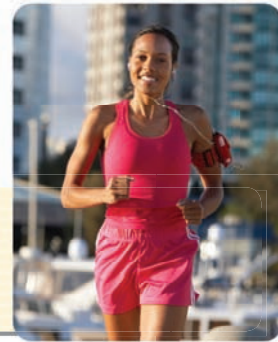


# 1.5 Use a Problem Solving Plan



**Before**

You used problem solving strategies.

**Now**

You will use a problem solving plan to solve problems.

**Why?**

So you can determine a route, as in Example 1.

## Key Vocabulary

- formula

COMMON CORE

**CC.9-12.A.CED.1** Create equations and inequalities in one variable and use them to solve problems.\*

## KEY CONCEPT

*For Your Notebook*

### A Problem Solving Plan

- STEP 1 Read and Understand** Read the problem carefully. Identify what you know and what you want to find out.
- STEP 2 Make a Plan** Decide on an approach to solving the problem.
- STEP 3 Solve the Problem** Carry out your plan. Try a new approach if the first one isn't successful.
- STEP 4 Look Back** Once you obtain an answer, check that it is reasonable.

## EXAMPLE 1 Read a problem and make a plan

**RUNNING** You run in a city. Short blocks are north-south and are 0.1 mile long. Long blocks are east-west and are 0.15 mile long. You will run 2 long blocks east, a number of short blocks south, 2 long blocks west, and back to your start. You want to run 2 miles at a rate of 7 miles per hour. How many short blocks must you run?

### Solution

**STEP 1 Read and Understand**

*What do you know?*

You know the length of each size block, the number of long blocks you will run, and the total distance you want to run.

You can conclude that you must run an even number of short blocks because you run the same number of short blocks in each direction.

*What do you want to find out?*

You want to find out the number of short blocks you should run so that, along with the 4 long blocks, you run 2 miles.

- STEP 2 Make a Plan** Use what you know to write a verbal model that represents what you want to find out. Then write an equation and solve it, as in Example 2.



### ANOTHER WAY

For an alternative method for solving the problem in Example 1, see the **Problem Solving Workshop**.



## EXAMPLE 2 Solve a problem and look back

Solve the problem in Example 1 by carrying out the plan. Then check your answer.

### Solution

#### IDENTIFY IRRELEVANT INFORMATION

The rate at which you run is given, but it is not needed to solve the problem. That information is irrelevant. All other given information is relevant, and no information needed to solve the problem is missing.

**STEP 3 Solve the Problem** Write a verbal model. Then write an equation. Let  $s$  be the number of short blocks you run.

Length of short block (miles/block)	·	Number of short blocks (blocks)	+	Length of long block (miles/block)	·	Number of long blocks (blocks)	=	Total distance (miles)
↓		↓		↓		↓		↓
0.1	·	$s$	+	0.15	·	4	=	2

The equation is  $0.1s + 0.6 = 2$ . One way to solve the equation is to use the strategy *guess, check, and revise*.

**Guess** an even number that is easily multiplied by 0.1. Try 20.

**Check** whether 20 is a solution.

$$0.1s + 0.6 = 2 \quad \text{Write equation.}$$

$$0.1(20) + 0.6 \stackrel{?}{=} 2 \quad \text{Substitute 20 for } s.$$

$$2.6 = 2 \quad \times \quad \text{Simplify; 20 does not check.}$$

**Revise.** Because  $2.6 > 2$ , try an even number less than 20. Try 14.

**Check** whether 14 is a solution.

$$0.1s + 0.6 = 2 \quad \text{Write equation.}$$

$$0.1(14) + 0.6 \stackrel{?}{=} 2 \quad \text{Substitute 14 for } s.$$

$$2 = 2 \quad \checkmark \quad \text{Simplify.}$$

► To run 2 miles, you should run 14 short blocks along with the 4 long blocks you run.

