minute costs \$.10.

CHAPTER 3

Chapter Review

Vocabulary

equivalent equations, p. 109
inverse operations, p. 109
base, height, p. 134
inequality, p. 140
solution of an inequality, p. 140
equivalent inequalities, p. 141

Vocabulary Review

1. List 2 pairs of inverse operations. Explain why these are called inverse operations.
2. How can two inequalities be equivalent? Give an example of equivalent inequalities.

Copy and complete the statement.

3. Two equations that have the same solution are ?.
4. A(n) ? is a statement formed by placing an inequality symbol between two expressions.

Review Questions

Solve the equation. *(Lessons 3.1, 3.2)*

5. $r - 11 = 21$ **6.** $v + 13 = 29$ **7.** $34 = g + 19$ **8.** $12p = 108$

9. $\frac{h}{5} = 8$ **10.** $\frac{z}{-7} = 23$ **11.** $-46 = \frac{w}{-28}$ **12.** $t - \frac{3}{7} = \frac{1}{7}$

13. $x + (-5) = -8$ **14.** $3.9 + y = 10.9$ **15.** $-9.5m = -22.8$ **16.** $-72 = -6n$

17. ATVs You rent an all-terrain vehicle that has $\frac{5}{8}$ of a tank of fuel. When you are done riding, there is $\frac{3}{8}$ of a tank left. Write a verbal model to represent the fraction of a tank of fuel you used. Then write and solve an algebraic model. *(Lesson 3.1)*

18. Intramurals A college brochure states that 215 students participate in intramural sports. This is one third of the students. How many students attend the college? *(Lesson 3.2)*

Solve the equation. *(Lesson 3.3)*

19. $2p - 5 = 13$ **20.** $19 + 8v = 43$ **21.** $9g + 16 = -29$

22. $-10c + 6 = 46$ **23.** $-82 = 53 - 5t$ **24.** $-33 = -15t - 12$

Review Questions

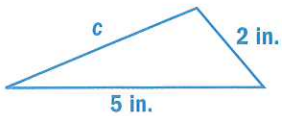
Solve the equation. *(Lesson 3.3)*

25. $\frac{d}{5} + 13 = -10$ **26.** $17 = \frac{x}{12} - 31$ **27.** $-21 - \frac{t}{3} = -6$ **28.** $-57 = -9 + \frac{w}{-7}$

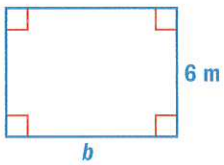
29. Fruit Baskets Your class is making fruit baskets and selling them to raise money for a charity. The supplies cost \$26 and the baskets sell for \$7 each. Your class makes a profit of \$100. How many baskets did your class sell? *(Lesson 3.4)*

Find the unknown dimension. *(Lesson 3.5)*

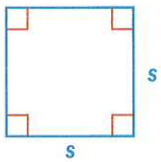
30. Perimeter = 11 in.



31. Perimeter = 28 m

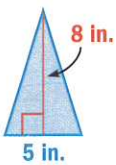


32. Perimeter = 26 cm



Find the area of the triangle. *(Lesson 3.5)*

33.



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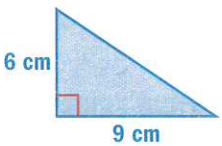

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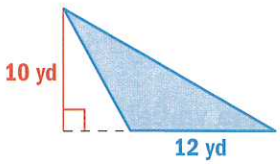


36. Ticket Line You are standing in line for concert tickets. The ticket window is at street level at the middle of one side of a building that is 30 feet long and 20 feet wide. The line extends from the ticket window, around the corner of the building, and all the way to the next corner of the building. How long is the line? Explain why there are two possible answers. *(Lesson 3.5)*

Solve and graph the inequality. *(Lessons 3.6, 3.7)*

37. $96 \geq -12 + c$ **38.** $-\frac{1}{3}x > 4$ **39.** $-96 < 24h$ **40.** $78 - k \leq 21$

Find the Error **Describe and correct the error in the solution.** *(Lessons 3.6, 3.7)*

41.

$$x + 7 < 17$$
$$\frac{-7}{} \quad \frac{-7}{}$$
$$x > 10$$

42.

$$-6c < 18$$
$$\frac{-6c}{-6} < \frac{18}{-6}$$
$$c < -3$$

CHAPTER 3

Chapter Test

Solve the equation.

