Area and Polygons

MODULE 13

COMMON CORE

ESSENTIAL QUESTION

How can you find the area of an irregular polygon using area formulas?

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Real-World Video

Quilting, painting, and other art forms use familiar geometric shapes, such as triangles and rectangles. To buy enough supplies for a project, you need to find or estimate the areas of each shape in the project.

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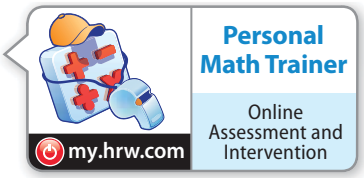
Are YOU Ready?

Complete these exercises to review skills you will need for this module.



Inverse Operations

EXAMPLES

$7k = 35$
$\frac{7k}{7} = \frac{35}{7}$
$k = 5$

k is multiplied by 7. Use the inverse operation, division.

$k + 7 = 9$
$k + 7 - 7 = 9 - 7$
$k = 2$

7 is added to k. Use the inverse operation, subtraction.

Solve each equation using the inverse operation.

1. $9p = 54$ _____ **2.** $m - 15 = 9$ _____ **3.** $\frac{b}{8} = 4$ _____ **4.** $z + 17 = 23$ _____

Metric Units

EXAMPLE

6 m = ▢ cm
6 m = 600 cm

Multiply to go from a larger unit to a smaller unit.

4,000 mL = ▢ L
4,000 mL = 4 L

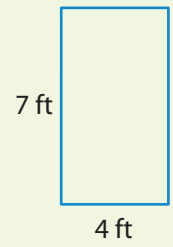
Divide to go from a smaller unit to a larger unit.

Convert to the given units.

5. 64 m = _____ cm **6.** 500 g = _____ kg **7.** 4.6 kL = _____ L

Area of Squares and Rectangles

EXAMPLE



Find the area of the rectangle.

$A = bh$
$= 7 \times 4$
$= 28$

Use the formula for the area of a rectangle. Substitute for base and height.

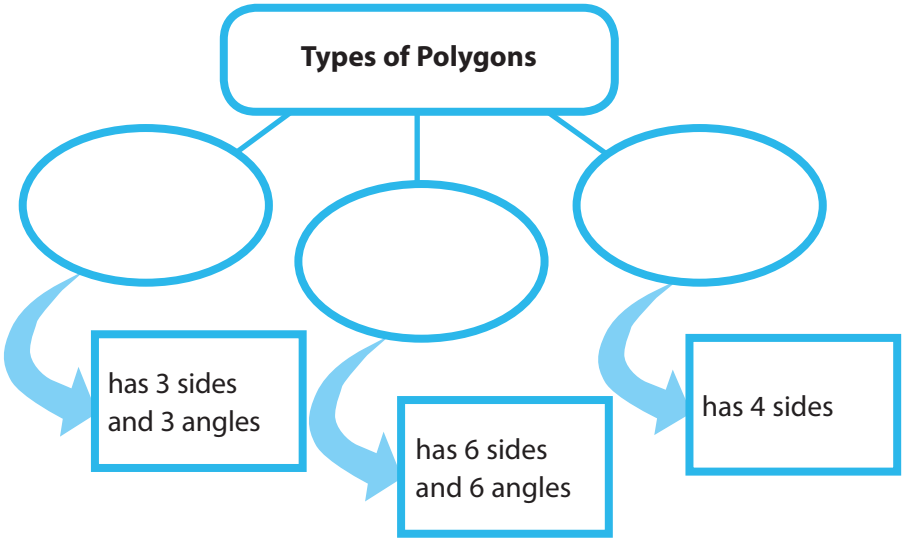
The area is 28 square feet.

8. Find the area of a rectangle with a base of 5 feet and a height of $9\frac{1}{2}$ feet _____

Reading Start-Up

Visualize Vocabulary

Use the ✔ words to complete the graphic. You will put one word in each oval.



Vocabulary

Review Words

- ✔ hexagon *(hexágono)*
- ✔ polygon *(polígono regular)*
- quadrilateral *(cuadrilátero)*
- rectangular prism *(prisma rectangular)*
- regular polygon *(polígono)*
- right triangle *(triángulo rectángulo)*
- ✔ triangle *(triángulo)*

Preview Words

- parallelogram *(paralelogramo)*
- rhombus *(rombo)*
- trapezoid *(trapecio)*

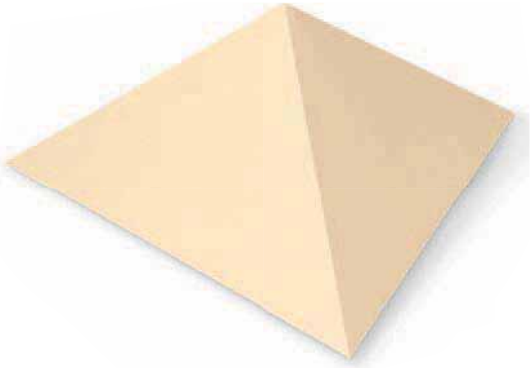
Understand Vocabulary

Match the term on the left to the correct expression on the right.

1. parallelogram	**A.** A quadrilateral in which all sides are congruent and opposite sides are parallel.
2. trapezoid	**B.** A quadrilateral in which opposite sides are parallel and congruent.
3. rhombus	**C.** A quadrilateral in which two sides are parallel.

Active Reading

Pyramid Before beginning the module, create a pyramid to help you organize what you learn. Label each side with one of the lesson titles from this module. As you study each lesson, write important ideas like vocabulary, properties, and formulas on the appropriate side.



MODULE 13

Unpacking the Standards

Understanding the standards and the vocabulary terms in the standards will help you know exactly what you are expected to learn in this module.

COMMON CORE **6.G.1**

Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

What It Means to You

You will use the formula for the area of a figure to write an equation that can be used to solve a problem.

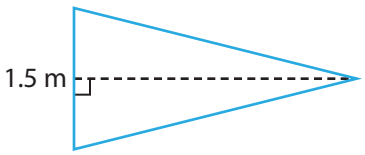
UNPACKING EXAMPLE 6.G.1

The Hudson Middle School wrestling team won the state tournament and was awarded a triangular pennant to display in the school gymnasium. The pennant has an area of 2.25 square meters. The base of the pennant is 1.5 meters long. Write an equation to find the height of the pennant.

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

$2.25 = \frac{1}{2}(1.5)h$

$2.25 = 0.75h$



An equation to find the height of the pennant is $2.25 = 0.75h$.

COMMON CORE **6.G.1**

Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

What It Means to You

You will use formulas to find the area of irregular polygons.

UNPACKING EXAMPLE 6.G.1

John is measuring his room for new carpet. Find the area of the room.