**STEP 4 Look Back** Check your answer by making a table. You run 0.6 mile on long blocks. Each two short blocks add 0.2 mile.

Short blocks	0	2	4	6	8	10	12	14
Total distance	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0

The total distance is 2 miles when you run 4 long blocks and 14 short blocks. The answer in Step 3 is correct.

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### GUIDED PRACTICE for Examples 1 and 2

- WHAT IF?** In Example 1, suppose that you want to run a total distance of 3 miles. How many short blocks should you run?

**FORMULAS** A **formula** is an equation that relates two or more quantities. You may find it helpful to use formulas in problem solving.

## KEY CONCEPT

*For Your Notebook*

### REVIEW FORMULAS

For additional formulas, see pp. SR16–SR20 and the Table of Formulas on pp. T2–T3.

### Formulas

#### Temperature

$$C = \frac{5}{9}(F - 32) \text{ where } F = \text{degrees Fahrenheit and } C = \text{degrees Celsius}$$

#### Simple interest

$I = Prt$  where  $I$  = interest,  $P$  = principal,  $r$  = interest rate (as a decimal), and  $t$  = time

#### Distance traveled

$d = rt$  where  $d$  = distance traveled,  $r$  = rate (constant or average speed), and  $t$  = time

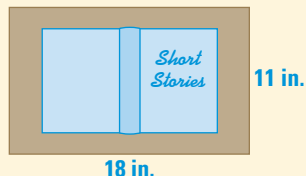
#### Profit

$P = I - E$  where  $P$  = profit,  $I$  = income, and  $E$  = expenses



### EXAMPLE 3 Standardized Test Practice

You are making a leather book cover. You need a rectangular piece of leather as shown. Find the cost of the piece if leather costs \$.25 per square inch.



- (A) \$14.50       (B) \$49.50  
 (C) \$58.00       (D) \$198.00

#### Solution

Use the formula for the area of a rectangle,  $A = lw$ , with  $l = 18$  inches and  $w = 11$  inches.

$$\begin{aligned}
 A &= lw && \text{Write area formula.} \\
 &= 18(11) && \text{Substitute 18 for } l \text{ and 11 for } w. \\
 &= 198 && \text{Simplify.}
 \end{aligned}$$

The area is 198 square inches, so the total cost is  $$.25(198) = \$49.50$ .

► The correct answer is B.  (A)  (B)  (C)  (D)

### ELIMINATE CHOICES

You can eliminate choices A and D by estimating. The area of the piece of leather is about 200 square inches, and  $$.25(200)$  is about \$50.



### GUIDED PRACTICE for Example 3

2. **GARDENING** A gardener determines the cost of planting daffodil bulbs to be \$2.40 per square foot. How much will it cost to plant daffodil bulbs in a rectangular garden that is 12 feet long and 5 feet wide?

- (A) \$40.80       (B) \$60       (C) \$81.60       (D) \$144

# 1.5 EXERCISES

## HOMework KEY

○ = See **WORKED-OUT SOLUTIONS**  
Exs. 5 and 17

★ = **STANDARDIZED TEST PRACTICE**  
Exs. 2, 11, 12, 20, and 22

◆ = **MULTIPLE REPRESENTATIONS**  
Ex. 21

## SKILL PRACTICE

**EXAMPLES**  
**1 and 2**  
for Exs. 3–5

- VOCABULARY** Give an example of a formula.
- ★ **WRITING** Describe how you can use a formula to solve the following problem: The inner edges of a cube-shaped pot have a length of 1.5 feet. How much does it cost to fill the planter if soil costs \$4 per cubic foot?

**READING AND UNDERSTANDING** In Exercises 3–5, identify what you know and what you need to find out. Identify any missing or irrelevant information. You do *not* need to solve the problem.