1. $s - 6 = 39$ **2.** $x + 12 = -2$ **3.** $14.6 = \frac{k}{2.5}$ **4.** $24v = 288$

5. $\frac{1}{9} = t + \frac{1}{9}$ **6.** $-9.8 = \frac{y}{-4.7}$ **7.** $5b - 7 = 120$ **8.** $-236 = 29 - 5g$

9. **Hiking** You go on a 20 mile hike. In the morning you hike 8.2 miles, and by 2:00 P.M., you have covered 7.5 more miles. Write and solve an equation to find how many miles you have left to go.

In Exercises 10 and 11, write and solve an equation.

10. A bookstore offers three books in a set for \$21.75. Each book costs the same amount. How much does each book cost?

11. A calf weighs 90 pounds. The calf gains 65 pounds a month. In how many months will the calf weigh 1000 pounds?

Translate the verbal phrase into an equation. Then solve the equation.

12. A number times 3 subtracted from 20 is -4.

13. The sum of 5 times a number and 14 is 9.

In Exercises 14 and 15, use the formula $P = 2l + 2w$. Solve the equation to find the unknown measure of the rectangle.

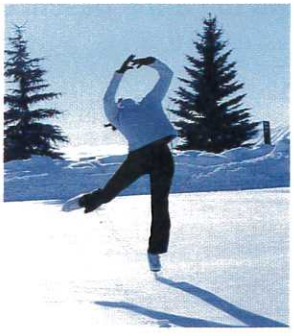
14. $P = 28$ in., $l = 13$ in. Find the width.

15. $P = 62$ cm, $w = 10$ cm. Find the length.

16. Find the height of a triangle with a base of 25 centimeters and an area of 200 square centimeters.

Solve the inequality.

17. $y + 78 < -124$ **18.** $-8.56 + k \geq 5.32$ **19.** $-8x < 64$



20. **Lunch** You and a friend are having lunch together. You can spend no more than \$30 on both meals. The total cost of your friend's meal is \$14.78. Write and solve an inequality to determine how much you can spend on your meal.

21. **Figure Skating** You are taking figure skating lessons. You can rent skates for \$5 per lesson. You can buy skates for \$75. What inequality expresses the number of lessons for which it is cheaper to buy skates?

Chapter Standardized Test

Test-Taking Strategy **Start to work as soon as the testing time begins. Keep working and stay focused on the test.**

Multiple Choice

1. Which is an inverse operation for the operation of adding -7?

A. Subtracting -7 **B.** Adding -7

C. Subtracting 7 **D.** Dividing by 7

2. Which equation does *not* have a solution of 8?

F. $x - 4 = 4$ **G.** $7 + x = 15$

H. $x - 4.4 = 3.6$ **I.** $x + 6.2 = 1.8$

3. Which equations are equivalent?

I. $\frac{3}{5}x = 3$ **II.** $\frac{x}{5} = 3$

III. $3x = 15$ **IV.** $-x = 15$

A. I and III **B.** II and IV

C. I, II, and IV **D.** I, III, and IV

4. The bill for the repair of a car is \$560. The cost of parts is \$440. The cost of labor is \$40 per hour. Which equation can you use to find the number of hours of labor?

F. $40 + 440x = 560$

G. $40x + 440 = 560$

H. $40(x + 440) = 560$

I. $40 + x + 440 = 560$

5. A rectangle has a perimeter of 54 inches and a width of 8 inches. What is the length of the rectangle?

A. 19 inches **B.** 26 inches

C. 38 inches **D.** 46 inches

6. A triangle has an area of 8 square feet. Which measurements *cannot* be the base length b and height h of the triangle?

F. $h = 4$ ft, $b = 8$ ft

G. $h = 8$ ft, $b = 2$ ft

H. $h = 1$ ft, $b = 16$ ft

I. $h = 4$ ft, $b = 4$ ft

7. Which statement about the inequality $x - 8 \geq -5$ is true?

A. The arrow on the graph of its solution set points to the left.

B. -5 is a solution.

C. 3 is not a solution.

D. The circle on the graph of the solution set is closed.

Short Response

8. Write and solve an equation for this sentence: The quotient of a number and -14 is 7.

Extended Response

9. The Uniform Building Code requires at least 20 square feet of space for each person in a classroom. A classroom is 28 feet long and 18 feet wide. Write and solve an inequality that models the number of people that can be in the classroom legally. Explain how to use the solution to find the maximum number of people allowed in the classroom.