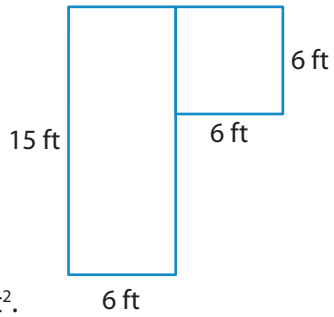
Find the area of the rectangle.

$A = bh = 15 \times 6 = 90 \text{ ft}^2$

Find the area of the square.

$A = s^2 = 6^2 = 36 \text{ ft}^2$

The total area is $90 \text{ ft}^2 + 36 \text{ ft}^2 = 126 \text{ ft}^2$.



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LESSON 13.1

Area of Quadrilaterals

COMMON CORE 6.G.1

Find the area of. . . special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; . . . .

ESSENTIAL QUESTION

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

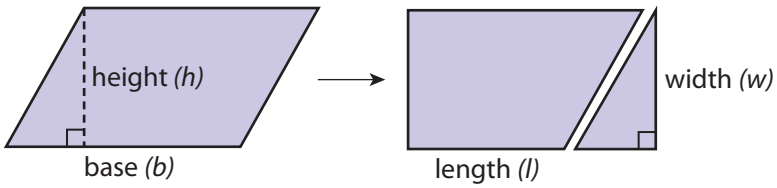
EXPLORE ACTIVITY COMMON CORE 6.G.1

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? $A =$ _____

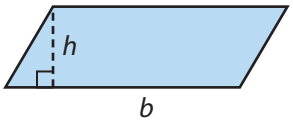
Math Talk
Mathematical Practices

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.

$A = bh$

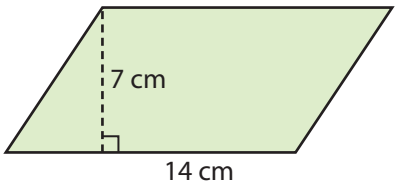


EXPLORE ACTIVITY *(cont'd)*

Reflect

1. Find the area of the parallelogram.

$A =$ _____



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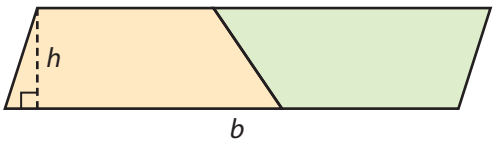
Finding the Area of a Trapezoid

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.



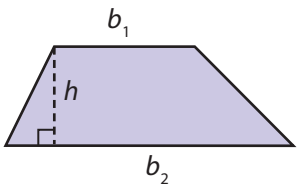
The height of the parallelogram is the same as the height of the trapezoid. The base of the parallelogram is the sum of the two bases of the trapezoid.

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

Area of a Trapezoid

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

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

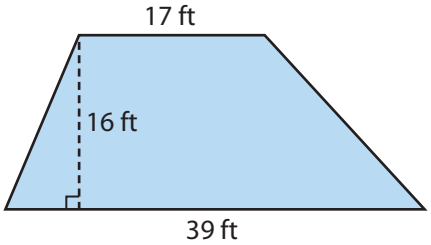


EXAMPLE 1

Real World

COMMON CORE 6.G.1

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



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

Use the formula for area of a trapezoid.

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

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

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

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

$= 448$ square feet Multiply.

Math Talk
Mathematical Practices

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?

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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? $A =$ _____ ft^2

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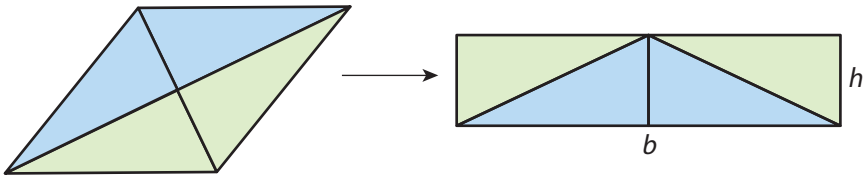
Finding the Area of a Rhombus

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.

$$A = b \cdot h$$
$$A = d_1 \cdot \tfrac{1}{2}d_2$$

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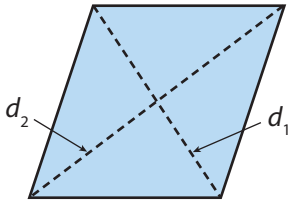
Area of a Rhombus

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

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



EXAMPLE 2

Real World

COMMON CORE 6.G.1

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.

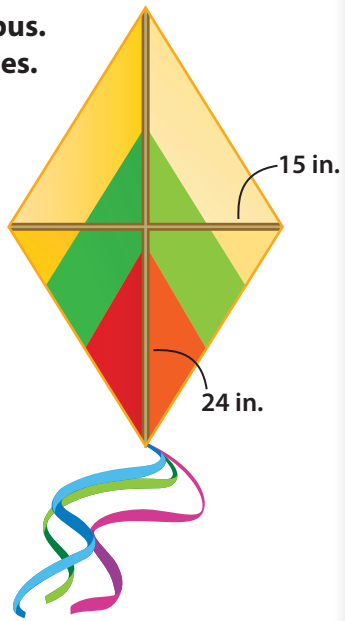
$d_1 = 15$ $\quad$ $d_2 = 24$

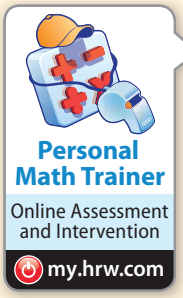
Use the formula for area of a rhombus.

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

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

$= 180$ square inches $\quad$ Multiply.





YOUR TURN

Find the area of each rhombus.

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

$A =$ _____ m^2

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

$A =$ _____ in^2

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

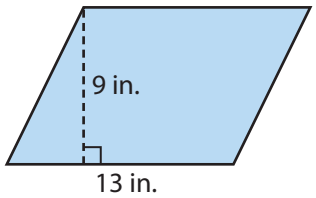
$A =$ _____ m^2

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

$A =$ _____ ft^2

Guided Practice

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

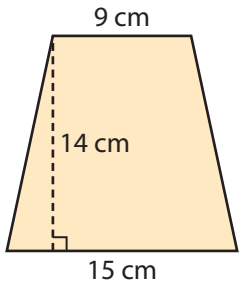


$A = bh$

$= (\_\_\_\_\_)(\_\_\_\_\_)$

$=$ _____ in^2

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

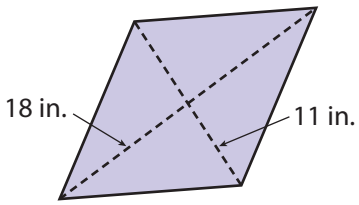


$A = \frac{1}{2}h(b_1 + b_2)$

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

$=$ _____ cm^2

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



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

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

$=$ _____ in^2

ESSENTIAL QUESTION CHECK-IN

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

_____

_____

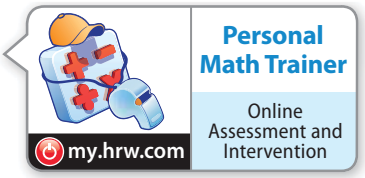
_____

_____

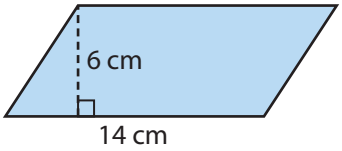
Name _____ Class _____ Date _____

13.1 Independent Practice

COMMON CORE 6.G.1



5. Find the area of the parallelogram.

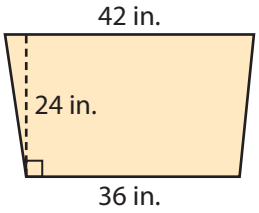


_____

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. Find the area of the trapezoid.

