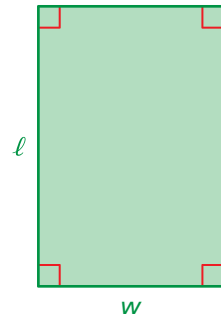


# 4.1 Areas of Parallelograms

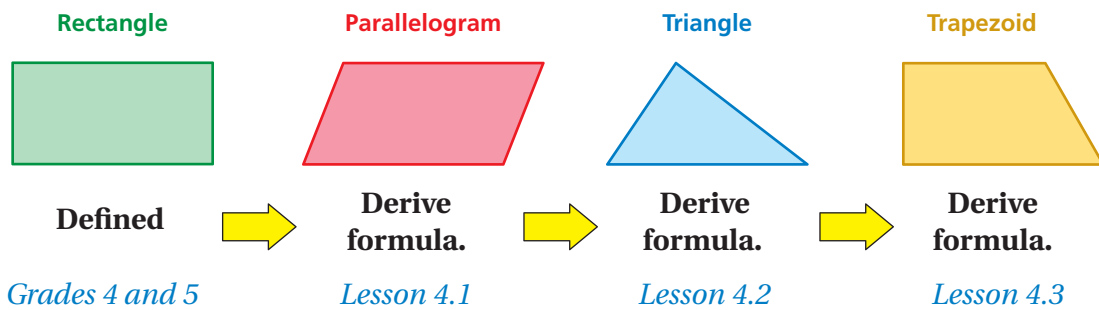
**Essential Question** How can you derive a formula for the area of a parallelogram?

A **polygon** is a closed figure in a plane that is made up of three or more line segments that intersect only at their endpoints. Several examples of polygons are parallelograms, triangles, and trapezoids.

The formulas for the areas of polygons can be derived from one area formula, the area of a rectangle. Recall that the area of a rectangle is the product of its length  $\ell$  and its width  $w$ . The process you use to derive these other formulas is called *deductive reasoning*.



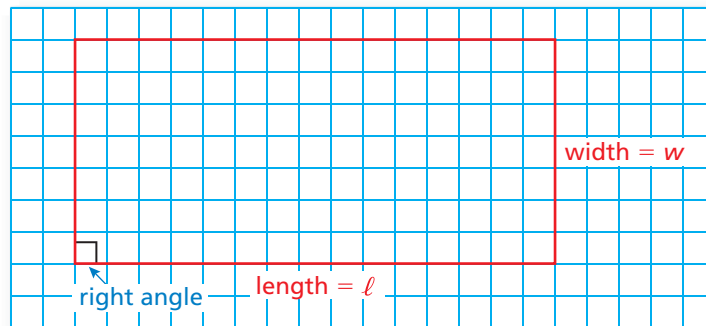
Area =  $\ell w$



## 1 ACTIVITY: Deriving the Area Formula of a Parallelogram

Work with a partner.

- Draw *any* rectangle on a piece of grid paper. An example is shown below. Label the length and width. Then find the area of your rectangle.



- Cut your rectangle into two pieces to form a parallelogram. Compare the area of the rectangle with the area of the parallelogram. What do you notice? Use your results to write a formula for the area  $A$  of a parallelogram.

$A =$   **Formula**



### Geometry

In this lesson, you will

- find areas of parallelograms.
- solve real-life problems.

