Chapter 13

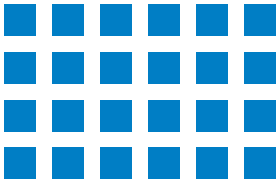
Algebra: Perimeter and Area

Show What You Know

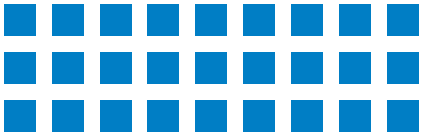
Check your understanding of important skills.

Name _____

▶ Missing Factors Find the missing factor.

1. 

_____ × 6 = 24

2. 

3 × _____ = 27

▶ Add Whole Numbers Find the sum.

3. 17 + 153 + 67 = _____

4. 8 + 78 + 455 = _____

5. 211 + 52 + 129 + 48 = _____

6. 42 + 9 + 336 + 782 = _____

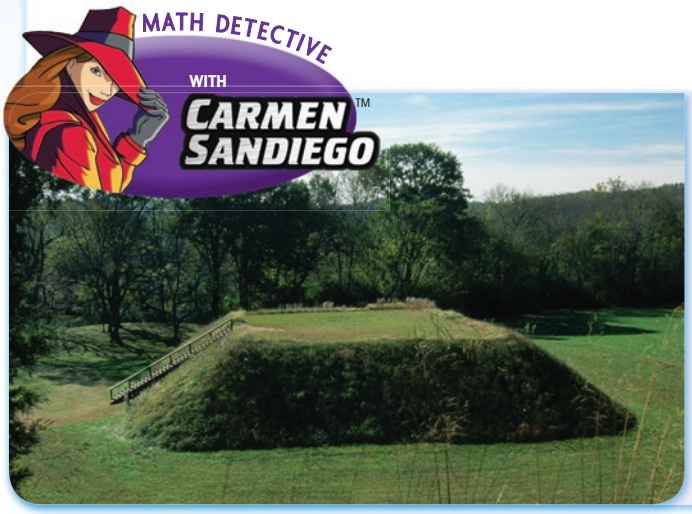
▶ Multiply Whole Numbers Find the product.

7. $\begin{array}{r} 78 \\ \times\ 6 \\ \hline \end{array}$

8. $\begin{array}{r} 29 \\ \times\ 7 \\ \hline \end{array}$

9. $\begin{array}{r} 42 \\ \times\ 5 \\ \hline \end{array}$

10. $\begin{array}{r} 57 \\ \times\ 9 \\ \hline \end{array}$

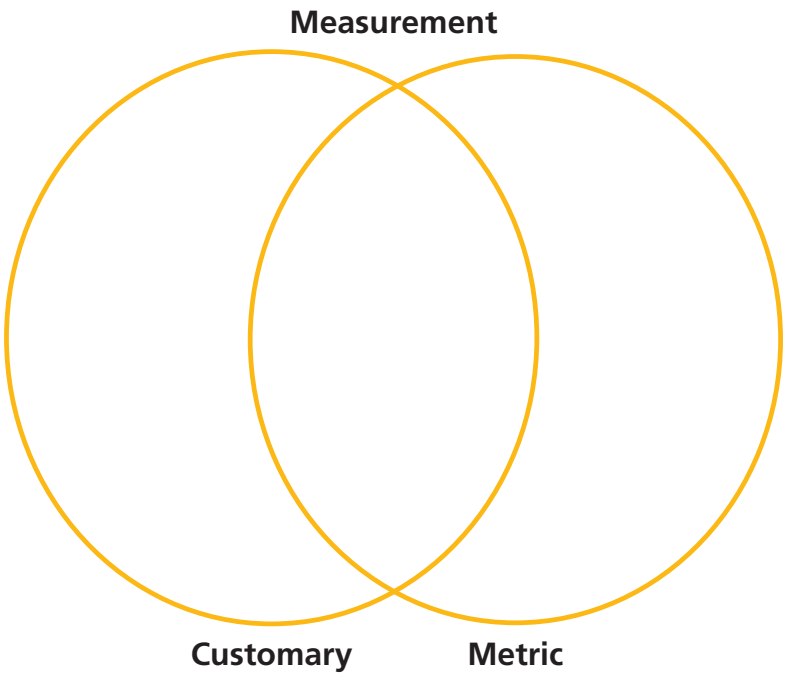


Native Americans once lived near Cartersville, Georgia, in an area that is now a state park. They constructed burial mounds that often contained artifacts, such as beads, feathers, and copper ear ornaments. One of the park's mounds is 63 feet in height. Be a Math Detective. If the top of the mound is rectangular in shape with a perimeter of 322 yards, what could be the side lengths of the rectangle?

Vocabulary Builder

Visualize It

Sort words with a ✓ using the Venn diagram.



Review Words

- ✓ centimeter
- ✓ foot
- ✓ inch
- ✓ kilometer
- ✓ meter
- ✓ mile
- ✓ yard

Preview Words

- ✓ area
- base
- ✓ formula
- ✓ height
- ✓ perimeter
- square unit

Understand Vocabulary

Write the word or term that answers the riddle.