- CRAFT SHOW** You make dog collars and anticipate selling all of them at a craft fair. You spent \$85 for materials and hope to make a profit of \$90. How much should you charge for each collar?
- DISTANCE RUNNING** One day Paul ran at a rate of 0.15 mile per minute for 40 minutes. The next day Paul and Jen ran together at a rate of 0.16 mile per minute for 50 minutes. How far did Paul run altogether?
- **TEMPERATURE** One day, the temperature in Rome, Italy, was 30°C. The temperature in Dallas, Texas, was 83°F. Which temperature was higher?

**ERROR ANALYSIS** Describe and correct the error in solving the problem.

A town is fencing a rectangular field that is 200 feet long and 150 feet wide. At \$10 per foot, how much will it cost to fence the field?

6. 
$$P = 200 + 150 = 350$$
$$\$10(350) = \$3500$$
 ✗

7. 
$$A = (200)(150) = 30,000$$
$$\$10(30,000) = \$300,000$$
 ✗

**EXAMPLE 3**  
for Exs. 8–12

**CHOOSING A FORMULA** In Exercises 8–10, state the formula that is needed to solve the problem. You do *not* need to solve the problem.

- The temperature is 68°F. What is the temperature in degrees Celsius?
- A store buys a baseball cap for \$5 and sells it for \$20. What is the profit?
- Find the area of a triangle with a base of 25 feet and a height of 8 feet.
- ★ **MULTIPLE CHOICE** What is the interest on \$1200 invested for 2 years in an account that earns simple interest at a rate of 5% per year?  
(A) \$12      (B) \$60      (C) \$120      (D) \$240
- ★ **MULTIPLE CHOICE** A car travels at an average speed of 55 miles per hour. How many miles does the car travel in 2.5 hours?  
(A) 22 miles      (B) 57.5 miles      (C) 110 miles      (D) 137.5 miles
- CHALLENGE** Write a formula for the length  $l$  of a rectangle given its perimeter  $P$  and its width  $w$ . Justify your thinking.

## PROBLEM SOLVING

### EXAMPLES

1, 2, and 3

for Exs. 14–18

14. **DVD STORAGE** A stackable storage rack holds 22 DVDs and costs \$21. How much would it cost to buy enough racks to hold 127 DVDs?

15. **FRAMING** For an art project, you make a square print with a side length of 8 inches. You make a frame using strips of wood  $1\frac{1}{4}$  inches wide. What is the area of the frame?

16. **MOUNTAIN BOARDS** You have saved \$70 to buy a mountain board that costs \$250. You plan to save \$10 each week. How many weeks will it take to save for the mountain board?

17. **HIKING** You are hiking. The total weight of your backpack and its contents is  $13\frac{3}{8}$  pounds. You want to carry no more than 15 pounds. How many extra water bottles can you add to your backpack if each bottle weighs  $\frac{3}{4}$  pound?

18. **PIZZA** Thick crust pizza requires about 0.15 ounce of dough per square inch of surface area. You have two rectangular pans, one that is 16 inches long and 14 inches wide, and one that is 15.5 inches long and 10 inches wide. How much more dough do you need to make a thick crust pizza in the larger pan than in the smaller one?

19. **SONAR** A diver uses a sonar device to determine the distance to her diving partner. The device sends a sound wave and records the time it takes for the wave to reach the diving partner and return to the device. Suppose the wave travels at a rate of about 4800 feet per second.





- The wave returns 0.2 second after it was sent. How far did the wave travel?
- How far away is the diving partner?

20. **★ EXTENDED RESPONSE** A gardener is reseeding a city park that has the shape of a right triangle with a base of 150 feet and a height of 200 feet. The third side of the park is 250 feet long.

