

LESSON 16.1 Area of Quadrilaterals

TEKS Expressions, equations, and relationships—**6.8.B** Model area formulas for parallelograms, trapezoids ... by decomposing and rearranging parts of these shapes. Also 6.8.D



ESSENTIAL QUESTION

How can you find the areas of parallelograms, rhombuses, and trapezoids?

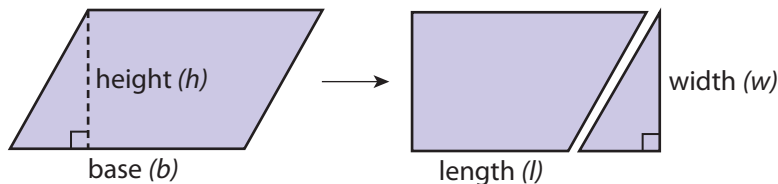
EXPLORE ACTIVITY

TEKS 6.8.B

Area of a Parallelogram

Recall that a rectangle is a special type of parallelogram.

- A** Draw a large parallelogram on grid paper. Cut out your parallelogram.
- B** Cut your parallelogram on the dashed line as shown. Then move the triangular piece to the other side of the parallelogram.



- C** What figure have you formed? _____

Does this figure have the same area as the parallelogram? _____

base of parallelogram = _____ of rectangle

height of parallelogram = _____ of rectangle

area of parallelogram = _____ of rectangle

What is the formula for the area of this figure? $A =$ _____

or _____

- D** What is the formula for the area of a parallelogram? $A =$ _____

Math Talk

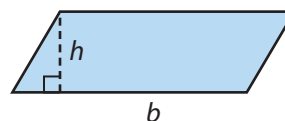
Mathematical Processes

How is the relationship between the length and width of a rectangle similar to the relationship between the base and height of a parallelogram?

Area of a Parallelogram

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

$$A = bh$$

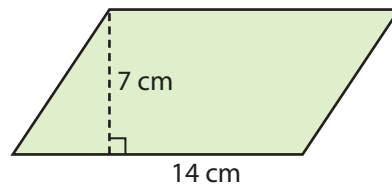


EXPLORE ACTIVITY (cont'd)

Reflect

- Find the area of the parallelogram.

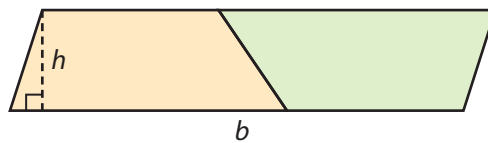
$A =$ _____



Math On the Spot
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Finding the Area of a Trapezoid

To find the formula for the area of a trapezoid, notice that two copies of the same trapezoid fit together to form a parallelogram. Therefore, the area of the trapezoid is $\frac{1}{2}$ the area of the parallelogram.



The height of the parallelogram is the same as the height of the trapezoid. The base of the parallelogram is the sum of the two bases of the trapezoid.

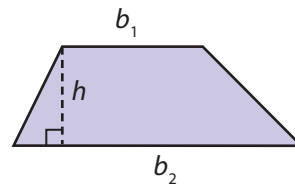
$$A = b \cdot h$$

$$A = (b_1 + b_2) \cdot h$$

Area of a Trapezoid

The area of a trapezoid is half its height multiplied by the sum of the lengths of its two bases.

$$A = \frac{1}{2}h(b_1 + b_2)$$



EXAMPLE 1



TEKS 6.8.D

A section of a deck is in the shape of a trapezoid. What is the area of this section of the deck?

$$b_1 = 17 \quad b_2 = 39 \quad h = 16$$

Use the formula for area of a trapezoid.

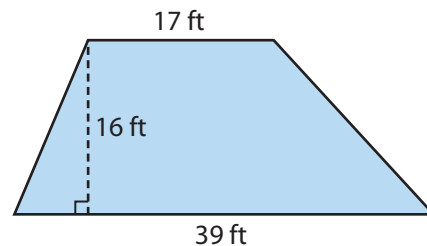
$$A = \frac{1}{2}h(b_1 + b_2)$$

$$= \frac{1}{2} \cdot 16(17 + 39) \quad \text{Substitute.}$$

$$= \frac{1}{2} \cdot 16(56) \quad \text{Add inside the parentheses.}$$

$$= 8 \cdot 56 \quad \text{Multiply } \frac{1}{2} \text{ and } 16.$$

$$= 448 \text{ square feet} \quad \text{Multiply.}$$

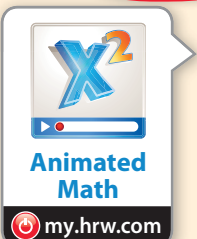


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Math Talk

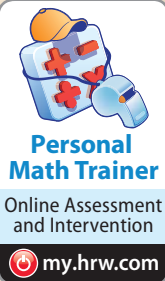


Does it matter which of the trapezoid's bases is substituted for b_1 and which is substituted for b_2 ? Why or why not?