1. I am the number of square units needed to cover a surface.

   _____

2. I am the distance around a shape.

   _____

3. I am a unit of area that measures 1 unit by 1 unit.

   _____

4. I am a set of symbols that expresses a mathematical rule.

   _____

Name _____

Perimeter

Essential Question How can you use a formula to find the perimeter of a rectangle?

UNLOCK the Problem REAL WORLD

Julio is putting a stone border around his rectangular garden. The length of the garden is 7 feet. The width of the garden is 5 feet. How many feet of stone border does Julio need?

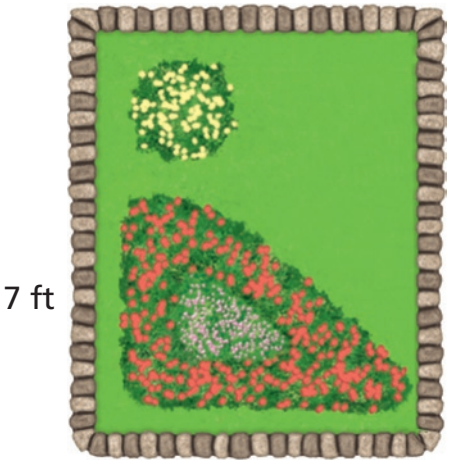
- Circle the numbers you will use.
- What are you asked to find?

_____

_____

Perimeter is the distance around a shape.

To find how many feet of stone border Julio needs, find the perimeter of the garden.



Use addition.

Perimeter of a Rectangle = length + width + length + width

$7 + 5 + 7 + 5 =$ _____

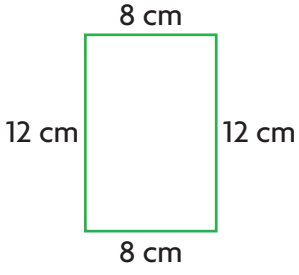
The perimeter is _____ feet.

So, Julio needs _____ feet of stone border.

Use multiplication.

A Find Perimeter of a Rectangle

Perimeter = (2 × length) + (2 × width)



Perimeter = (2 × 12) + (2 × 8)

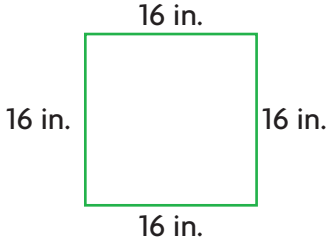
= 24 + 16

= _____

So, the perimeter is _____ centimeters.

B Find Perimeter of a Square

Perimeter = 4 × one side



Perimeter = 4 × 16

= _____

So, the perimeter is _____ inches.

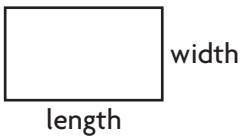
MATHEMATICAL PRACTICES

Math Talk **Explain** how using addition and using multiplication to find the perimeter of a rectangle are related.

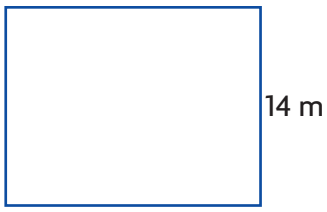
Use a Formula A **formula** is a mathematical rule. You can use a formula to find perimeter.

$P = (2 \times l) + (2 \times w)$

P ↑ perimeter; l ↑ length; w ↑ width



Example **Find the perimeter of the rectangle.**



$P = (2 \times l) + (2 \times w)$

$= (2 \times$ _____ $) + (2 \times$ _____ $)$ Think: Write the measures you know.

$=$ _____ $+$ _____ Think: Do what is in parentheses first.

$=$ _____

The perimeter of the rectangle is _____.

1. Can you use the Distributive Property to write the formula $P = (2 \times l) + (2 \times w)$ another way? **Explain.**

_____

_____

_____

_____

Try This! **Write a formula for the perimeter of a square.**

Use the letter _____ for perimeter.

Use the letter _____ for the length of a side.

Formula: _____

2. **Justify** the formula you wrote for the perimeter of a square.

_____

_____

_____

_____

Name _____

Share and Show

Formulas for Perimeter

Rectangle:
$P = (2 \times l) + (2 \times w)$ or
$P = 2 \times (l + w)$

Square:
$P = 4 \times s$

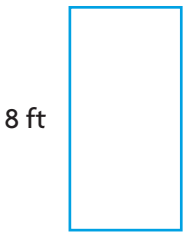
1. Find the perimeter of the rectangle.

$P = (\_\_\_\_ \times \_\_\_\_) + (\_\_\_\_ \times \_\_\_\_)$

$= (\_\_\_\_ \times \_\_\_\_) + (\_\_\_\_ \times \_\_\_\_)$

$= \_\_\_\_ + \_\_\_\_$

$= \_\_\_\_$



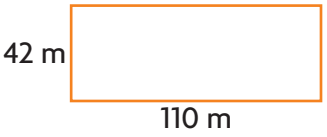
The perimeter is _____ feet.

Find the perimeter of the rectangle or square.

2.

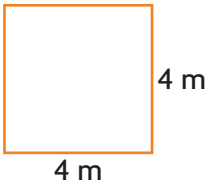
_____ yards

3.



_____ meters

4.