Strategies for Answering

Multiple Choice Questions

You can use the problem solving plan on page 39 to solve any problem. The strategies below can help you answer a multiple choice question. You can also use these strategies to check whether your answer to a multiple choice question is reasonable.

Strategy: Estimate the Answer

Problem 1

You will use powers and exponents to solve this problem.

The table shows how many pennies you save each day. If the pattern continues, what is the first day you will save more than ten dollars worth of pennies?

Day	1	2	3
Pennies	$2^1 = 2$	$2^2 = 4$	$2^3 = 8$

A. Day 8

B. Day 9

C. Day 10

D. Day 11

Estimate: 2^8 is a little more than 250, so $2^9 > 500$ and $2^{10} > 1000$. The correct answer is C.

Strategy: Use Visual Clues

Problem 2

The garden's area is 900 square feet. Use the Guess, Check, and Revise strategy to find the length of one side of the garden. Each side of the garden is 30 feet long.

How many feet of fencing do you need to enclose the square garden shown?

F. 30 ft

G. 60 ft

H. 90 ft

I. 120 ft

Multiply the side length by 4 to find the total amount of fencing needed. To enclose the garden, you need 120 feet of fencing. The correct answer is I.

Strategy: Use Number Sense

The problem involves integers, not fractions or decimals.

Problem 3

When multiplying a positive integer by a negative integer, the product is ?.

A. greater than the positive integer

B. greater than the negative integer

C. less than or equal to the negative integer

D. less than the negative integer

The sign is negative and the absolute value of the product is greater than or equal to either factor. C is the correct answer.

Eliminating Unreasonable Choices The strategies used to find the correct answers for Problems 1–3 are the same strategies you can use to eliminate answer choices that are unreasonable or obviously incorrect.

Read the problem carefully. Degrees Fahrenheit are 32° more than almost twice the temperature in degrees Celsius.

Problem 4

The average body temperature of a polar bear is 37°C. Use the formula $F = 1.8C + 32$ to find the temperature in degrees Fahrenheit.

F. 34°F — *Not* correct. A temperature of about 1°C is 34°F.

G. 69°F

H. 74.95°F

I. 98.6°F — $1.8(37) + 32 = 98.6$, so the correct answer is I.

Watch Out!

Some answers that appear correct at first glance may be incorrect. Be aware of common errors.

Your turn now

Explain why the selected answer choice is unreasonable.

1. Two times a number plus 7 is −21. What is the number?

A. −14 **B.** −7 **C.** 7 **D.** 14

2. Your school earns $1.50 for every T-shirt sold. Find the minimum number of T-shirts you must sell in order to raise $500.

F. 333 **G.** 334 **H.** 500 **I.** 750

UNIT 1
Chapters 1–3

PRACTICING Test-Taking Skills

Multiple Choice

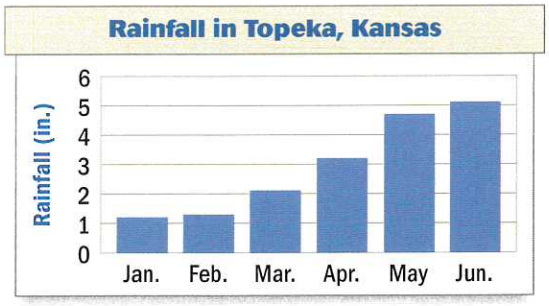
1. Ryan rode his bike 15 miles in 2 hours 30 minutes. What is his average speed in miles per hour?

A. 6 **B.** 6.5 **C.** 34.5 **D.** 37.5

2. Bob's exam of 21 questions takes 50 minutes. He needs at least 10 minutes for the extended response question. He uses an equal amount of time on all of the 20 multiple choice problems. What is the greatest number of minutes Bob can spend on one multiple choice problem?