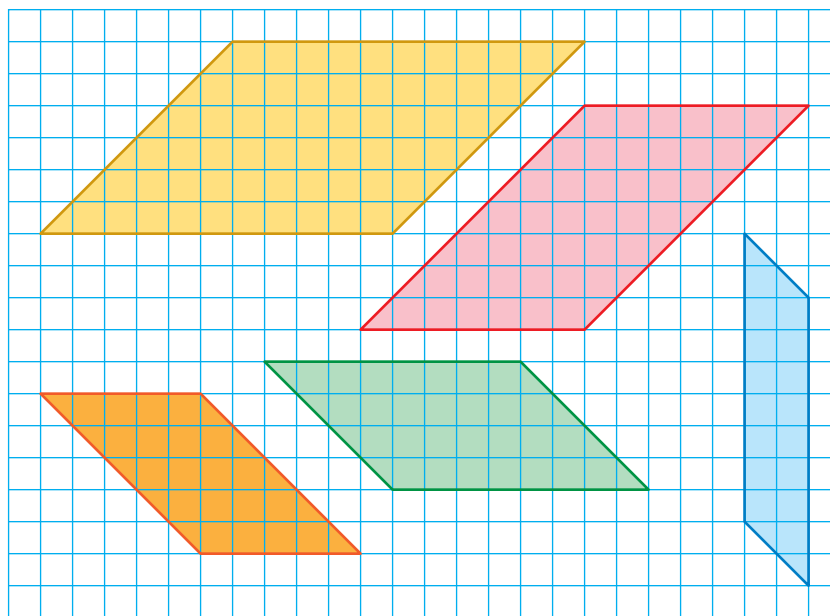
Learning Standard 6.G.1

2

**ACTIVITY: Finding Areas of Parallelograms****Math Practice 3****Use Assumptions**

How are rectangles and parallelograms similar? How can you use this information to solve the problem?

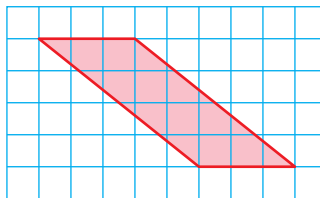
Work with a partner.



- Find the area of each parallelogram by cutting it into two pieces to form a rectangle.
- Use the formula you wrote in Activity 1 to find the area of each parallelogram. Compare your answers to those in part (a).
- Count unit squares for each parallelogram to check your results.

**What Is Your Answer?**

- IN YOUR OWN WORDS** How can you derive a formula for the area of a parallelogram?
- REASONING** The areas of a rectangle and a parallelogram are equal. The length of a rectangle is equal to the base of the parallelogram. What can you say about the width of the rectangle and the height of the parallelogram? Draw a diagram to support your answer.
- What is the height of the parallelogram shown? How do you know?

**Practice**

Use what you learned about the areas of parallelograms to complete Exercises 3–5 on page 156.

### Key Vocabulary

polygon, p. 152

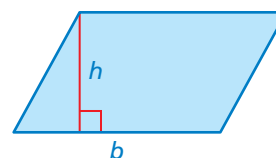
The *area* of a polygon is the amount of surface it covers. You can find the area of a parallelogram in much the same way as you can find the area of a rectangle.

## Key Idea

### Area of a Parallelogram

**Words** The area  $A$  of a parallelogram is the product of its base  $b$  and its height  $h$ .

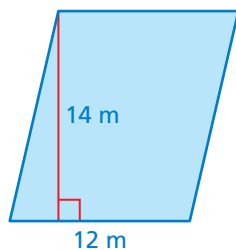
**Algebra**  $A = bh$



## EXAMPLE 1 Finding Areas of Parallelograms

Find the area of each parallelogram.

a.

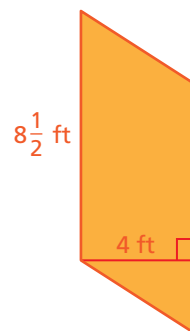


$$\begin{aligned} A &= bh \\ &= 12(14) \\ &= 168 \end{aligned}$$

Write formula.  
Substitute values.  
Multiply.

∴ The area of the parallelogram is 168 square meters.

b.



$$\begin{aligned} A &= bh \\ &= 8\frac{1}{2}(4) \\ &= 34 \end{aligned}$$

∴ The area of the parallelogram is 34 square feet.

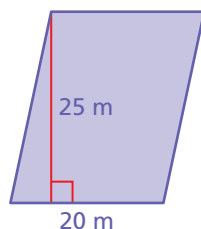
### Remember

Area is measured in square units.

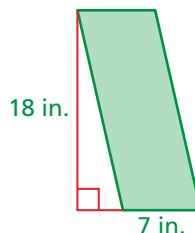
## On Your Own

Find the area of the parallelogram.

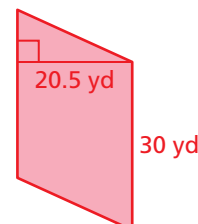
1.



2.

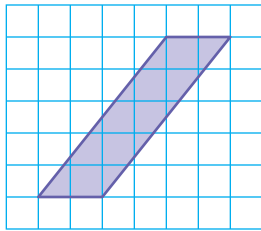


3.



Now You're Ready  
Exercises 3–8

## EXAMPLE 2 Finding the Area of a Parallelogram on a Grid

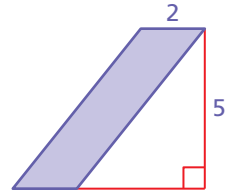


**Find the area of the parallelogram.**

Count grid lines to find the dimensions.