_____ meters

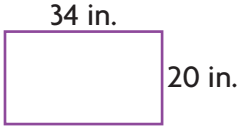
MATHEMATICAL PRACTICES

Math Talk Can you use the formula $P = (2 \times l) + (2 \times w)$ to find the perimeter of a square? **Explain.**

On Your Own

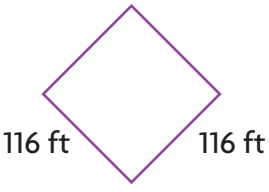
Find the perimeter of the rectangle or square.

5.



_____ inches

6.

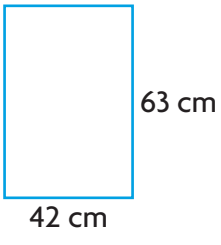


_____ feet

7.

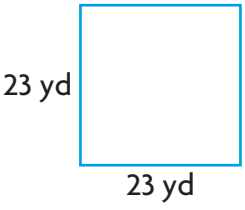
_____ meters

8.



_____ centimeters

9.



_____ yards

10.

_____ inches

UNLOCK the Problem REAL WORLD

11. Alejandra plans to sew fringe on a scarf. The scarf is shaped like a rectangle. The length of the scarf is 48 inches. The width is one half the length. How much fringe does Alejandra need?

Ⓐ 72 inches Ⓒ 120 inches

Ⓑ 96 inches Ⓓ 144 inches

a. Draw a picture of the scarf, and label the given measurements on your drawing.

b. What do you need to find?

_____

c. What formula will you use?

_____

d. Show the steps you use to solve the problem.

e. Complete.

The length of the scarf is _____ inches.

The width is one half the length

or _____ ÷ 2.

The width is _____ inches.

So, the perimeter is (_____ × _____) +

(_____ × _____) = _____ inches.

f. Fill in the bubble for the correct answer choice above.

12. H.O.T. What is the side length of a square with a perimeter of 44 centimeters?

Ⓐ 4 centimeters

Ⓑ 11 centimeters

Ⓒ 22 centimeters

Ⓓ 176 centimeters

13. Mr. Wong is putting a brick edge around his rectangular patio. What is the perimeter of the patio?

Ⓐ 28 ft Ⓑ 38 ft Ⓒ 56 ft Ⓓ 66 ft

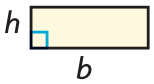
Name _____

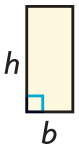
Area

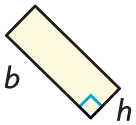
Essential Question How can you use a formula to find the area of a rectangle?

UNLOCK the Problem REAL WORLD

The **base, *b,*** of a two-dimensional figure can be any side. The **height, *h,*** is the measure of a perpendicular line segment from the base to the top of the figure.





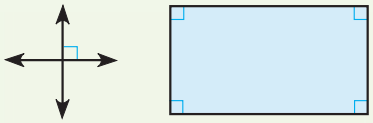


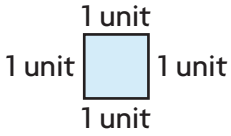
Area is the number of **square units** needed to cover a flat surface. A square unit is a square that is 1 unit long and 1 unit wide. To find the area of a figure, count the number of square units inside the figure.

How are the base, height, and area of a rectangle related?

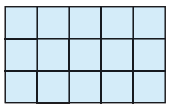
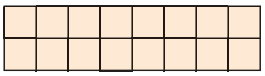
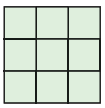
Remember

Perpendicular lines and perpendicular line segments form right angles.





Complete the table to find the area.

Figure	Base	Height	Area
	5 units		
			
			

1. What relationship do you see among the base, height, and area?

_____

_____

MATHEMATICAL PRACTICES

Math Talk How do you decide which side of a rectangle to use as the base?

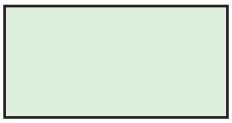
2. Write a formula for the area of a rectangle. Use the letter *A* for area. Use the letter *b* for base. Use the letter *h* for height.

Formula: _____

Use a Formula You can use a formula to find the area.

$A = b \times h$

↑ area ↑ base ↑ height



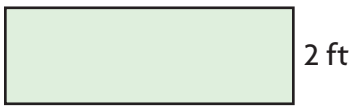
Math Idea

You can think of the base and height of a rectangle as length (l) and width (w), since the length and width are perpendicular. You can write the formula for the area (A) of a rectangle as $A = l \times w$.

Examples

Use a formula to find the area of a rectangle and a square.

A



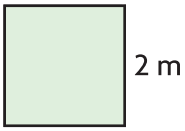
$A = b \times h$

$= \_\_\_\_ \times \_\_\_\_$

$= \_\_\_\_$

The area is _____.

B



$A = b \times h$

$= \_\_\_\_ \times \_\_\_\_$

$= \_\_\_\_$

The area is _____.

Try This! **Write a formula for the area of a square.**

Use the letter _____ for area.

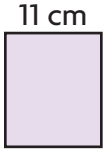
Use the letter _____ for the length of a side.

Formula: _____

Share and Show

MATH BOARD

1. Find the area of the rectangle.



$A = b \times \_\_\_\_$

$= \_\_\_\_ \times \_\_\_\_$

$= \_\_\_\_$

Name _____

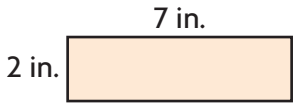
Formulas for Area

Rectangle: $A = b \times h$

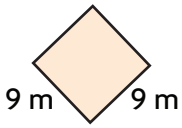
Square: $A = s \times s$

Find the area of the rectangle or square.