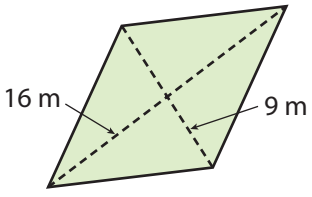


_____

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. Find the area of the rhombus.



_____

10. The diagonals of a rhombus are 21 m and 32 m. What is the area of the rhombus?

_____

11. 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?

_____

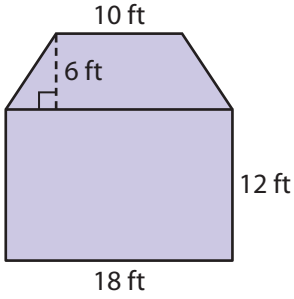
12. A kite in the shape of a rhombus has diagonals that are 25 inches long and 15 inches long. What is the area of the kite?

_____

13. 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?

_____

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



_____

_____

_____

_____

_____

_____

_____

15. **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?

H.O.T. FOCUS ON HIGHER ORDER THINKING

16. **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.

17. **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.

18. **Multiple Representations** The diagonals of a rhombus are 12 in. and 16 in. long. The length of a side of the rhombus is 10 in. What is the height of the rhombus? Explain how you found your answer.

Work Area

LESSON

13.2 Area of Triangles

COMMON CORE 6.G.1

Find the area of right triangles, other triangles, . . . by composing into rectangles . . .

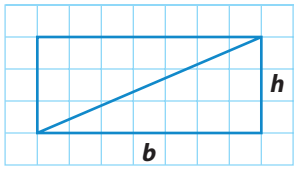
ESSENTIAL QUESTION

How do you find the area of a triangle?

EXPLORE ACTIVITY 1

COMMON CORE 6.G.1

Area of a Right Triangle



A Draw a large rectangle on grid paper.

What is the formula for the area of a rectangle? $A =$ _____

B Draw one diagonal of your rectangle.

The diagonal divides the rectangle into _____.

Each one represents _____ of the rectangle.

Use this information and the formula for area of a rectangle to write a formula for the area of a right triangle. $A =$ _____

Reflect

1. **Communicate Mathematical Ideas** In the formula for the area of a right triangle, what do b and h represent?

_____

EXPLORE ACTIVITY 2

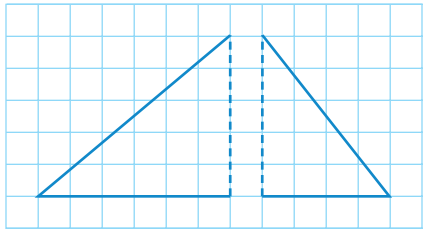
COMMON CORE 6.G.1

Area of a Triangle

A Draw a large triangle on grid paper. Do not draw a right triangle.

B Cut out your triangle. Then trace around it to make a copy of your triangle. Cut out the copy.

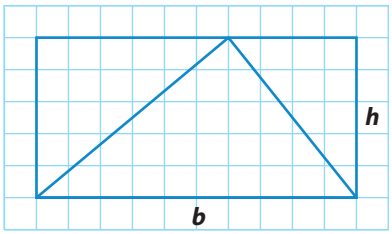
C Cut one of your triangles into two pieces by cutting through one angle directly across to the opposite side. Now you have three triangles — one large triangle and two smaller right triangles.



EXPLORE ACTIVITY 2 *(cont'd)*

When added together, the areas of the two smaller triangles equal the _____ of the large triangle.

D Arrange the three triangles into a rectangle.



What fraction of the rectangle does the large triangle represent? _____

The area of the rectangle is $A = bh$. What is the area of the large triangle? $A =$ _____

How does this formula compare to the formula for the area of a right triangle that you found in Explore Activity 1?

_____

Reflect

2. **Communicate Mathematical Ideas** What type of angle is formed by the base and height of a triangle?

_____

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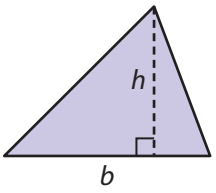
Finding the Area of a Triangle

Area of a Triangle

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

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

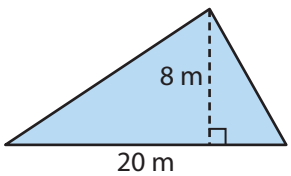


EXAMPLE 1

COMMON CORE 6.G.1

Find the area of each triangle.

A



$b = 20$ meters $\quad h = 8$ meters

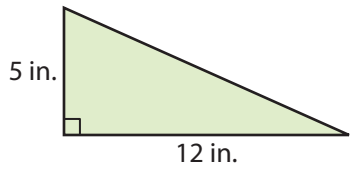
$A = \frac{1}{2}bh$

$= \frac{1}{2}(20 \text{ meters})(8 \text{ meters})$ Substitute.

$= 80$ square meters Multiply.

Find the area of each triangle.

B



$b = 12$ inches $\quad h = 5$ inches

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

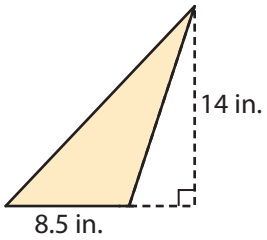
$= \frac{1}{2}(12 \text{ inches})(5 \text{ inches})$ Substitute.

$= 30$ square inches Multiply.

YOUR TURN

Find the area of the triangle.

3.



$A =$ _____

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Math Talk

Mathematical Practices

Why can you also write the formula for the area of a triangle as $A = \frac{bh}{2}$?

Problem Solving Using Area of Triangles

You can use the formula for the area of a triangle to solve real-world problems.

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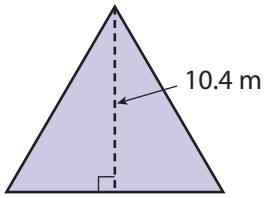
EXAMPLE 2

Real World

COMMON CORE 6.G.1

Each triangular face of the Pyramid of Peace in Kazakhstan is made up of 25 smaller equilateral triangles. These triangles have measurements as shown in the diagram. What is the area of one of the smaller equilateral triangles?