The base  $b$  is 2 units, and the height  $h$  is 5 units.

$$\begin{aligned} A &= bh && \text{Write formula.} \\ &= 2(5) && \text{Substitute values.} \\ &= 10 && \text{Multiply.} \end{aligned}$$

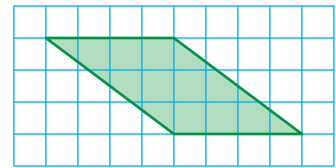


∴ The area of the parallelogram is 10 square units.

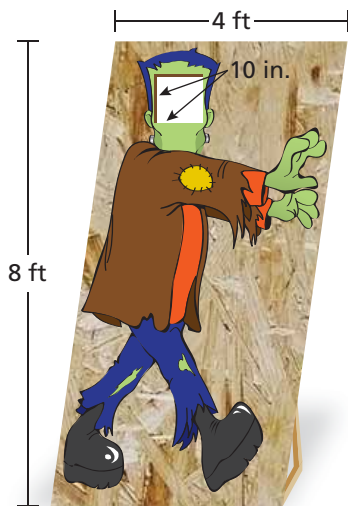
**Now You're Ready**  
Exercises 11–13

### On Your Own

4. Find the area of the parallelogram.



## EXAMPLE 3 Real-Life Application



**You make a photo prop for a school fair. You cut a 10-inch square out of a parallelogram-shaped piece of wood. What is the area of the photo prop?**

Convert the dimensions of the piece of wood to inches.

There are 12 inches in 1 foot, so the base is  $4 \cdot 12 = 48$  inches and the height is  $8 \cdot 12 = 96$  inches.

Use a verbal model to solve the problem.

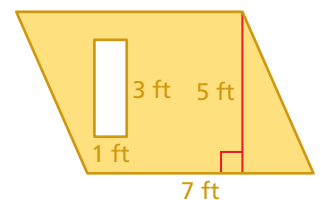
$$\begin{aligned} \text{area of photo prop} &= \text{area of wood} - \text{area of square} \\ &= 96(48) - 10^2 && \text{Substitute.} \\ &= 96(48) - 100 && \text{Evaluate } 10^2. \\ &= 4608 - 100 && \text{Multiply 96 and 48.} \\ &= 4508 && \text{Subtract 100 from 4608.} \end{aligned}$$

∴ The area of the photo prop is 4508 square inches.

**Now You're Ready**  
Exercises 14–16

### On Your Own

5. Find the area of the shaded region.
6. **WHAT IF?** In Example 3, you cut a 12-inch square out of the piece of wood. What is the area of the photo prop?



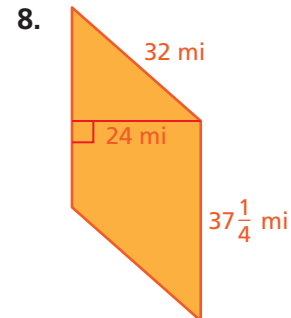
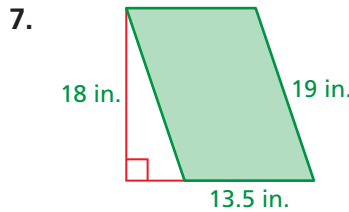
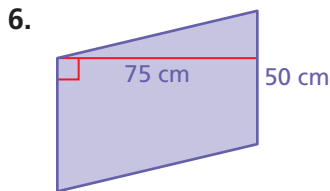
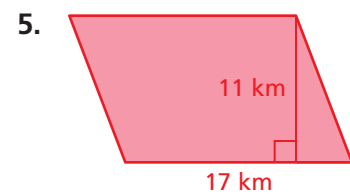
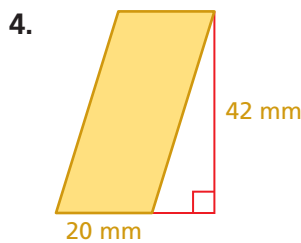
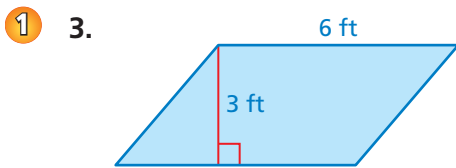
# 4.1 Exercises

## Vocabulary and Concept Check

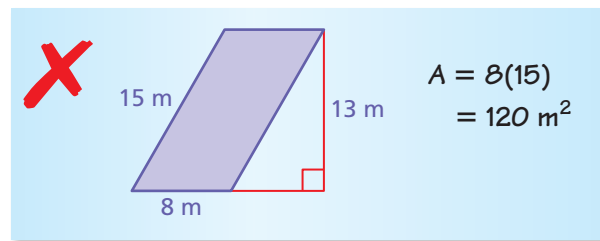
- WRITING** What is the area of a polygon? Explain how the perimeter and the area of the polygon are different.
- CHOOSE TOOLS** Construct a parallelogram that has an area of 24 square inches. Explain your method.