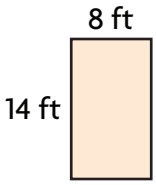
2.



3.



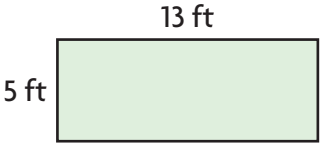
4.



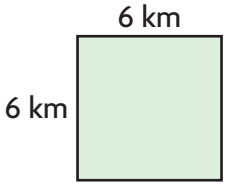
On Your Own

Find the area of the rectangle or square.

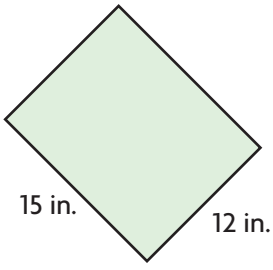
5.



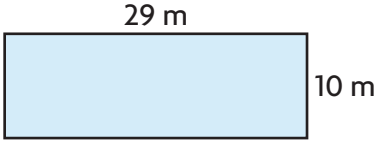
6.



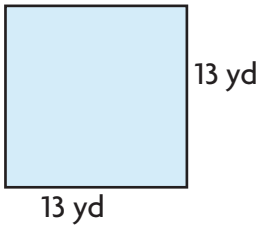
7.



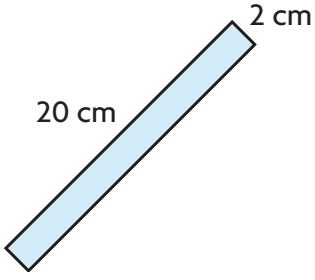
8.



9.



10.



MATHEMATICAL PRACTICES

Math Talk **Explain** how to find the area of a square if you only know the length of one side is 23 feet.

Practice: Copy and Solve **Find the area of the rectangle.**

11. base: 16 feet

height: 6 feet

12. base: 9 yards

height: 17 yards

13. base: 14 centimeters

height: 11 centimeters

UNLOCK the Problem REAL WORLD

14. Nancy and Luke are drawing plans for rectangular flower gardens. In Nancy's plan, the garden is 18 feet by 12 feet. In Luke's plan, the garden is 15 feet by 15 feet. Who drew the garden plan with the greater area? What is the area?

Ⓐ Luke; 205 square feet

Ⓑ Nancy; 206 square feet

Ⓒ Nancy; 216 square feet

Ⓓ Luke; 225 square feet

a. What do you need to find? _____

_____

b. What formula will you use? _____

c. What units will you use to write the answer? _____

d. Show the steps to solve the problem.

e. Complete the sentences.

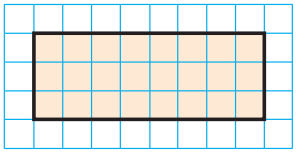
The area of Nancy's garden is _____.

The area of Luke's garden is _____.

_____ garden has the greater area.

f. Fill in the bubble for the correct answer choice above.

15. H.O.T. Find the area of the rectangle.



The length of one small square is 4 feet.

Ⓐ 32 square feet

Ⓑ 88 square feet

Ⓒ 336 square feet

Ⓓ 384 square feet

16. Sonia is buying carpet for the dining room, which measures 15 feet by 12 feet. How many square feet of carpet does Sonia need to cover the dining room?

Ⓐ 45 square feet

Ⓑ 54 square feet

Ⓒ 170 square feet

Ⓓ 180 square feet

FOR MORE PRACTICE:
Standards Practice Book, pp. P249–P250

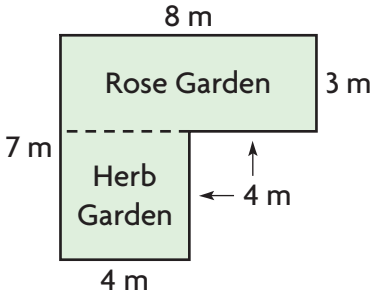
Name _____

Area of Combined Rectangles

Essential Question How can you find the area of combined rectangles?

UNLOCK the Problem REAL WORLD

Jan is visiting a botanical garden with her family. The diagram shows two rectangular sections of the garden. What is the total area of the two sections?

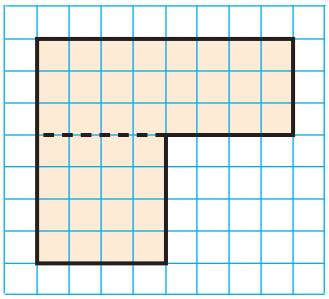


There are different ways to find the area of combined rectangles.

One Way Count square units.

Materials ■ grid paper

- Draw the garden on grid paper. Then find the area of each section by counting squares inside the shape.



1 square = 1 square meter

Rose Garden	Herb Garden
Area = _____ square meters	Area = _____ square meters

- Add the areas.

_____ + _____ = _____ square meters

Another Way Use the area formula for a rectangle.

A Rose Garden

$A = b \times h$

= _____ × _____

= _____ square meters

B Herb Garden

$A = b \times h$

= _____ × _____

= _____ square meters

- Add the areas.