F. 1 **G.** 2 **H.** 3 **I.** 4

3. The graph shows the inches of rainfall in Topeka, Kansas. What is the best estimate of rainfall in April?



A. 2.5 in. **B.** 3.0 in. **C.** 3.2 in. **D.** 3.5 in.

4. The height of a triangle is 12 inches, and its base is 5 inches long. What is its area?

F. 17 in. **G.** 30 in.^{2} **H.** 60 in. **I.** 60 in.^{2}

5. The student council made \$130 at a school dance. Now they have \$50. How much money did they spend?

A. \$70 **B.** \$80 **C.** \$180 **D.** \$190

6. A bank statement for the month of January is shown below. What is the sum of the transactions in this month?

January 5	+\$25
January 6	−\$15
January 15	−\$30

F. −\$20 **G.** \$20 **H.** \$40 **I.** \$70

7. Meg is scuba diving. She ascends to the surface at a rate of 30 feet per minute. After 2 minutes, her elevation is −15 feet. What was Meg's elevation when she began her ascent?

A. −75 ft **B.** −45 ft **C.** 45 ft **D.** 75 ft

8. A lacrosse field is 110 yards long and 60 yards wide. Which of the following is true about a lacrosse field?

F. Its length is more than twice its width.

G. Its perimeter is 170 yards.

H. Its perimeter is 6600 yards.

I. Its area is 6600 square yards.

9. Sara leaves at 8:30 A.M. and drives at an average speed of 55 miles per hour. She reaches her destination at 11:30 A.M. How many miles does Sara travel?

A. 18.3 **B.** 160 **C.** 165 **D.** 260

10. Each week Annie makes \$40 babysitting, spends \$25 at the mall, and spends \$8 at the movies. Annie saves the rest of her money. Which expression tells how much money Annie saves after 5 weeks?

F. $40 - 25 - 8 + 5$ **G.** $40 - (25 + 8) \cdot 5$

H. $5 \cdot (40 - 25 + 8)$ **I.** $(40 - 25 - 8) \cdot 5$

Short Response

11. A package of 8 erasers costs $.64, and a package of 12 costs $.88. Ms. Maddox needs at least 44 erasers for her class. How many of each kind of package should she buy in order to pay the least amount of money? Explain your answer.

12. The perimeter of a rectangular field is 500 feet. The field is 100 feet wide. How long is the field? Draw a diagram and explain how you found your answer.

13. A person must be at least 16 years old to have a driver's license in North Carolina. Tracy got her license 6 years ago. Write an inequality that expresses Tracy's age. Graph the solution of the inequality on a number line. Explain your inequality and your graph.

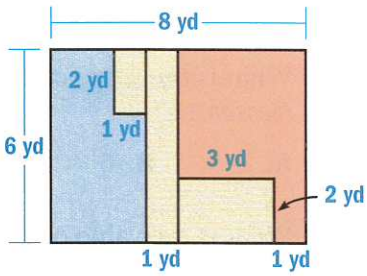
14. Caleb and Peter hiked for 2 hours, took a break, then hiked some more. They traveled 10.5 miles at an average speed of 3 miles per hour. For how many hours did Caleb and Peter hike after their break? Write and solve an equation to find your answer. Explain your steps.

15. Rachel has $60 in savings. If she saves $5 each week, in how many weeks will she have $100 in savings? Write and solve an equation to find your answer.

16. Rob and Angela shared a roll of tickets at an amusement park. Angela took half of the tickets and used 15 of them. Now she has 30 tickets. How many tickets were on the original roll? Explain how you found your answer.

Extended Response

17. Alice bought carpet for two rooms in her house. The floor plan of the rooms is shown here. Find the area of the room with red carpet and the area of the room with blue carpet.



Alice spent $444 total on carpet. The red carpet cost $14 per square yard. Find the cost of the blue carpet per square yard.

How much would it cost for Alice to carpet both rooms in blue? Explain how you found your answer.

18. The results of a poll are shown at the right. Use the data to make a frequency table using the following 4 intervals: *0–1 day*, *2–3 days*, *4–5 days*, and *6–7 days*.

Use your frequency table to create a histogram of the data.

How many people polled use a computer more than once a week? Which data display is more helpful when answering that question? Explain.

How many days a week do you use a computer at home?

