1.1 Solving Simple Equations
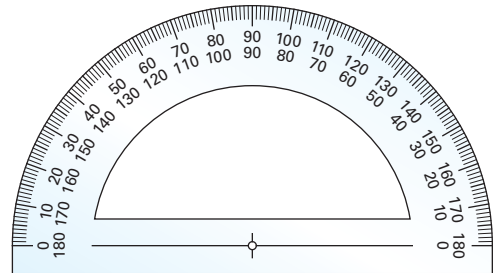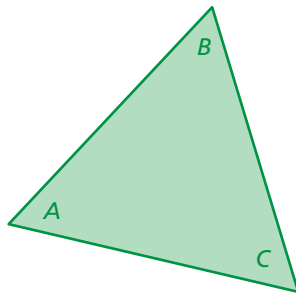
STATE STANDARDS

MA.8.A.1.1

Essential Question How can you use inductive reasoning to discover rules in mathematics? How can you test a rule?
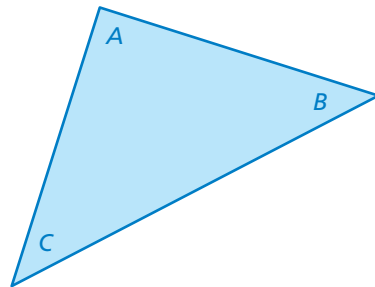
1 ACTIVITY: Sum of the Angles of a Triangle

Work with a partner. Copy the triangles. Use a protractor to measure the angles of each triangle. Copy and complete the table to organize your results.

a.

b.

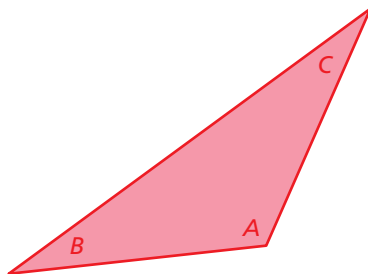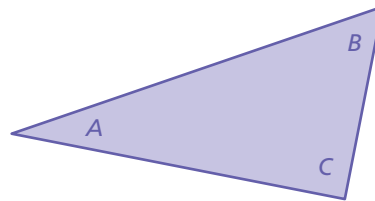**c.**

d.

| Triangle	Angle A (degrees)	Angle B (degrees)	Angle C (degrees)	$A + B + C$
a.				
b.				
c.				
d.				

2 ACTIVITY: Writing a Rule

Work with a partner. Use inductive reasoning to write and test a rule.

a. Use the completed table in Activity 1 to write a rule about the sum of the angle measures of a triangle.

b. **TEST YOUR RULE** Draw four triangles that are different from those in Activity 1. Measure the angles of each triangle. Organize your results in a table. Find the sum of the angle measures of each triangle.

3 ACTIVITY: Applying Your Rule

Work with a partner. Use the rule you wrote in Activity 2 to write an equation for each triangle. Then, solve the equation to find the value of *x*. Use a protractor to check the reasonableness of your answer.

a.

27°

$x°$

82°

b.

52°

43°

$x°$

c.

62.5°

77°

$x°$

d.

33.4°

$x°$

51.3°
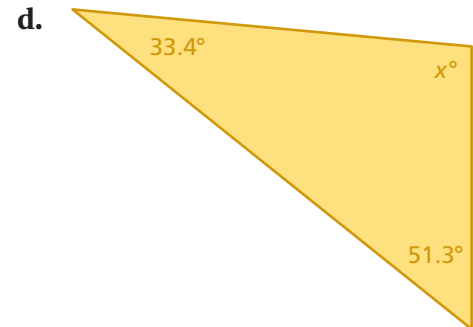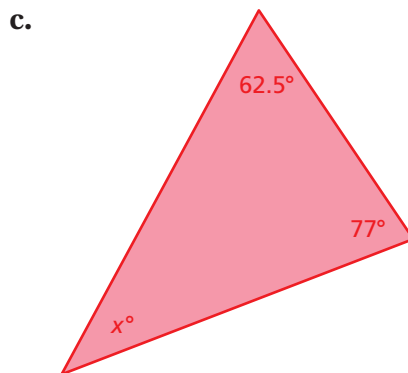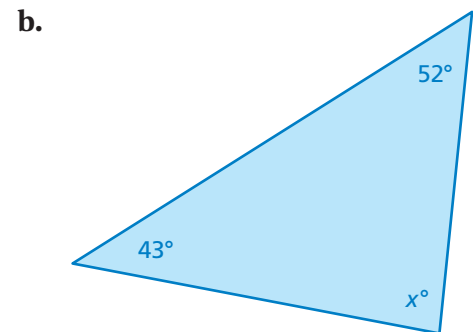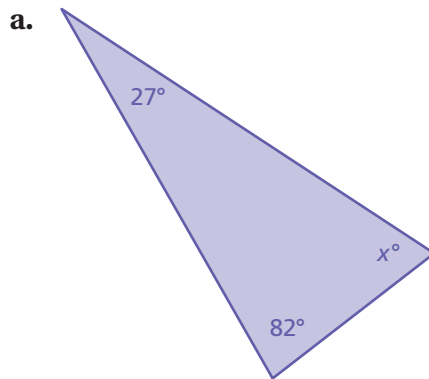
What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you use inductive reasoning to discover rules in mathematics? How can you test a rule? How can you use a rule to solve problems in mathematics?