_____ + _____ = _____ square meters

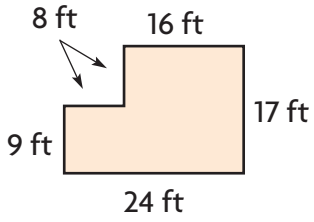
So, the total area is _____ square meters.

MATHEMATICAL PRACTICES

Math Talk Is there another way you could divide the figure to find the total area? **Explain.**

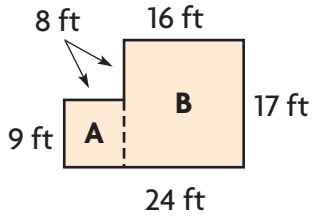
Example

Greg is laying carpet in the space outside his laundry room. The diagram shows where the carpet will be installed. The space is made of combined rectangles. What is the area of the carpeted space?



You can find the area using addition or subtraction.

One Way Use addition.

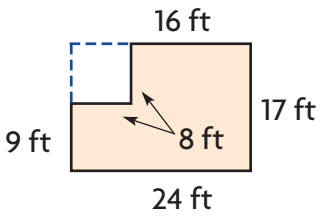


Rectangle A	Rectangle B
$A = b \times h$	$A = b \times h$
$= 8 \times$ _____	$=$ _____ $\times 17$
$=$ _____	$=$ _____

Sum of the areas:

_____ + _____ = _____ square feet

Another Way Use subtraction.



Area of whole space	Area of missing section
$A = b \times h$	$A = b \times h$
$= 24 \times$ _____	$=$ _____ $\times$ _____
$=$ _____	$=$ _____

Difference between the areas:

_____ − _____ = _____ square feet

So, the area of the carpeted space is _____ square feet.

- Is there another way you could divide the figure to find the total area? **Explain.**

_____

_____

_____

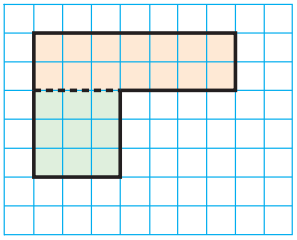
_____

Name _____

Share and Show

MATH BOARD

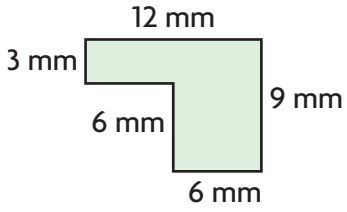
1. Explain how to find the total area of the figure.



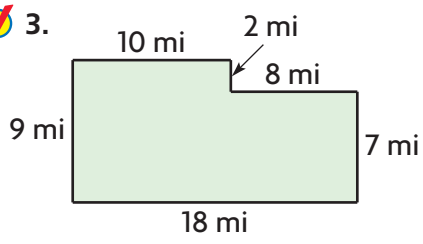
1 square = 1 square foot

Find the area of the combined rectangles.

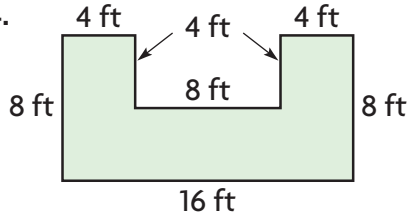
2.



3.



4.



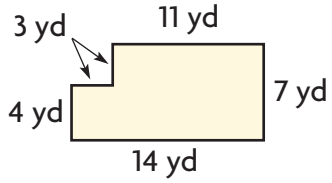
MATHEMATICAL PRACTICES

Math Talk **Describe** the characteristics of combined rectangles.

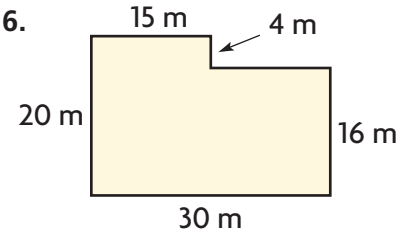
On Your Own

Find the area of the combined rectangles.

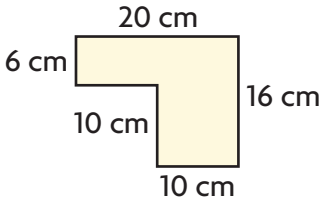
5.



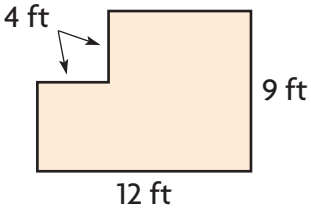
6.



7.

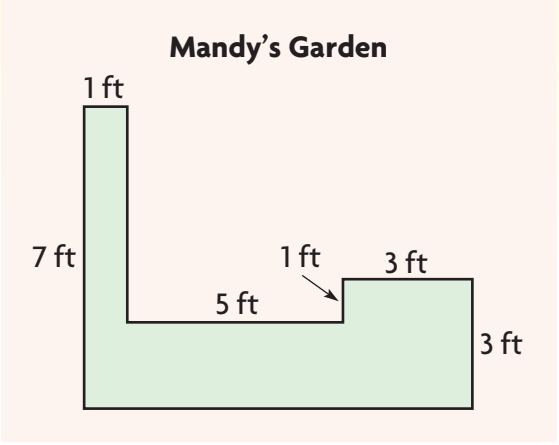


8. H.O.T. **Write Math** **Explain** how to find the perimeter and area of the combined rectangles at the right.



UNLOCK the Problem REAL WORLD

9. The diagram shows the layout of Mandy's garden. The garden is the shape of combined rectangles. What is the area of the garden?



a. What do you need to find?