STEP 1 Identify the length of the base and the height of the triangle.

$b = 12$ m and $h = 10.4$ m

STEP 2 Use the formula to find the area of the triangle.

$A = \frac{1}{2}bh$ Substitute.

$= \frac{1}{2}(12)(10.4)$ Multiply.

$= 62.4$

The area of one small equilateral triangle is 62.4 m^2.

Reflect

4. **Persevere in Problem Solving** What is the total area of one face of the pyramid? What is the total surface area of the faces of the pyramid, not counting the bottom? (Hint: the bottom of the pyramid is a square.)

_____

_____

_____

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YOUR TURN

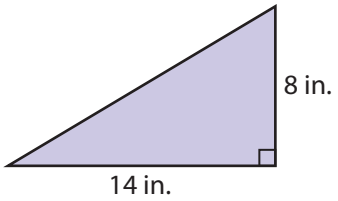
5. Amy needs to order a shade for a triangular-shaped window that has a base of 6 feet and a height of 4 feet. What is the area of the shade?

_____

Guided Practice

Find the area of each triangle. (Explore Activities 1 and 2, Example 1)

1.



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

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

= _____ in^2

2. A pennant in the shape of a triangle has a base of 12 inches and a height of 30 inches. What is the area of the pennant? (Example 2)

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

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

= _____ in^2

ESSENTIAL QUESTION CHECK-IN

3. How do you find the area of a triangle?

_____

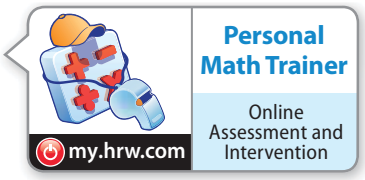
_____

_____

Name _____ Class _____ Date _____

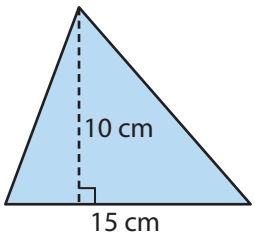
13.2 Independent Practice

COMMON CORE 6.G.1



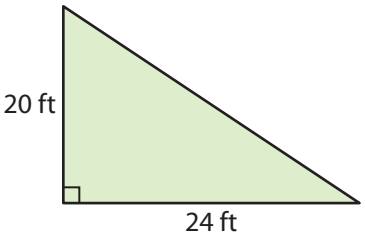
Find the area of each triangle.

4.



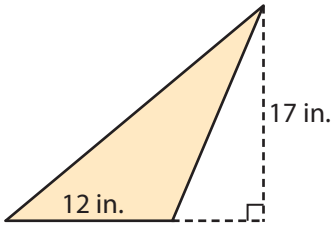
_____

5.



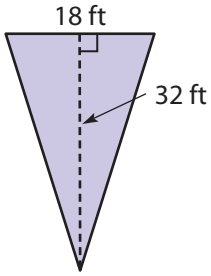
_____

6.



_____

7.



_____

8. What is the area of a triangle that has a base of $15\frac{1}{4}$ in. and a height of 18 in.?

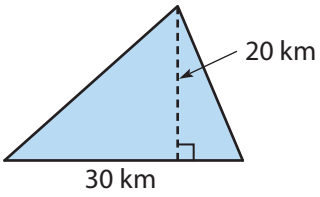
_____

9. A right triangle has legs that are 11 in. and 13 in. long. What is the area of the triangle?

_____

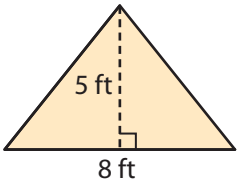
10. A triangular plot of land has the dimensions shown in the diagram. What is the area of the land?

_____



11. The front part of a tent has the dimensions shown in the diagram. What is the area of this part of the tent?

_____



12. **Multistep** The sixth-grade art students are making a mosaic using tiles in the shape of right triangles. Each tile has leg measures of 3 centimeters and 5 centimeters. If there are 200 tiles in the mosaic, what is the area of the mosaic?

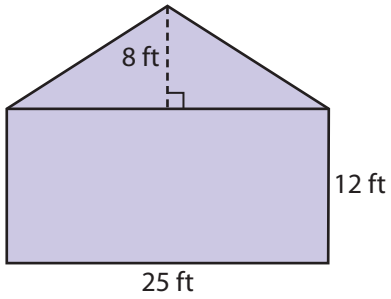
_____

13. **Critique Reasoning** Monica has a triangular piece of fabric. The height of the triangle is 15 inches and the triangle's base is 6 inches. Monica says that the area of the fabric is 90 in^2. What error did Monica make? Explain your answer.

_____

_____

14. **Multistep** Wayne is going to paint the side of the house shown in the diagram. What is the area that will be painted? Explain how you found your answer.



H.O.T. FOCUS ON HIGHER ORDER THINKING

Work Area

15. **Communicate Mathematical Ideas** Explain how the areas of a triangle and a parallelogram with the same base and height are related.

16. **Analyze Relationships** A rectangle and a triangle have the same area. If their bases are the same lengths, how do their heights compare? Justify your answer.

17. **What If?** A right triangle has an area of 18 square inches.

a. If the triangle is an isosceles triangle, what are the lengths of the legs of the triangle?

b. If the triangle is not an isosceles triangle, what are all the possible lengths of the legs, if the lengths are whole numbers?

LESSON 13.3

Solving Area Equations

COMMON CORE 6.G.1

Find the area of right triangles, other triangles, special quadrilaterals, and polygons . . .; apply these techniques in the context of solving...problems. *Also 6.EE.7*

ESSENTIAL QUESTION

How do you use equations to solve problems about area of rectangles, parallelograms, trapezoids, and triangles?

Problem Solving Using the Area of a Triangle

Recall that the formula for the area of a triangle is $A = \frac{1}{2}bh$. You can also use the formula to find missing dimensions if you know the area and one dimension.

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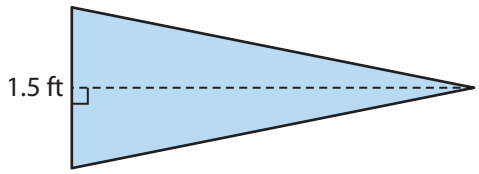
EXAMPLE 1

Real World

COMMON CORE 6.G.1, 6.EE.7

The Hudson High School wrestling team just won the state tournament and has been awarded a triangular pennant to hang on the wall in the school gymnasium. The base of the pennant is 1.5 feet long. It has an area of 2.25 square feet. What is the height of the pennant?



$A = \frac{1}{2}bh$ Write the formula.

$2.25 = \frac{1}{2}(1.5)h$ Use the formula to write an equation.

$2.25 = 0.75h$ Multiply $\frac{1}{2}$ and 1.5.