- One bag of grass seed covers 3750 square feet and costs \$27.50. How many bags are needed? What is the total cost?
- Wire fencing costs \$23.19 for each 50 foot roll. How much does it cost to buy fencing to enclose the area?
- Fence posts cost \$3.19 each and should be placed every 5 feet. How many posts are needed, and how much will they cost altogether? *Explain.*



21.  **MULTIPLE REPRESENTATIONS** Homeowners are building a square closet in a rectangular room that is 24 feet long and 18 feet wide. They want the remaining floor area to be at least 400 square feet. Because they don't want to cut any of the 1 foot by 1 foot square floor tiles, the side length of the closet floor should be a whole number of feet.
- Making a Table** Make a table showing possible side lengths of the closet floor and the remaining area for each side length.
  - Writing an Inequality** Write an inequality to describe the situation. Use your table to find the greatest possible side length of the closet floor.
22.  **SHORT RESPONSE** A farmer plans to build a fence around a rectangular pen that is 16 feet long. The area of the pen is 80 square feet. Is 40 feet of fencing enough to fence in the pen? *Explain.*
23. **CHALLENGE** You and your friend live 12 miles apart. You leave home at the same time and travel toward each other. You walk at a rate of 4 miles per hour and your friend bicycles at a rate of 11 miles per hour.
- How long after you leave home will you meet? How far from home will each of you be?
  - Suppose your friend bicycles at a rate of 12 miles per hour. How much sooner will you meet? How far from home will each of you be?

## QUIZ

**Write an equation or an inequality.**

- 4 more than twice a number  $n$  is equal to 25.
- The quotient of a number  $x$  and 2 is no more than 9.

**Check whether the given number is a solution of the equation or inequality.**

- $13 - 2x = 5$ ; 4
- $5d - 4 \geq 16$ ; 4
- $4y + 3 \geq 15$ ; 3
- CAR TRAVEL** One car travels about 28.5 miles on each gallon of gas. Suppose the average price of gas is \$2 per gallon. About how much would the gas for a 978 mile trip cost?





Make sense of problems and persevere in solving them.

**Another Way to Solve Example 1**

**MULTIPLE REPRESENTATIONS** In Example 1, you saw how to solve a problem about running using an equation. You can also solve the problem by using the strategy *draw a diagram*.

**PROBLEM**

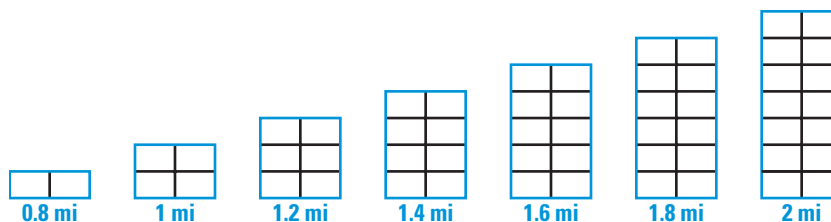
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**METHOD**

**Drawing a Diagram** You can draw a diagram to solve the problem.

**STEP 1** Read the problem carefully. It tells you the lengths of a short block and a long block. You plan to run 4 long blocks and a distance of 2 miles.

**STEP 2** Draw a pair of rectangles to represent running 1 short block in each direction. The total distance is  $4(0.15) + 2(0.1) = 0.8$  mile. Continue adding pairs of rectangles until the total distance run is 2 miles.



► You should run 14 short blocks.



**PRACTICE**

- BAKING** A cake pan is 9 inches wide and 11 inches long. How many 3 inch by 3 inch square pieces can you cut? Solve this problem using an equation. Then draw a diagram. *Explain* why a diagram is useful.
- SWIMMING** A 12 foot rope strung through 4 floats marks off the deep end of a pool. Each end of the rope is 3 feet from a float. The floats are equally spaced. How far apart are they? Solve this problem using two different methods.

- ERROR ANALYSIS** Describe and correct the error in solving Exercise 2.

$$4x + 6 = 12$$

$$4(1.5) + 6 = 12$$

The floats are 1.5 feet apart.

- GEOMETRY** The length of a rectangle is twice its width. The perimeter is 72 inches. What is its length? Solve this problem using two different methods.