_____

b. How can you divide the figure to help you find the total area?

_____

_____

c. What operations will you use to help you find the answer?

_____

d. Draw a diagram to show how you divided the figure. Then show the steps to solve the problem.

So, the area of the garden is _____.

10. **Test Prep** Ms. Greene hired a contractor to remodel her house. What could the contractor use the area formula to find?

Ⓐ the amount of fencing to put around the backyard

Ⓑ the amount of floor the carpeting should cover

Ⓒ the amount of water needed to fill the pool

Ⓓ the amount of wallpaper border to put around the ceiling

FOR MORE PRACTICE:
Standards Practice Book, pp. P251–P252

Name _____

Mid-Chapter Checkpoint

Vocabulary

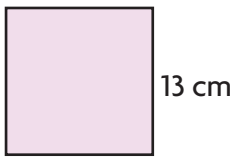
Choose the best term from the box.

Vocabulary
area
base
formula
perimeter
square unit (sq un)

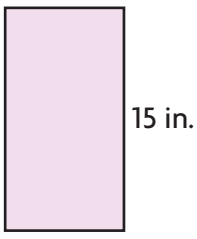
1. A square that is 1 unit wide and 1 unit long is a _____. (p. 501)
2. The _____ of a two-dimensional figure can be any side. (p. 501)
3. A set of symbols that expresses a mathematical rule is called a _____. (p. 498)
4. The _____ is the distance around a shape. (p. 497)

Concepts and Skills

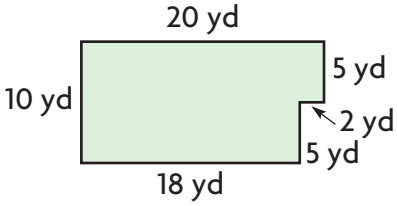
Find the perimeter and area of the rectangle or square.

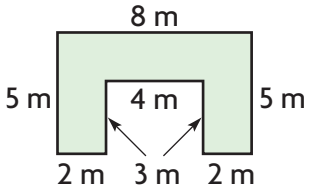
5. 

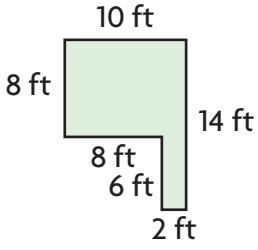
6. 

7. 

Find the area of the combined rectangles.

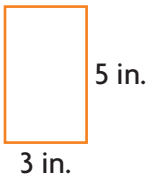
8. 

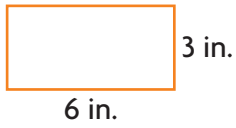
9. 

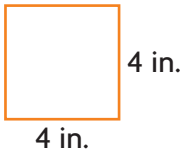
10. 

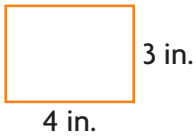
Fill in the bubble completely to show your answer.

11. Which figure has the greatest perimeter?

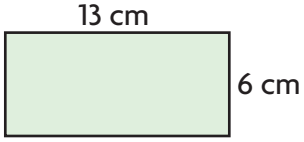
Ⓐ 

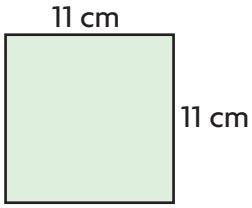
Ⓑ 

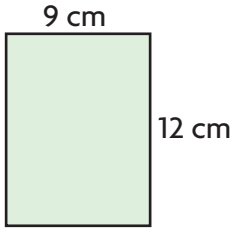
Ⓒ 

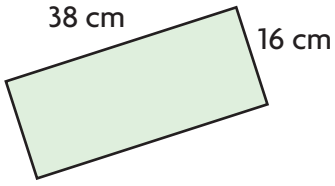
Ⓓ 

12. Which figure has an area of 108 square centimeters?

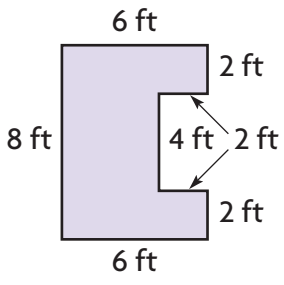
Ⓐ 

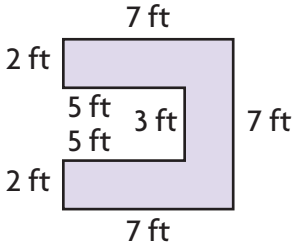
Ⓑ 

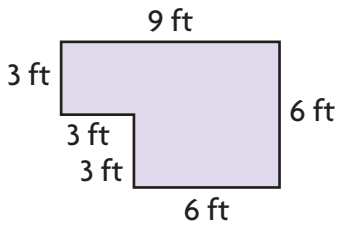
Ⓒ 

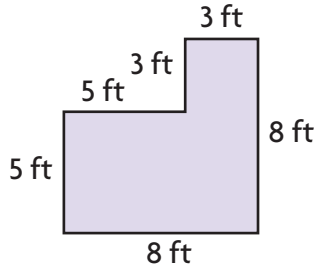
Ⓓ 

13. Which of the combined rectangles has an area of 40 square feet?

Ⓐ 

Ⓑ 

Ⓒ 

Ⓓ 

Name _____

Find Unknown Measures

Essential Question How can you find an unknown measure of a rectangle given its area or perimeter?