Practice

Use what you learned about solving simple equations to complete Exercises 4–6 on page 7.

1.1 Lesson

Remember

Addition and subtraction are inverse operations.

🔑 Key Ideas

Addition Property of Equality

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

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

Subtraction Property of Equality

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

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

EXAMPLE 1 Solving Equations Using Addition or Subtraction

a. Solve $x - 7 = -6$.

$$x - 7 = -6 \qquad \text{Write the equation.}$$

Undo the subtraction. $\longrightarrow$
$$\underline{+\ 7 \qquad +\ 7} \qquad \text{Add 7 to each side.}$$
$$x = \quad 1 \qquad \text{Simplify.}$$

∴ The solution is $x = 1$.

Check
$$x - 7 = -6$$
$$1 - 7 \stackrel{?}{=} -6$$
$$-6 = -6 \ ✓$$

b. Solve $y + 3.4 = 0.5$.

$$y + 3.4 = \quad 0.5 \qquad \text{Write the equation.}$$

Undo the addition. $\longrightarrow$
$$\underline{-\ 3.4 \qquad -\ 3.4} \qquad \text{Subtract 3.4 from each side.}$$
$$y = \quad -2.9 \qquad \text{Simplify.}$$

∴ The solution is $y = -2.9$.

Check
$$y + 3.4 = 0.5$$
$$-2.9 + 3.4 \stackrel{?}{=} 0.5$$
$$0.5 = 0.5 \ ✓$$

c. Solve $h + 2\pi = 3\pi$.

$$h + 2\pi = \quad 3\pi \qquad \text{Write the equation.}$$

Undo the addition. $\longrightarrow$
$$\underline{-\ 2\pi \qquad -\ 2\pi} \qquad \text{Subtract } 2\pi \text{ from each side.}$$
$$h = \quad \pi \qquad \text{Simplify.}$$

∴ The solution is $h = \pi$.

Solve the equation. Check your solution.

1. $b + 2 = -5$ **2.** $g - 1.7 = -0.9$ **3.** $-3 = k + 3$

4. $r - \pi = \pi$ **5.** $t - \dfrac{1}{4} = -\dfrac{3}{4}$ **6.** $5.6 + z = -8$

Key Ideas

Remember

Multiplication and division are inverse operations.

Multiplication Property of Equality

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

Algebra   If $a = b$, then $a \cdot c = b \cdot c$.

Division Property of Equality

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

Algebra   If $a = b$, then $a \div c = b \div c, c \neq 0$.

EXAMPLE 2   **Solving Equations Using Multiplication or Division**

a. Solve $-\dfrac{3}{4}n = -2$.

$$-\dfrac{3}{4}n = -2 \qquad \text{Write the equation.}$$

Use the reciprocal. $\longrightarrow -\dfrac{4}{3} \cdot \left(-\dfrac{3}{4}n\right) = -\dfrac{4}{3} \cdot -2 \qquad$ Multiply each side by $-\dfrac{4}{3}$, the reciprocal of $-\dfrac{3}{4}$.

$$n = \dfrac{8}{3} \qquad \text{Simplify.}$$

∴ The solution is $n = \dfrac{8}{3}$.

b. Solve $\pi x = 3\pi$.

$$\pi x = 3\pi \qquad \text{Write the equation.}$$

Undo the multiplication. $\longrightarrow \dfrac{\pi x}{\pi} = \dfrac{3\pi}{\pi} \qquad$ Divide each side by π.

$$x = 3 \qquad \text{Simplify.}$$

∴ The solution is $x = 3$.

Check
$$\pi x = 3\pi$$
$$\pi(3) \stackrel{?}{=} 3\pi$$
$$3\pi = 3\pi \ \checkmark$$

Solve the equation. Check your solution.

7. $\dfrac{y}{4} = -7$ **8.** $6\pi = \pi x$ **9.** $0.09w = 1.8$

EXAMPLE 3 | **Standardized Test Practice**

What value of k makes the equation $k + 4 \div 0.2 = 5$ true?