6	4	2	1	7	3
5	3	0	1	2	2
5	7	6	4	2	3
1	3	2	3	2	

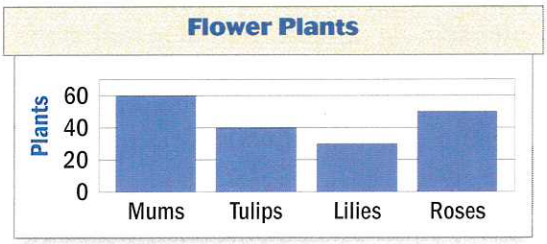
Cumulative Practice for Chapters 1–3

Chapter 1

Multiple Choice **In Exercises 1–8, choose the letter of the correct answer.**

1. How many more mums than tulips are in the garden? Refer to the graph. *(Lesson 1.1)*

A. 10 **B.** 20 **C.** 30 **D.** 40



2. Which operation is performed first when evaluating the expression $9 + 3(4 - 2) \cdot 6 \div 3$? *(Lesson 1.2)*

F. + **G.** − **H.** • **I.** ÷

3. What is the value of $2 \cdot 6 - 10 \div 2$? *(Lesson 1.2)*

A. 1 **B.** 6 **C.** 7 **D.** 17

4. What is the value of the expression $8x - 4y$ when $x = 4$ and $y = 6$? *(Lesson 1.3)*

F. 8 **G.** 16 **H.** 32 **I.** 38

5. What is the value of the expression $(6 - 2)^2 - 8 + 3^3$? *(Lesson 1.4)*

A. 9 **B.** 17 **C.** 27 **D.** 35

6. What is the value of w in the equation $w + 18 = 36$? *(Lesson 1.5)*

F. $\frac{1}{2}$ **G.** 2 **H.** 18 **I.** 54

7. Nicki is driving at a rate of 50 miles per hour. How many hours will it take her to travel 275 miles? *(Lesson 1.6)*

A. 5 **B.** 5.5 **C.** 22 **D.** 22.5

8. A package of 8 computer disks costs \$10, and a package of 15 disks costs \$16.50. How much money will you save per disk if you buy a package of 15 instead of a package of 8? *(Lesson 1.7)*

F. \$.15 **G.** \$1.25 **H.** \$1.50 **I.** \$6.50

9. **Short Response** A store has 10 pairs of black shoes and three times as many pairs of brown shoes as black. There are 10 more pairs of sandals than black shoes. What is the total number of sandals and shoes? *(Lesson 1.7)*

10. **Extended Response** You are planting a rectangular garden and want to separate the garden area from the rest of your yard with a wooden border. You have 32 pieces of wood that are each one foot long. You want to build the border without cutting any of the wood. *(Lesson 1.6)*

a. List all the possible dimensions (length and width) of the garden border that you can build with your 32 pieces of wood.

b. Find the area of each of the rectangles in your list.

c. Which of the dimensions in your list would give the garden the largest area?

d. Describe the difference in appearance between the rectangles with the largest area and the smallest area.

Chapter 2

Multiple Choice **In Exercises 11–20, choose the letter of the correct answer.**

11. Which set of integers is listed in order from least to greatest? *(Lesson 2.1)*

A. $-3, -10, -5, -1, 0$

B. $0, -1, -3, -5, -10$

C. $0, -3, -1, -5, -10$

D. $-10, -5, -3, -1, 0$

12. What is the value of the expression $-39 + (-61) + 74 + (-24)$? *(Lesson 2.2)*

F. -50 **G.** 28 **H.** 50 **I.** 150

13. A seal dove 120 meters beneath the surface of the sea, then ascended 90 meters. What is the elevation of the seal? *(Lesson 2.3)*