UNLOCK the Problem REAL WORLD

Tanisha is painting a mural that is in the shape of a rectangle. The mural covers an area of 54 square feet. The base of the mural measures 9 feet. What is its height?

Use a formula for area.

- What do you need to find?

_____

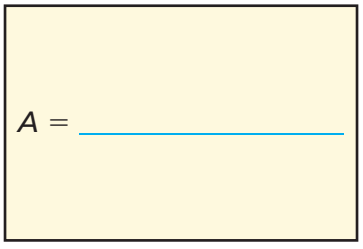
- What information do you know?

_____

Example 1 Find an unknown measure given the area.

MODEL

Think: Label the measures you know. Use *n* for the unknown.



b = _____

RECORD

Use the model to write an equation and solve.

_____ = _____ _____ Write the formula for area.

_____ = _____ _____ Use the model to write an equation.

54 = 9 × _____ What times 9 equals 54?

The value of *n* is _____.

Think: *n* is the height of the mural.

So, the height of the mural is _____ feet.

MATHEMATICAL PRACTICES

Math Talk **Explain** how you can use division to find an unknown factor.

1. **What if** the mural were in the shape of a square with an area of 81 square feet? What would the height of the mural be? **Explain.**

_____

_____

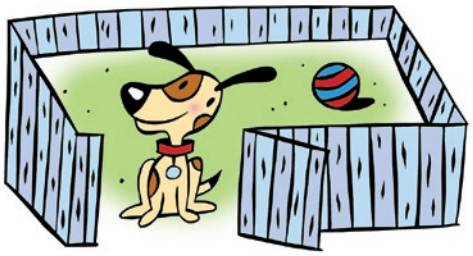
2. **Explain** how you can find an unknown side length of any square, when given only the area of the square.

_____

_____

_____

Example 2 Find an unknown measure given the perimeter.



Gary is building an outdoor pen in the shape of a rectangle for his dog. He will use 24 meters of fencing. The pen will be 3 meters wide. How long will the pen be?

Use a formula for perimeter.

MODEL

Think: Label the measures you know. Use *n* for the unknown.

$w =$ _____

$l =$ _____

$P =$ _____

RECORD

Use the model to write an equation and solve.

$P = (2 \times l) + (2 \times w)$

_____ = (_____ _____) + (_____ _____)

_____ = (_____ _____) + _____

Think: $(2 \times n)$ is an unknown addend.

24 = _____ + 6 **Think:** What is 24 − 6?

The value of $(2 \times n)$ is 18.

To find the value of *n*, find the unknown factor.

$2 \times$ _____ = 18

The value of *n* is _____.

Think: *n* is the length of the pen.

So, the pen will be _____ long.

ERROR Alert

Check that you are using the correct formula. Are you given the area or the perimeter?

Try This! **The perimeter of a square is 24 feet. Find the side length.**

Draw a model.

Write an equation.

$P = 4 \times s$

Name _____

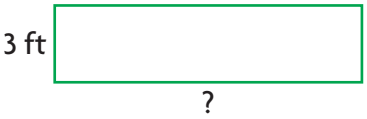
Share and Show

1. Find the unknown measure. The area of the rectangle is 36 square feet.

$A = b \times h$

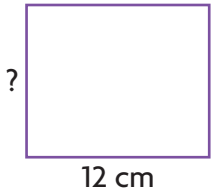
_____ $= b \times$ _____

The base of the rectangle is _____.



Find the unknown measure of the rectangle.

2.



Perimeter = 44 centimeters

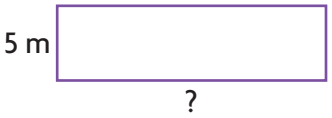
width = _____

3.

Area = 108 square inches

height = _____

4.



Area = 90 square meters

base = _____

On Your Own

MATHEMATICAL PRACTICES

Math Talk **Explain** how using the area formula helps you find the base of a rectangle when you know its area and height.

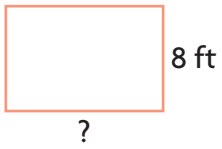
Find the unknown measure of the rectangle.

5.

Perimeter = 34 yards

length = _____

6.



Area = 96 square feet

base = _____

7.

Area = 126 square centimeters

height = _____

8. H.O.T. **Write Math** A square has an area of 49 square inches. **Explain** how to find the perimeter of the square.

_____

_____

_____

_____

Problem Solving REAL WORLD

9. H.O.T. The area of a swimming pool is 120 square meters. The width of the pool is 8 meters. What is the length of the pool in centimeters?

_____

10. **Test Prep** An outdoor deck is 7 feet wide. The perimeter of the deck is 64 feet. What is the length of the deck?