$\frac{2.25}{0.75} = \frac{0.75h}{0.75}$ Divide both sides of the equation by 0.75.

$3 = h$

The height of the pennant is 3 feet.

Math Talk
Mathematical Practices

How can you use units in the formula to confirm that the units for the height are in feet?

YOUR TURN

1. Renee is sewing a quilt whose pattern contains right triangles. Each quilt piece has a height of 6 in. and an area of 24 in^2.

How long is the base of each quilt piece? _____

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Writing Equations Using the Area of a Trapezoid

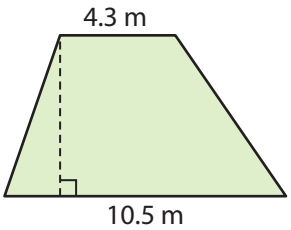
You can use the formula for area of a trapezoid to write an equation to solve a problem.

EXAMPLE 2

Real World

COMMON CORE 6.G.1, 6.EE.7

A garden in the shape of a trapezoid has an area of 44.4 square meters. One base is 4.3 meters long and the other base is 10.5 meters long. The height of the trapezoid is the width of the garden. How wide is the garden?



$A = \frac{1}{2}h(b_1 + b_2)$ Write the formula.

$44.4 = \frac{1}{2}h(4.3 + 10.5)$ Use the formula to write an equation.

$44.4 = \frac{1}{2}h(14.8)$ Add inside parentheses.

$44.4 = 7.4h$ Multiply $\frac{1}{2}$ and 14.8.

$\frac{44.4}{7.4} = \frac{7.4h}{7.4}$ Divide both sides of the equation by 7.4.

$6 = h$

The garden is 6 meters wide.

Math Talk
Mathematical Practices
How can you check that the answer is reasonable?

Reflect

2. **Communicate Mathematical Ideas** Explain why the first step after substituting is addition.

_____

_____

_____

_____

YOUR TURN

3. The cross section of a water bin is shaped like a trapezoid. The bases of the trapezoid are 18 feet and 8 feet long. It has an area of 52 square feet. What is the height of the cross section?

_____

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Solving Multistep Problems

You can write and solve equations that represent real-world problems related to relationships in geometry.

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EXAMPLE 3 Problem Solving

COMMON CORE 6.G.1

John and Mary are using rolls of fabric to make a rectangular stage curtain for their class play. The rectangular piece of fabric on each roll measures 2.5 feet by 15 feet. If the area of the curtain is 200 square feet, what is the least number of rolls they need?

Analyze Information

Rewrite the question as a statement.

- Find the least number of rolls of fabric needed to cover an area of 200 ft^2.

List the important information.

- Each roll of fabric is a 2.5 foot by 15 foot rectangle.
- The area of the curtain is 200 square feet.

Formulate a Plan

Write an equation to find the area of each roll of fabric.

Use the area of the curtain and the area of each roll to write an equation to find the least number of rolls.

Solve

STEP 1 Write an equation to find the area of each roll of fabric.

$A = lw$

$A = 15 \cdot 2.5$

$A = 37.5\ ft^2$

STEP 2 Write an equation to find the least number of rolls.

$n = 200 \div 37.5$

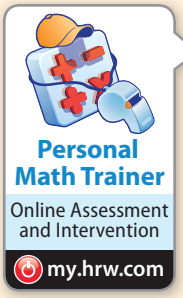
$n = 5\frac{1}{3}$

STEP 3 The problem asks for the least number of rolls needed. Since 5 rolls will not be enough, they will need 6 rolls to make the curtain.

John and Mary will need 6 rolls of fabric to make the curtain.

Justify and Evaluate

The area of each roll is about 38 ft^2. Since 38 $ft^2 \cdot 6 = 228\ ft^2$, the answer is reasonable.



YOUR TURN

4. A parallelogram-shaped field in a park needs sod. The parallelogram has a base of 21.5 meters and a height of 18 meters. The sod is sold in pallets of 50 square meters. How many pallets of sod are needed to fill the field?

_____

Guided Practice

1. A triangular bandana has an area of 70 square inches. The height of the triangle is $8\frac{3}{4}$ inches. Write and solve an equation to find the length of the base of the triangle. (Example 1)

_____

2. The top of a desk is shaped like a trapezoid. The bases of the trapezoid are 26.5 and 30 centimeters long. The area of the desk is 791 square centimeters. The height of the trapezoid is the width of the desk. Write and solve an equation to find the width of the desk. (Example 2)

_____

3. Taylor wants to paint his rectangular deck that is 42 feet long and 28 feet wide. A gallon of paint covers about 350 square feet. How many gallons of paint will Taylor need to cover the entire deck? (Example 3)

Write an equation to find the _____ of the deck.

Write and solve the equation.

Write an equation to find the _____.

Write and solve the equation.

Taylor will need _____ gallons of paint.

ESSENTIAL QUESTION CHECK-IN

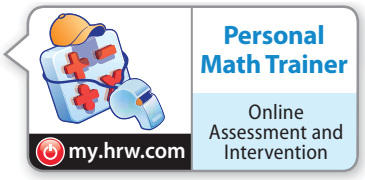
4. How do you use equations to solve problems about area of rectangles, parallelograms, trapezoids, and triangles?

_____

Name _____ Class _____ Date _____

13.3 Independent Practice

COMMON CORE 6.G.1, 6.EE.7



5. A window shaped like a parallelogram has an area of $18\frac{1}{3}$ square feet. The height of the window is $3\frac{1}{3}$ feet. How long is the base of the window?

6. A triangular sail has a base length of 2.5 meters. The area of the sail is 3.75 square meters. How tall is the sail?

7. A section in a stained glass window is shaped like a trapezoid. The top base is 4 centimeters and the bottom base is 2.5 centimeters long. If the area of the section of glass is 3.9 square centimeters, how tall is the section?

8. **Multistep** Amelia wants to paint three walls in her family room. Two walls are 26 feet long by 9 feet wide. The other wall is 18 feet long by 9 feet wide.

a. What is the total area of the walls that Amelia wants to paint?

b. Each gallon of paint covers about 250 square feet. How many gallons of paint should Amelia buy to paint the walls?

9. **Critical Thinking** The area of a triangular block is 64 square inches. If the base of the triangle is twice the height, how long are the base and the height of the triangle?

10. **Multistep** Alex needs to varnish the top and the bottom of a dozen rectangular wooden planks. The planks are 8 feet long and 3 feet wide. Each pint of varnish covers about 125 square feet and costs $3.50.

a. What is the total area that Alex needs to varnish?

b. How much will it cost Alex to varnish all the wooden planks?

11. **Multistep** Leia cuts congruent triangular patches with an area of 45 square centimeters from a rectangular piece of fabric that is 18 centimeters long and 10 centimeters wide. How many of the patches can Leia cut from 32 pieces of the fabric?

