

## 2.4 Start Thinking

When solving equations, steps are typically done in the opposite order of the order of operations. For example, you need to “undo” subtraction before multiplication to solve  $3x - 2 = 4$ .

Describe one instance in which you must multiply or divide before undoing addition or subtraction. Create an example to illustrate.

## 2.4 Warm Up

State the mistake made in solving the equation. Rewrite the solution so it is correct.

1.  $f - 23 = -17$   
 $f - 23 - 23 = -17 - 23$   
 $f = -40$

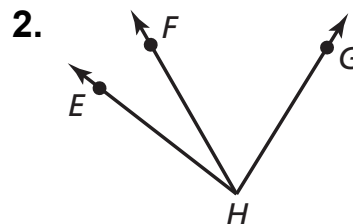
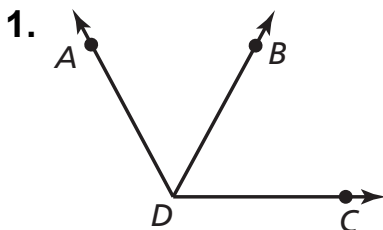
2.  $8r = 4$   
 $\frac{8r}{-8} = \frac{4}{-8}$   
 $r = -\frac{1}{2}$

3.  $\frac{4}{7}m = 22$   
 $\left(\frac{7}{4}\right)\frac{4}{7}m = \left(\frac{4}{7}\right)22$   
 $m = \frac{88}{7}$

4.  $-\frac{n}{6} = 3$   
 $\frac{6}{1} \cdot \left(-\frac{n}{6}\right) = 6 \cdot 3$   
 $n = 18$

## 2.4 Cumulative Review Warm Up

Write three different angles in the diagram.



## 2.4 Practice A

In Exercises 1–3, solve the equation. Justify each step.

1.  $3x + 4 = 31$

2.  $3(2x + 1) = 15$

3.  $\frac{1}{2}(16x - 8) = 2(x + 16)$

In Exercises 4–6, solve the equation for the given variable. Justify each step.

4.  $p = 2v; v$

5.  $V = \pi r^2 h; h$

6.  $S = \pi rs + \pi r^2; s$

In Exercises 7 and 8, name the property of equality that the statement illustrates.

7. If  $x = y$ , then  $-2x = -2y$ .

8. If  $m\angle A = m\angle B$  and  $m\angle B = 42^\circ$ , then  $m\angle A = 42^\circ$ .

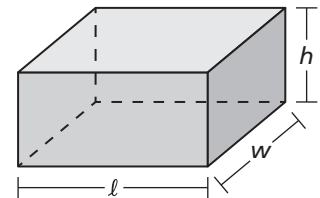
In Exercises 9–11, use the property to copy and complete the statement.

9. Addition Property of Equality: If  $m\angle J = 30^\circ$ , then  $m\angle J + m\angle K = \underline{\hspace{2cm}}$ .

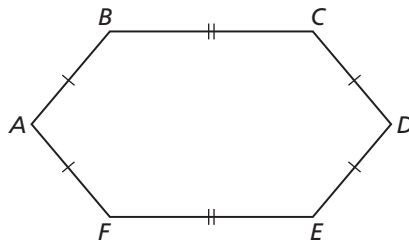
10. Reflexive Property of Equality:  $GH = \underline{\hspace{2cm}}$

11. Distributive Property: If  $3(x + 7) = 30$ , then  $\underline{\hspace{1cm}} + \underline{\hspace{1cm}} = 30$ .

12. The formula for the surface area of a rectangular prism is given by the equation  $A = 2\ell w + 2\ell h + 2hw$ , where  $\ell$  is the length,  $w$  is the width, and  $h$  is the height. Solve the formula for  $w$  and justify each step. Then find the width of the prism if the total surface area is 52 square inches, the length is 2 inches, and the height is 4 inches.



13. In the diagram,  $AB = 3$  and  $BC = 5$ . Find the perimeter of the hexagon. Justify your answer using the properties of equality.



# 2.4

## Practice B

In Exercises 1 and 2, solve the equation. Justify each step.

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

2.  $-1(x + 5) = 3[x + (2x - 1)]$

In Exercises 3 and 4, solve the equation for the given variable. Justify each step.

3.  $I = \frac{1}{2}mr^2; m$

4.  $E = \frac{1}{2}mv^2 + 9.8mh; h$

In Exercises 5 and 6, name the properties of equality that the statement illustrates.

5. If  $x = y$ , then  $2x - 6 = 2y - 6$ .

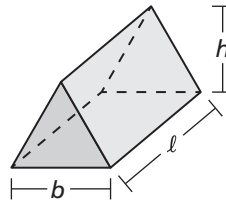
6. If  $m\angle A = m\angle B$  and  $m\angle B = 42^\circ$ , then  $m\angle A + 10 = 52^\circ$ .

In Exercises 7 and 8, use the property to copy and complete the statement.

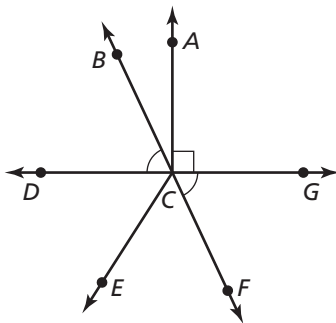
7. Multiplication Property of Equality: If  $m\angle J = 30^\circ$ , then  $2m\angle J = \underline{\hspace{2cm}}$ .