## Practice and Problem Solving

Find the area of the parallelogram.

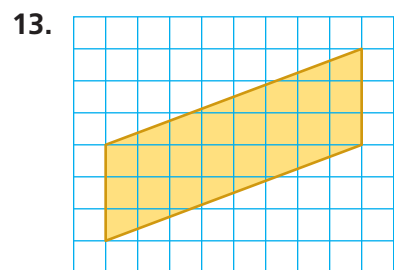
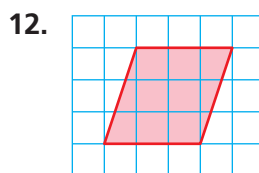
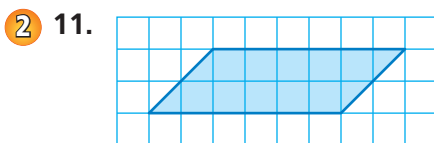


9. **ERROR ANALYSIS** Describe and correct the error in finding the area of the parallelogram.

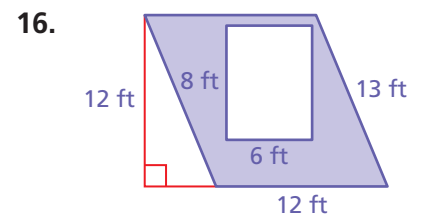
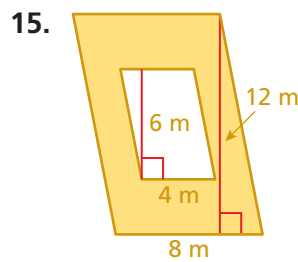
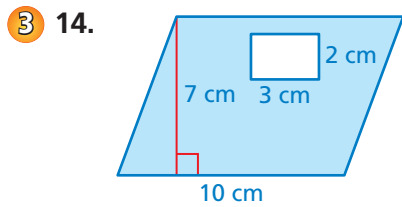


10. **CERAMIC TILE** A ceramic tile in the shape of a parallelogram has a base of 4 inches and a height of 1.5 inches. What is the area of the tile?

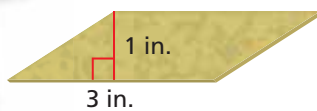
Find the area of the parallelogram.



Find the area of the shaded region.

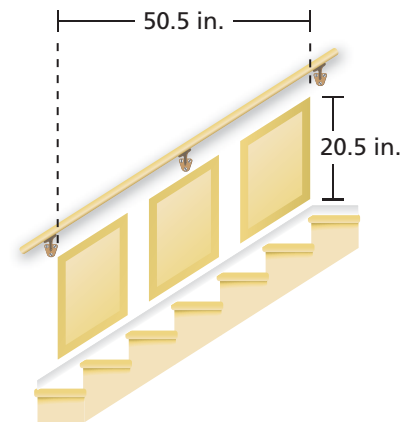


17. **DECK** Your deck has an area of 128 square feet. After adding a section, the area will be  $s^2 + 128$  square feet. Draw a diagram of how this can happen.



18. **T-SHIRT DESIGN** You use the parallelogram-shaped sponge to create the T-shirt design. The area of the design is 66 square inches. How many times do you use the sponge to create the design? Draw a diagram to support your answer.

19. **STAIRCASE** The staircase has three parallelogram-shaped panels that are the same size. The horizontal distance between each panel is 4.25 inches. What is the area of one panel?



20. **REASONING** Find the missing dimensions in the table.

Parallelogram	Base	Height	Area
A	$x + 4$		$5x + 20$
B		8	$8x - 24$
C	6		$12x + 6y$

21. **Logic** Each dimension of a parallelogram is multiplied by a positive number  $n$ . Write an expression for the area of the new parallelogram.



## Fair Game Review What you learned in previous grades & lessons

Use mental math to multiply. (*Skills Review Handbook*)

22.  $\frac{1}{2} \times 26$

23.  $82 \times 20$

24.  $16 \times 30$

25.  $\frac{1}{2} \times 236$

26. **MULTIPLE CHOICE** Which of the following describes angle  $B$ ? (*Skills Review Handbook*)

(A) acute

(B) obtuse

(C) right

(D) isosceles