12. **Multistep** A farmer needs to buy fertilizer for two fields. One field is shaped like a trapezoid, and the other is shaped like a triangle. The trapezoidal field has bases that are 35 and 48 yards and a height of 26 yards. The triangular field has the same height as the trapezoidal field and a base of 39 yards. Each bag of fertilizer covers 150 square yards. How many bags of fertilizer does the farmer need to buy?

13. A tennis court for singles play is 78 feet long and 27 feet wide.

a. The court for doubles play is 9 feet wider than the court for singles play. How much more area is covered by the tennis court used for doubles play?

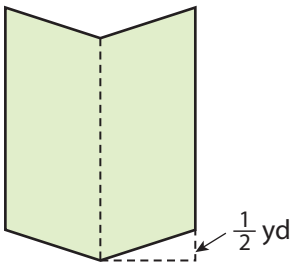
b. The junior court for players 8 and under is 36 feet long and 18 feet wide. How much more area is covered by the tennis court used for singles play?

c. The court for players 10 and under is 18 feet shorter than the court for singles play. How much more area is covered by the tennis court used for singles play?

14. **Draw Conclusions** The cross section of a metal ingot is a trapezoid. The cross section has an area of 39 square centimeters. The top base of the cross section is 12 centimeters. The length of the bottom base is 2 centimeters greater than the top base. How tall is the metal ingot? Explain.

H.O.T. FOCUS ON HIGHER ORDER THINKING

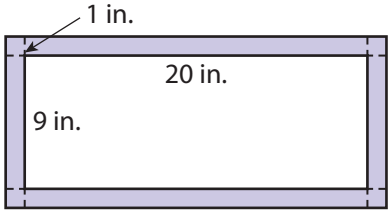
15. **Analyze Relationships** A mirror is made of two congruent parallelograms as shown in the diagram. The parallelograms have a combined area of $9\frac{1}{3}$ square yards. The height of each parallelogram is $1\frac{1}{3}$ yards.



a. How long is the base of each parallelogram?

b. What is the area of the smallest *rectangle* of wall that the mirror could fit on?

16. **Persevere in Problem Solving** A watercolor painting is 20 inches long by 9 inches wide. Ramon makes a border around the watercolor painting by making a mat that adds 1 inch to each side of the length and the width. What is the area of the mat?



Work Area

LESSON

13.4 Area of Polygons

COMMON CORE 6.G.1

Find the area of ... polygons by composing into rectangles or decomposing into triangles and other shapes ....

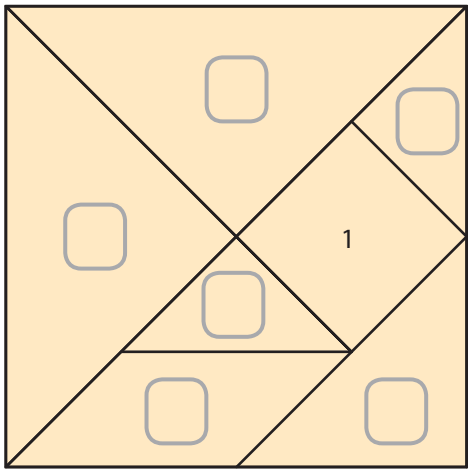
ESSENTIAL QUESTION

How can you find the area of a polygon by breaking it into simpler shapes?

EXPLORE ACTIVITY COMMON CORE 6.G.1

Finding Areas Using Tangrams

A tangram is a square that is divided into smaller shapes. The area of the small square is 1 square unit. Use a tangram to find the area of each of the other tangram pieces.

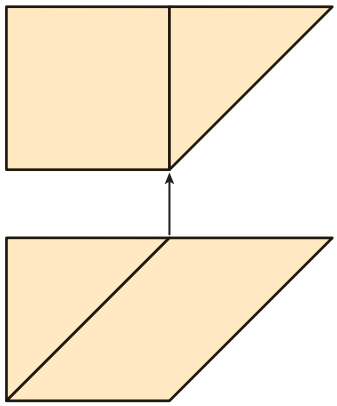


A Place one large triangle on top of the other large triangle. What is true about these two triangles? What does this mean about the areas of these two triangles?

_____

B Place the two small triangles on top of the square. What is the area of each small triangle? Write this area on the diagram. _____

C Arrange the square and one of the small triangles as shown.



What is the combined area? _____

Place the parallelogram and the other small triangle on top of the combined square and triangle. What is the area of the parallelogram? Explain.

_____

_____

_____

_____

Reflect

1. **Critical Thinking** Complete the rest of the diagram by filling in the remaining areas. Explain how you found your answers.

_____

_____

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Finding Areas of Polygons

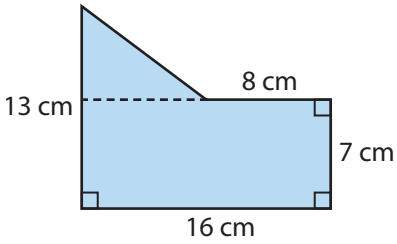
You can find the areas of polygons by breaking the polygons into smaller shapes. Then you can apply area formulas you already know.

EXAMPLE 1

COMMON CORE 6.G.1

Find the area of each polygon.

A **STEP 1** Draw a horizontal line segment on the diagram that divides the polygon into a rectangle and a triangle.



STEP 2 Find the area of the rectangle.

$A = bh = 16 \cdot 7 = \mathbf{112}$ square centimeters

STEP 3 Find the area of the triangle.

$b = 16 - 8 = 8$ $\quad h = 13 - 7 = 6$

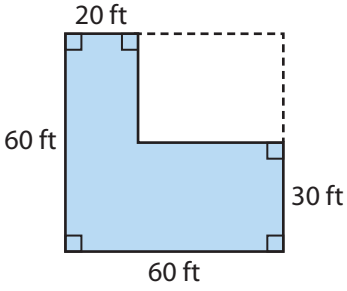
$A = \frac{1}{2}bh = \frac{1}{2} \cdot 8 \cdot 6 = \mathbf{24}$ square centimeters

STEP 4 Add the areas from Steps 2 and 3 to find the total area.

$A = \mathbf{112} + \mathbf{24} = 136$ square centimeters

Math Talk
Mathematical Practices
What other shapes could you divide the polygon in A into? What formulas would you use?

B **STEP 1** Extend the top edge and the right edge of the polygon to form a square with side length 60 feet. Find the area of this square.



$60 \cdot 60 = \mathbf{3600}$ square feet

STEP 2 Notice that the square you drew has a rectangular "missing piece." Find the area of this missing piece.

$b = 60 - 20 = 40$ $\quad h = 60 - 30 = 30$

$A = bh = 40 \cdot 30 = \mathbf{1200}$ square feet

STEP 3 Subtract the area in Step 2 from the area in Step 1.