A. -210 m **B.** -30 m

C. 30 m **D.** 210 m

14. Find the value of the expression $3c + 3a - b$ when $a = -4$, $b = 8$, and $c = -6$. *(Lesson 2.4)*

F. -38 **G.** -32 **H.** -22 **I.** 18

15. What is the value of $\frac{147}{-7}$? *(Lesson 2.5)*

A. -140 **B.** -21 **C.** 21 **D.** 140

16. Which expression is equivalent to $-3 + 5 - (-2) - 7$? *(Lesson 2.6)*

F. $-3 - (-2) - 7 + 5$

G. $-3 + (-2) - 7 + 5$

H. $-3 - 7 - 2 + 5$

I. $-3 - (-2) + 7 - 5$

17. Which expression is equivalent to $5 - 3x + 4 - 2y - x$? *(Lesson 2.7)*

A. $2x + 2y - x$ **B.** $9 - 4x - 2y$

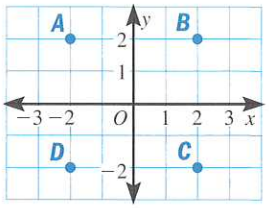
C. $2x + y$ **D.** $9 - 2x - 2y$

18. Which expression is equivalent to $-3(2x + 4)$? *(Lesson 2.7)*

F. $-6x + 4$ **G.** $-6x + 12$

H. $-6x - 12$ **I.** $-6x - 3$

19. Which points have a y-coordinate of -2 in the coordinate plane? *(Lesson 2.8)*



A. A and B **B.** B and C

C. A and D **D.** C and D

20. The point $(-3, 6)$ is in which quadrant? *(Lesson 2.8)*

F. I **G.** II **H.** III **I.** IV

21. **Short Response** Find the mean elevation of the locations listed in the table below.

Location	Elevation
Salinas Chicas, Argentina	−40 m
Lake Eyre, Australia	−15 m
Baltic Sea	0 m
Laguna Salada, Mexico	−10 m
Caspian Sea	−20 m
Lake Maggiore, Switzerland	195 m
Death Valley, United States	−86 m

Which locations have an elevation below the mean? *(Lesson 2.5)*

GO ON

PRACTICING Test-Taking Skills

Cumulative Practice continued

22. Extended Response In a coordinate plane, plot the points $A(-1, 3)$, $B(4, 3)$, $C(4, -4)$, and $D(-1, -4)$. Connect the points to form a rectangle. *(Lesson 2.8)*

a. Find the length, width, and area of the rectangle.

b. Draw a new rectangle that has twice the length and twice the width of the original rectangle. Find the area of the new rectangle.

c. Does the new rectangle have twice the area of the original rectangle? Explain.

Chapter 3

Multiple Choice In Exercises 23–29, choose the letter of the correct answer.

23. What is the value of n in the equation $n - 34 = -17$? *(Lesson 3.1)*

A. -51 **B.** -17 **C.** 17 **D.** 51

24. Laura ran at a rate of 3.6 miles per hour. She ran 3 miles total. Which equation could you use to find how many hours Laura ran? *(Lesson 3.2)*

F. $3.6x = 3$ **G.** $x \div 3.6 = 3$

H. $3x = 3.6$ **I.** $3.6 - 3 = x$

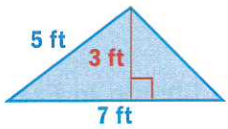
25. What is the value of x in the equation $20 = 3x + 2$? *(Lesson 3.3)*

A. 6 **B.** 7 **C.** 8.5 **D.** 16

26. On each weekday that she worked in July, Kate worked 6 hours. She also worked 9 hours on one Saturday. Kate worked 117 hours total in July. How many weekdays did Kate work in July? *(Lesson 3.4)*

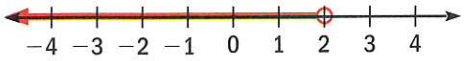
F. 7 **G.** 9 **H.** 12 **I.** 18

27. What is the area of the triangle? *(Lesson 3.5)*



A. $7.5\ ft^2$ **B.** $10.5\ ft^2$ **C.** $17.5\ ft^2$ **D.** $21\ ft^2$

28. Which inequality is represented by the graph? *(Lesson 3.6)*



F. $x \le 2$ **G.** $x > 2$ **H.** $x < 2$ **I.** $x \ge 2$

29. Solve the inequality $x - 4 \le -12$. *(Lesson 3.6)*

A. $x \le -16$ **B.** $x \ge -16$

C. $x \le -8$ **D.** $x \ge -8$

30. Short Response Kaila traveled from her house to the city library by bus. She took one bus 2 miles. Then she changed buses. The second bus traveled at an average speed of 55 miles per hour. Kaila's entire trip covered 18 miles. How much time did she spend on the second bus? Write and solve an equation to answer the question. *(Lesson 3.4)*

31. Extended Response Gabe, Frank, and Sam are playing a game. The player with the most points at the end is the winner. Gabe has four more than twice as many points as Frank. Frank has three less than half as many points as Sam. Sam has 60 points. *(Lessons 3.4, 3.6)*

a. Write equations that you can use to find each player's total number of points.

b. Which player is in first place? second place? third place?

c. Write and solve an inequality to show how many more points Frank needs to win.