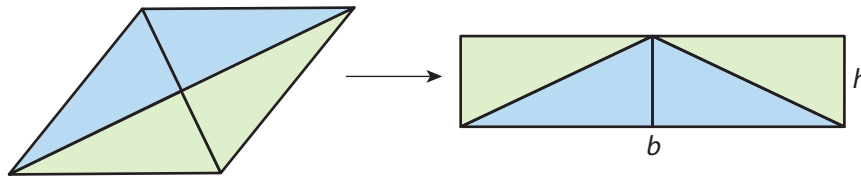
YOUR TURN

2. Another section of the deck is also shaped like a trapezoid. For this section, the length of one base is 27 feet, and the length of the other base is 34 feet. The height is 12 feet. What is the area of this section of the deck? $A = \underline{\hspace{2cm}}$ ft²



Finding the Area of a Rhombus

A **rhombus** is a quadrilateral in which all sides are congruent and opposite sides are parallel. A rhombus can be divided into four triangles that can then be rearranged into a rectangle.



The base of the rectangle is the same length as one of the diagonals of the rhombus. The height of the rectangle is $\frac{1}{2}$ the length of the other diagonal.

$$A = b \cdot h$$

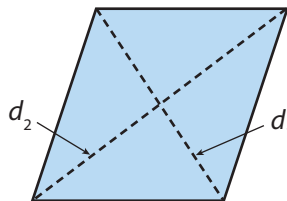
$$\downarrow \quad \downarrow$$

$$A = d_1 \cdot \frac{1}{2}d_2$$

Area of a Rhombus

The area of a rhombus is half of the product of its two diagonals.

$$A = \frac{1}{2} d_1 d_2$$



EXAMPLE 2



TEKS 6.8.B

Cedric is constructing a kite in the shape of a rhombus. The spars of the kite measure 15 inches and 24 inches. How much fabric will Cedric need for the kite?

To determine the amount of fabric needed, find the area of the kite.

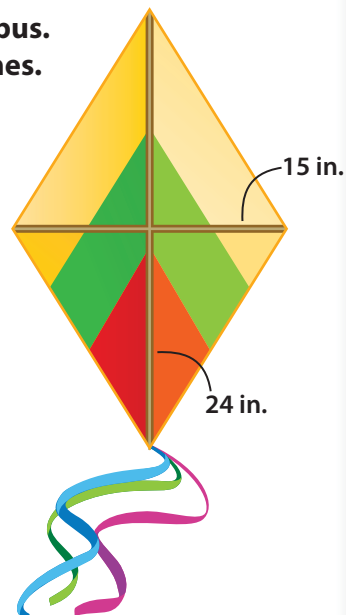
$$d_1 = 15 \quad d_2 = 24$$

Use the formula for area of a rhombus.

$$A = \frac{1}{2} d_1 d_2$$

$$= \frac{1}{2} (15)(24) \quad \text{Substitute.}$$

$$= 180 \text{ square inches} \quad \text{Multiply.}$$



YOUR TURN

Find the area of each rhombus.

3. $d_1 = 35$ m; $d_2 = 12$ m

$A = \underline{\hspace{2cm}}$ m²

4. $d_1 = 9.5$ in.; $d_2 = 14$ in.