(A) -15 (B) -5 (C) -3 (D) 1.5
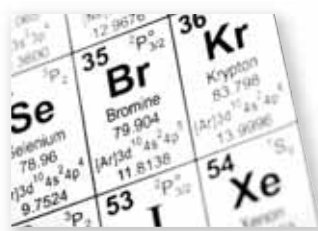
$$k + 4 \div 0.2 = 5 \qquad \text{Write the equation.}$$
$$k + 20 = 5 \qquad \text{Divide 4 by 0.2.}$$
$$\underline{-20 \quad -20} \qquad \text{Subtract 20 from each side.}$$
$$k = -15 \qquad \text{Simplify.}$$

∴ The correct answer is (A).

EXAMPLE 4 | **Real-Life Application**

The *melting point* of a solid is the temperature at which the solid becomes a liquid. The melting point of bromine is $\frac{1}{30}$ of the melting point of nitrogen. Write and solve an equation to find the melting point of nitrogen.

The melting point of bromine is $-7°C$.

Words   The melting point of bromine   is $\frac{1}{30}$ of   the melting point of nitrogen.

Variable   Let n be the melting point of nitrogen.

Equation $-7 = \frac{1}{30} \cdot n$

$$-7 = \frac{1}{30}n \qquad \text{Write the equation.}$$
$$30 \cdot (-7) = 30 \cdot \left(\frac{1}{30}n\right) \qquad \text{Multiply each side by 30.}$$
$$-210 = n \qquad \text{Simplify.}$$

∴ The melting point of nitrogen is $-210°C$.

On Your Own

Now You're Ready
Exercises 33–38

10. Solve $p - 8 \div \frac{1}{2} = -3$.   **11.** Solve $q + \left|-10\right| = 2$.

12. The melting point of mercury is about $\frac{1}{4}$ of the melting point of krypton. The melting point of mercury is $-39°C$. Write and solve an equation to find the melting point of krypton.

✓ Vocabulary and Concept Check

1. **VOCABULARY** Which of the operations $+$, $-$, $\times$, and $\div$ are inverses of each other?

2. **VOCABULARY** Are the equations $3x = -9$ and $4x = -12$ equivalent? Explain.

3. **WHICH ONE DOESN'T BELONG?** Which equation does *not* belong with the other three? Explain your reasoning.
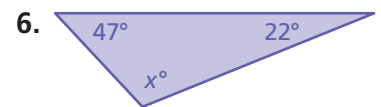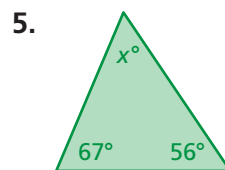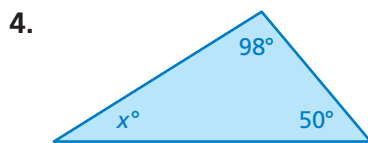
| $x - 2 = 4$ | $x - 3 = 6$ | $x - 5 = 1$ | $x - 6 = 0$ |

Practice and Problem Solving

Find the value of x. Use a protractor to check the reasonableness of your answer.

4.

98°

$x°$ 50°

5.

$x°$

67°   56°

6.

47°   22°

$x°$

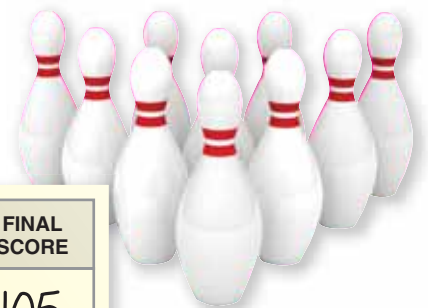**Solve the equation. Check your solution.**

① 7. $x + 12 = 7$

8. $g - 16 = 8$

9. $-9 + p = 12$

10. $0.7 + y = -1.34$

11. $x - 8\pi = \pi$

12. $4\pi = w - 6\pi$

13. $\dfrac{5}{6} = \dfrac{1}{3} + d$

14. $\dfrac{3}{8} = r + \dfrac{2}{3}$

15. $n - 1.4 = -6.3$

16. **CONCERT** A discounted concert ticket is $14.50 less than the original price p. You pay $53 for a discounted ticket. Write and solve an equation to find the original price.

17. **BOWLING** Your friend's final bowling score is 105. Your final bowling score is 14 pins less than your friend's final score.

   a. Write and solve an equation to find your final score.

   b. Your friend made a spare in the tenth frame. Did you? Explain.

9	10	FINAL SCORE
8 — 7 ∕ 6		
89	105	105
6 3 9		
82		?

Solve the equation. Check your solution.