$A = \mathbf{3600} - \mathbf{1200} = 2400$ square feet

Reflect

2. Describe another way to find the area of the polygon in B.

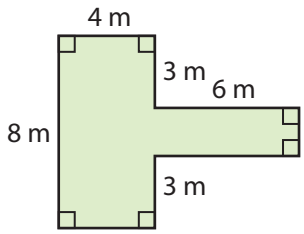
_____

_____

YOUR TURN

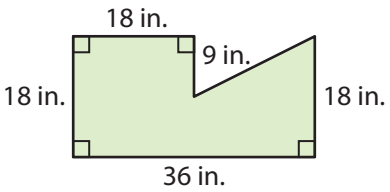
Find the area of each polygon.

3.



$A =$ _____ square meters

4.



$A =$ _____ square inches

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Solving Real-World Problems

You can apply the technique of dividing a shape into smaller shapes in problems that involve finding area.

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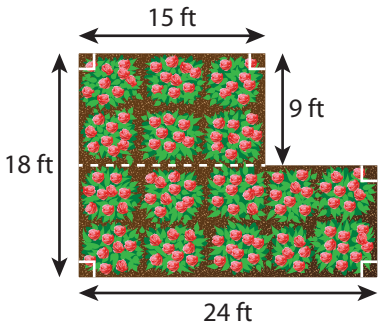
EXAMPLE 2

Real World

COMMON CORE 6.G.1

The diagram shows the shape and dimensions of Teresa's rose garden.



A Find the area of the garden.

STEP 1 Draw a horizontal line segment on the diagram that divides the polygon into two rectangles, one on top of the other.

STEP 2 Find the area of the smaller (top) rectangle.

$A = bh = 15 \cdot 9 = \mathbf{135}$ square feet

STEP 3 Find the area of the larger (bottom) rectangle.

The base of the larger rectangle is 24 feet.

The height is $18 - 9 = 9$ feet.

$A = bh = 24 \cdot 9 = \mathbf{216}$ square feet

STEP 4 Add the areas from Steps 2 and 3 to find the total area.

$A = \mathbf{135} + \mathbf{216} = 351$ square feet

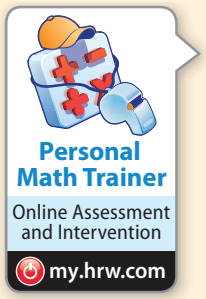
The area of the garden is 351 square feet.

B Teresa wants to buy mulch for her garden. One bag of mulch covers 12 square feet. How many bags will she need?

$\frac{351 \text{ square feet}}{12 \text{ square feet}} = 29.25$ *Divide to find the number of bags needed.*

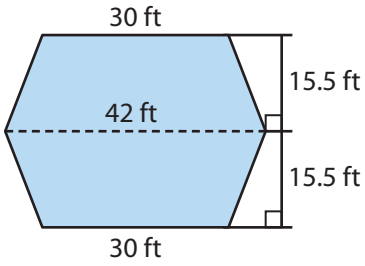
Teresa will need to buy 30 bags of mulch.

My Notes



YOUR TURN

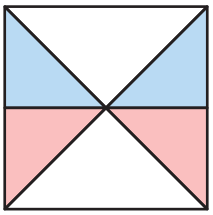
5. The diagram shows the floor plan of a hotel lobby. Carpet costs $3 per square foot. How much will it cost to carpet the lobby?



_____

Guided Practice

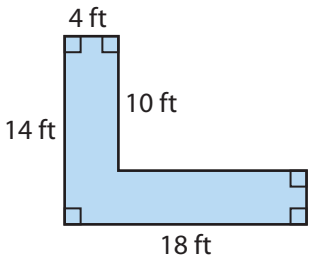
1. In the diagram, the area of the large square is 1 square unit. Two diagonal segments divide the square into four equal-sized triangles. Two of these triangles are divided into smaller red and blue triangles that all have the same height and base length. Find the area of a red triangle. (Explore Activity)



_____

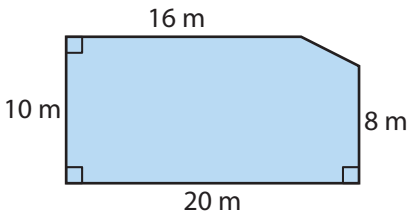
Find the area of each polygon. (Example 1)

2.



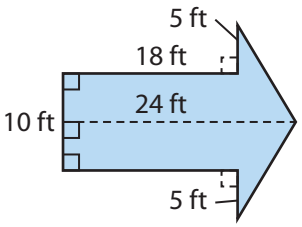
$A =$ _____ square feet

3.



$A =$ _____ square meters

4. Jess is painting a giant arrow on a playground. Find the area of the giant arrow. If one can of paint covers 100 square feet, how many cans should Jess buy? (Example 2)



_____

ESSENTIAL QUESTION CHECK-IN

5. How can you find the area of a polygon that is not one for which you know an area formula?

_____

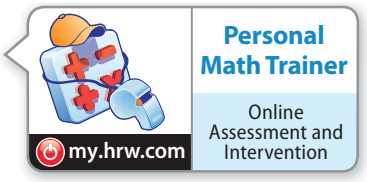
_____

_____

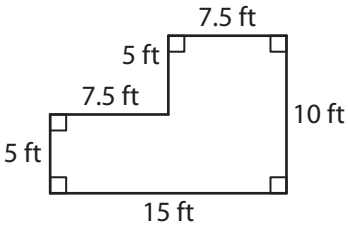
Name _____ Class _____ Date _____

13.4 Independent Practice

COMMON CORE 6.G.1



6. Alice wants to put wall-to-wall carpeting in a small room with the floor plan shown.



a. Alice says she can find the area of the room by dividing the floor plan into two trapezoids. Show how she can divide the floor plan. Then find the area using her method.

_____

b. Describe another way to find the area.

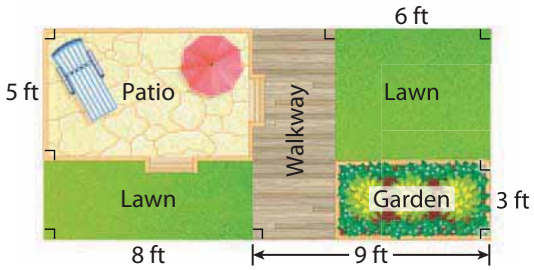
_____

_____

c. How much will Alice pay for carpet that costs $4.50 per square foot?

_____

7. Hal's backyard has a patio, a walkway, and a garden.



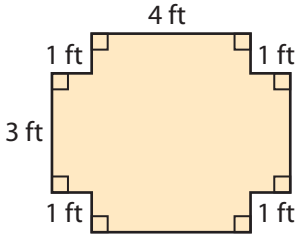
a. About what percent of the total area of Hal's backyard is the area taken up by the patio, walkway, and garden? Round to the nearest whole percent.