8. Transitive Property: If  $3x + y = 7$  and  $7 = 5x - 2y$ , then  $\underline{\hspace{2cm}}$ .

9. The formula for the volume  $V$  of a triangular prism is given by the equation  $V = \frac{1}{2}bh\ell$ , where  $b$  is the base of the triangle,  $h$  is the height of the triangle, and  $\ell$  is the length of the prism. Solve the formula for  $b$ . Justify each step. Then find the base of a prism with a volume of 128 cubic meters, a height of 8 meters, and a length of 4 meters.



10. In the diagram,  $m\angle ACB = 25^\circ$  and  $\overline{CE}$  bisects  $\angle DCF$ . Explain how to find  $m\angle DCE$ .



## 2.4 Enrichment and Extension

### Algebraic Reasoning

In Exercises 1 and 2, solve for the indicated variable. Justify each step.

1. Solve for  $a$ :  $S = \frac{n}{2}[2a + (n - 1)d]$

2. Solve for  $r$ :  $V = \frac{1}{3}\pi h^2(3r - h)$

3. Write a justification for each step of the mathematical induction proof, which proves that  $10^n - 1$  is divisible by 9.

a.  $10^k - 1 = 9r$

a. \_\_\_\_\_

b.  $10^k = 9r + 1$

b. \_\_\_\_\_

c.  $10(10^k) = 10(9r + 1)$

c. \_\_\_\_\_

d.  $10^{k+1} = 10(9r + 1)$

d. \_\_\_\_\_

e.  $10^{k+1} = 90r + 10$

e. \_\_\_\_\_

f.  $10^{k+1} - 1 = 90r + 9$

f. \_\_\_\_\_

g.  $10^{k+1} - 1 = 9(10r + 1)$

g. \_\_\_\_\_

4. Suppose you receive a raise at work. Your current wage (in dollars per hour) is represented by  $c$ , the percent increase (as a decimal) in your wage is represented by  $r$ , and your new wage (in dollars per hour) is represented by  $n$ .

a. Use the given information to write a pay raise formula that you can use to calculate your new wage  $n$ .

b. Solve the formula from part (a) for  $r$  and write a reason for each step.

c. Use the result for part (b) to find your percent increase if your current wage is \$10.50 and your new wage will be \$10.71.

d. Suppose your co-worker receives a 4% pay raise and her new wage is \$10.24. Find your co-worker's old wage. Explain the steps you used to find your answer.

# 2.4 Puzzle Time

## How Can You Share Five Apples With Seven Friends?

Write the letter of each answer in the box containing the exercise number.

Identify the algebraic properties of equality that are represented.

1. If  $a = b$ , then  $a \cdot c = b \cdot c, c \neq 0$ .
2. If  $a = b$ , then  $a - c = b - c$ .
3. If  $a = b$ , then  $a$  can be substituted for  $b$  (or  $b$  for  $a$ ) in any equation or expression.
4. If  $a = b$ , then  $\frac{a}{c} = \frac{b}{c}, c \neq 0$ .
5. If  $a = b$ , then  $a + c = b + c$ .
6. sum:  $a(b + c) = ab + ac$ ,  
difference:  $a(b - c) = ab - ac$
7. If  $a = b$  and  $b = c$ , then  $a = c$ . If  $AB = CD$  and  $CD = EF$ , then  $AB = EF$ . If  $m\angle A = m\angle B$  and  $m\angle B = m\angle C$ , then  $m\angle A = m\angle C$ .
8. If  $a = b$ , then  $b = a$ . If  $AB = CD$ , then  $CD = AB$ . If  $m\angle A = m\angle B$ , then  $m\angle B = m\angle A$ .
9.  $a = a, AB = AB, m\angle A = m\angle A$

| Answers         |                   |
|-----------------|-------------------|
| E. Subtraction  | R. C              |
| I. Inverse      | P. Multiplication |
| Q. I            | A. Addition       |
| M. Substitution | D. Converse       |
| F. G            | A. Division       |
| E. Distributive | B. Transformation |
| V. H            | E. Transitive     |
| A. Symmetric    | P. D              |
| M. Reverse      | C. Reflexive      |
| L. B            | O. Algebraic      |
| S. A            | U. E              |
| K. F            |                   |

Match the property of equality to the statement it illustrates.

(A) Reflexive, (B) Subtraction, (C) Distributive, (D) Multiplication, (E) Transitive, (F) Symmetric, (G) Division, (H) Addition, (I) Substitution

10. If  $x = y$ , then  $6x = 6y$ .
11. If  $AB = BC$ , then  $AB - 2 = BC - 2$ .
12.  $m\angle A = m\angle A$
13. If  $AB = CD$  and  $CD = 6$ , then  $AB = 6$ .
14. If  $a = b$ , then  $b = a$ .

|   |   |    |   |  |   |   |    |    |   |    |   |    |   |   |
|---|---|----|---|--|---|---|----|----|---|----|---|----|---|---|
| 3 | 5 | 14 | 2 |  | 4 | 1 | 10 | 11 | 6 | 12 | 8 | 13 | 9 | 7 |
|---|---|----|---|--|---|---|----|----|---|----|---|----|---|---|