② **18.** $7x = 35$

19. $4 = -0.8n$

20. $6 = -\dfrac{w}{8}$

21. $\dfrac{m}{\pi} = 7.3$

22. $-4.3g = 25.8$

23. $\dfrac{3}{2} = \dfrac{9}{10}k$

24. $-7.8x = -1.56$

25. $-2 = \dfrac{6}{7}p$

26. $3\pi d = 12\pi$

27. ERROR ANALYSIS Describe and correct the error in solving the equation.

✗
$$-1.5 + k = 8.2$$
$$k = 8.2 + (-1.5)$$
$$k = 6.7$$

28. TENNIS A gym teacher orders 42 tennis balls. Each package contains 3 tennis balls. Which of the following equations represents the number x of packages?

$x + 3 = 42$ $3x = 42$ $\dfrac{x}{3} = 42$ $x = \dfrac{3}{42}$

In Exercises 29–32, write and solve an equation to answer the question.

29. PARK You clean a community park for 6.5 hours. You earn $42.25. How much do you earn per hour?

30. SPACE SHUTTLE A space shuttle is scheduled to launch from Kennedy Space Center in 3.75 hours. What time is it now?

31. BANKING After earning interest, the balance of an account is $420. The new balance is $\dfrac{7}{6}$ of the original balance. How much interest was earned?

Launch Time
11:20 A.M.

Tallest Coasters at Cedar Point	
Roller Coaster	**Height (feet)**
Top Thrill Dragster	420
Millennium Force	310
Magnum XL-200	205
Mantis	?

32. ROLLER COASTER Cedar Point amusement park has some of the tallest roller coasters in the United States. The Mantis is 165 feet shorter than the Millennium Force. What is the height of the Mantis?

Solve the equation. Check your solution.

③ **33.** $-3 = h + 8 \div 2$

34. $12 = w - \left| -7 \right|$

35. $q + \left| 6.4 \right| = 9.6$

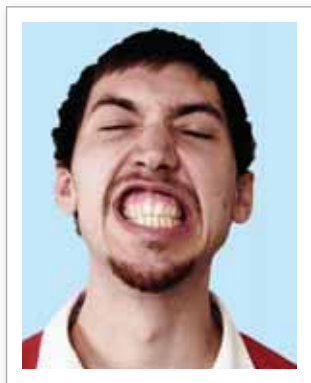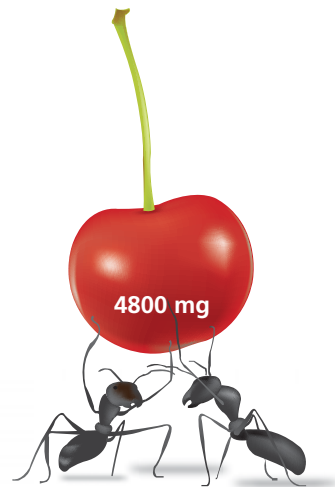**36.** $d - 2.8 \div 0.2 = -14$

37. $\dfrac{8}{9} = x + \dfrac{1}{3}(7)$

38. $p - \dfrac{1}{4} \cdot 3 = -\dfrac{5}{6}$

**39. CRITICAL THINKING** Is the solution of $-2x = -15$ *greater than* or *less than* -15? Explain.

40. OPEN-ENDED Write a subtraction equation and a division equation that each has a solution of -2.

41. ANTS Some ant species can carry 50 times their body weight. It takes 32 ants to carry the cherry. About how much does each ant weigh?

4800 mg

42. PICTURES One-fourth of the girls and one-eighth of the boys in an eighth grade retake their school pictures. The photographer retakes pictures for 16 girls and 7 boys. How many students are in the eighth grade?

43. VOLUME The volume V of the cylinder is 72π cubic inches. Use the formula $V = Bh$ to find the height h of the cylinder.

h

$B = 9\pi$ in.²
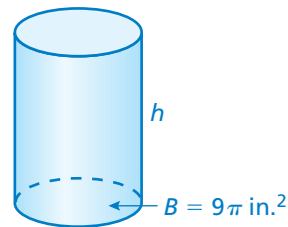
44. **Critical Thinking** A neighbor pays you and two friends $90 to paint her garage. The money is divided three ways in the ratio $2:3:5$.

   a. How much is each share?

   b. What is one possible reason the money is not divided evenly?

Fair Game Review What you learned in previous grades & lessons

Simplify the expression.

45. $2(x - 2) + 5x$

46. $0.4b - 3.2 + 1.2b$

47. $\dfrac{1}{4}g + 6g - \dfrac{2}{3}$

48. MULTIPLE CHOICE The temperature at 4 P.M. was $-12\,°C$. By 11 P.M. the temperature had dropped 14 degrees. What was the temperature at 11 P.M.?
Ž

   Ⓐ $-26\,°C$ **Ⓑ** $-2\,°C$ **Ⓒ** $2\,°C$ **Ⓓ** $26\,°C$