$A = \underline{\hspace{2cm}}$ in²

5. $d_1 = 10$ m; $d_2 = 18$ m

$A = \underline{\hspace{2cm}}$ m²

6. $d_1 = 8\frac{1}{4}$ ft; $d_2 = 40$ ft

$A = \underline{\hspace{2cm}}$ ft²

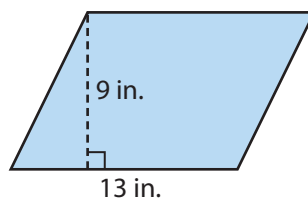
Guided Practice

1. Find the area of the parallelogram. (Explore Activity)

$A = bh$

$= (\underline{\hspace{1cm}})(\underline{\hspace{1cm}})$

$= \underline{\hspace{1cm}}$ in.²

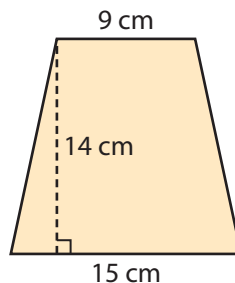


2. Find the area of the trapezoid. (Example 1)

$A = \frac{1}{2}h(b_1 + b_2)$

$= \frac{1}{2}(\square)(\square + \square)$

$= \underline{\hspace{1cm}}$ cm²

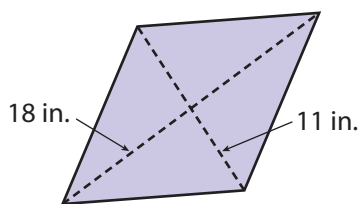


3. Find the area of the rhombus. (Example 2)

$A = \frac{1}{2}d_1d_2$

$= \frac{1}{2}(\square)(\square)$

$= \underline{\hspace{1cm}}$ in.²



ESSENTIAL QUESTION CHECK-IN

4. How can you find the areas of parallelograms, rhombuses, and trapezoids?

16.1 Independent Practice



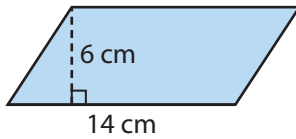
TEKS 6.8.B, 6.8.D



Personal Math Trainer

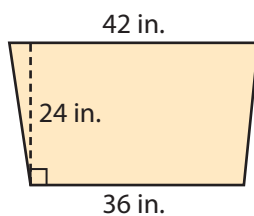
Online Assessment and Intervention

5. Rearrange the parts of the parallelogram to form a rectangle. Find the area of the parallelogram and the area of the rectangle. What is the relationship between the areas?



6. What is the area of a parallelogram that has a base of $12\frac{3}{4}$ in. and a height of $2\frac{1}{2}$ in.?

7. Draw a copy of the trapezoid to form a parallelogram. Find the area of the trapezoid and the area of the parallelogram. What is the relationship between the areas?



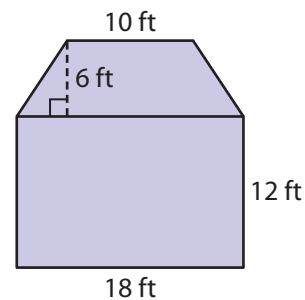
8. The bases of a trapezoid are 11 meters and 14 meters. Its height is 10 meters. What is the area of the trapezoid?

9. The seat of a bench is in the shape of a trapezoid with bases of 6 feet and 5 feet and a height of 1.5 feet. What is the area of the seat?

10. A kite in the shape of a rhombus has diagonals that are 25 inches long and 15 inches long. What is the area of the kite?

11. A window in the shape of a parallelogram has a base of 36 inches and a height of 45 inches. What is the area of the window?

12. **Communicate Mathematical Ideas** Find the area of the figure. Explain how you found your answer.



13. **Multistep** A parking space shaped like a parallelogram has a base of 17 feet and a height is 9 feet. A car parked in the space is 16 feet long and 6 feet wide. How much of the parking space is not covered by the car?

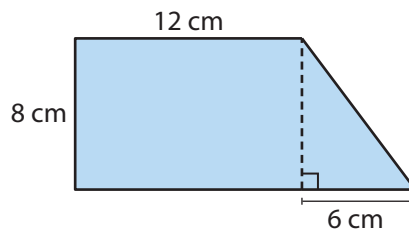


FOCUS ON HIGHER ORDER THINKING

14. **Critique Reasoning** Simon says that to find the area of a trapezoid, you can multiply the height by the top base and the height by the bottom base. Then add the two products together and divide the sum by 2. Is Simon correct? Explain your answer.

15. **Multistep** The height of a trapezoid is 8 in. and its area is 96 in^2 . One base of the trapezoid is 6 inches longer than the other base. What are the lengths of the bases? Explain how you found your answer.

16. **Critique Reasoning** Find the area of the trapezoid using the formula $A = \frac{1}{2}h(b_1 + b_2)$. Decompose the trapezoid into a rectangle and a triangle and find the area of each. Then find the sum of the two areas. Compare this sum with the area of the trapezoid.



Work Area