_____

b. One longer side of Hal's backyard lies next to the back of his house. Hal wants to build a fence that costs $9.75 per foot around the other three sides. How much will Hal spend on his new fence?

_____

8. The students in a furniture-making class make a tabletop shaped like the figure shown.



a. What is the area of the tabletop?

_____

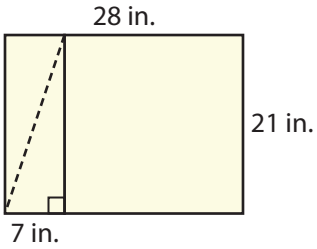
b. One of the students wants to make a tabletop shaped like a right triangle. This tabletop will have the same area as the tabletop shown. What are a set of possible lengths for the sides of the tabletop that meet in a right angle? Explain.

_____

_____

_____

9. **Multistep** Cho is making banners shaped like triangles out of a rectangular piece of fabric. She cuts out two triangular banners as shown.



a. What is the area of a triangular banner?

_____

b. What are the dimensions of the fabric left over after Cho cuts out the two banners?

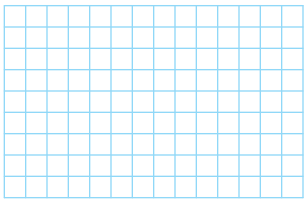
_____

c. What is the maximum number of banners that Cho can cut out from the fabric? Will she use all the fabric?

_____

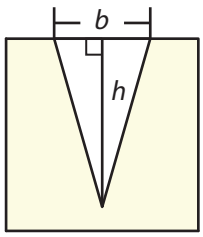
H.O.T. FOCUS ON HIGHER ORDER THINKING

10. **Persevere in Problem Solving** The base of a parallelogram is 8 units, and the height is 5 units. A segment divides the parallelogram into two identical trapezoids. The height of each trapezoid is 5 units. Draw the parallelogram and the two trapezoids on the grid shown. Then find the area of one of the trapezoids.



_____

11. **Persevere in Problem Solving** The figure shown is a square with a triangular hole cut into one side. The ratio of the height h of the triangle to a side length of the square is 7 to 8. The ratio of the base b of the triangle to the side length of the square is 1 to 2. If the area of the square is 64 square inches, what is the area of the shaded part of the square? Show your work.



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Work Area

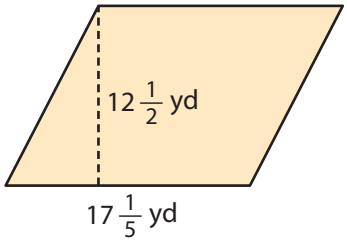
MODULE QUIZ

Ready to Go On?

Personal Math Trainer
Online Assessment and Intervention
my.hrw.com

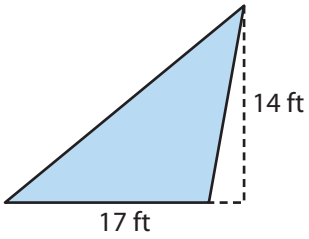
13.1 Area of Quadrilaterals

1. Find the area of the figure.



13.2 Area of Triangles

2. Find the area of the triangle.



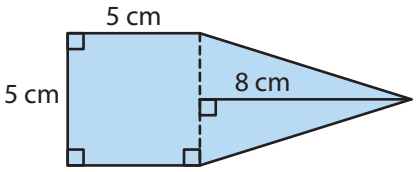
13.3 Solving Area Equations

3. A triangular pane of glass has a height of 30 inches and an area of 270 square inches. What is the length of the base of the pane?

4. A tabletop in the shape of a trapezoid has an area of 6,550 square centimeters. Its longer base measures 115 centimeters, and the shorter base is 85 centimeters. What is the height?

13.4 Area of Polygons

5. Find the area of the polygon.



_____ square centimeters

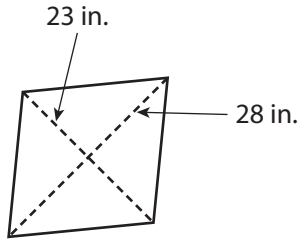
ESSENTIAL QUESTION

6. How can you find the area of an irregular polygon using area formulas?

Assessment Readiness

Selected Response

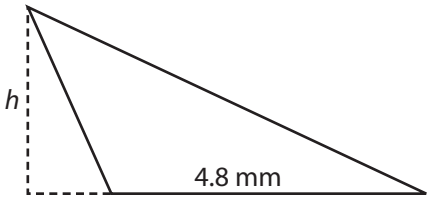
1. The lengths of the diagonals of the rhombus are given. What is the area of the rhombus?



Ⓐ 161 in^2 Ⓒ 644 in^2

Ⓑ 322 in^2 Ⓓ 966 in^2

2. In the triangle below, the value of h is $\frac{3}{4}$ the side length that is labeled on the figure. What is the area of the triangle?



Ⓐ 3.6 mm^2 Ⓒ 8.64 mm^2

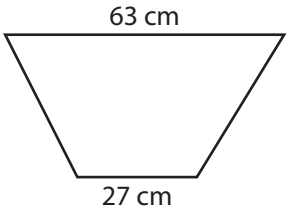
Ⓑ 6.4 mm^2 Ⓓ 17.28 mm^2

3. Tim is designing a logo. The logo is a polygon whose shape is a square attached to an equilateral triangle. The square and the equilateral triangle have side lengths of 2 centimeters, and the equilateral triangle has a height of about 1.7 cm. Find the area of the logo.

Ⓐ 1.7 cm^2 Ⓒ 5.7 cm^2

Ⓑ 4 cm^2 Ⓓ 7.4 cm^2

4. The trapezoid below has an area of 1,575 cm^2.



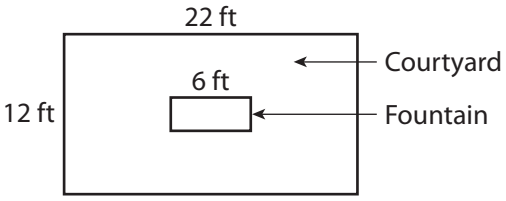
Which equation could you solve to find the height of the trapezoid?

Ⓐ $45h = 1{,}575$ Ⓒ $850.5h = 1{,}575$

Ⓑ $90h = 1{,}575$ Ⓓ $1{,}701h = 1{,}575$

Mini-Task

5. Cindy is designing a rectangular fountain in the middle of a courtyard. The rest of the courtyard will be covered in stone.



The part of the courtyard that will be covered in stone has an area of 246 square feet.

a. What is the width of the fountain?

_____

b. What fraction of the area of the courtyard will be occupied by the fountain?

_____