Ⓐ 14 feet Ⓒ 39 feet

Ⓑ 25 feet Ⓓ 50 feet

Connect to Science

Mountain Lions

Mountain lions are also known as cougars, panthers, or pumas. Their range once was from coast to coast in North America and from Argentina to Alaska. Hunting and habitat destruction now restricts their range to mostly mountainous, unpopulated areas.

Mountain lions are solitary animals. A male's territory often overlaps two females' territories but never overlaps another male's. The average size of a male's territory is 108 square miles, but it may be smaller or larger depending on how plentiful food is. The average size of a female's territory is 54 square miles.

11. A male and female mountain lion have overlapped territories. The area of overlap is 28 square miles. Using the data above, how much of the male's and female's territory is not shared?

_____

_____

12. A male mountain lion has a rectangular territory with an area of 96 square miles. If his territory is 8 miles wide, what is the length of his territory?

_____

Name _____

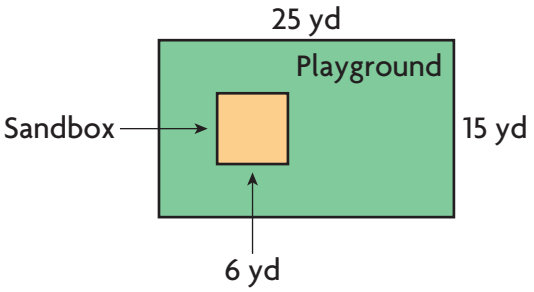
Problem Solving • Find the Area

Essential Question How can you use the strategy *solve a simpler problem* to solve area problems?

UNLOCK the Problem REAL WORLD

A landscaper is laying turf for a rectangular playground. The turf will cover the whole playground except for a square sandbox. The diagram shows the playground and sandbox. How many square yards of turf will the landscaper use?

Use the graphic organizer below to solve the problem.



Read the Problem

What do I need to find?

I need to find how many _____ the landscaper will use.

What information do I need to use?

The turf will cover the _____.

The turf will not cover the _____.

The length and width of the playground are _____ and _____.

The side length of the square sandbox is _____.

How will I use the information?

I can solve simpler problems.

Find the area of the _____.

Find the area of the _____.

Then _____ the area of the _____ from the area of the _____.

Solve the Problem

First, find the area of the playground.

$A = b \times h$

$= \_\_\_\_ \times \_\_\_\_$

$= \_\_\_\_$ square yards

Next, find the area of the sandbox.

$A = s \times s$

$= \_\_\_\_ \times \_\_\_\_$

$= \_\_\_\_$ square yards

Last, subtract the area of the sandbox from the area of the playground.

$$\begin{array}{r} 375 \\ -\ 36 \\ \hline \square \end{array}$$ square yards

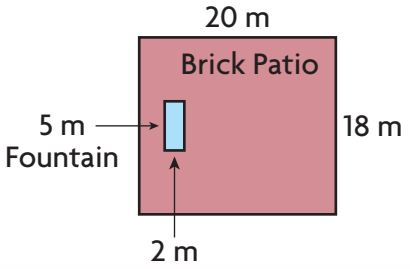
So, the landscaper will use _____ _____ of turf to cover the playground.

MATHEMATICAL PRACTICES

Math Talk **Explain** how the strategy helped you to solve the problem.

Try Another Problem

Zach is laying a rectangular brick patio for a new museum. Brick will cover the whole patio except for a rectangular fountain, as shown in the diagram. How many square meters of brick does Zach need?



Read the Problem	Solve the Problem
What do I need to find?	
What information do I need to use?	
How will I use this information?	

- How many square meters of brick does Zach need? **Explain.**

Name _____

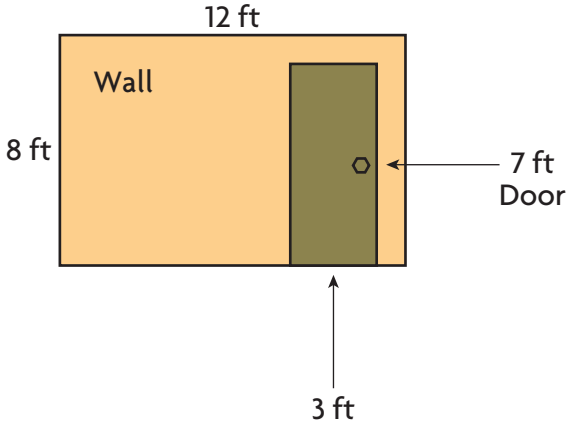
Share and Show

MATH BOARD

UNLOCK the Problem Tips

- Use the Problem Solving MathBoard.
- Underline important facts.
- Choose a strategy you know.

1. Lila is wallpapering one wall of her bedroom, as shown in the diagram. She will cover the whole wall except for the doorway. How many square feet of wallpaper does Lila need?



First, find the area of the wall.

$A = b \times h$

$= \_\_\_\_ \times \_\_\_\_$

$= \_\_\_\_$ square feet

Next, find the area of the door.

$A = b \times h$

$= \_\_\_\_ \times \_\_\_\_$

$= \_\_\_\_$ square feet

Last, subtract the area of the door from the area of the wall.

$\_\_\_\_ - \_\_\_\_ = \_\_\_\_$ square feet

So, Lila needs _____ of wallpaper.

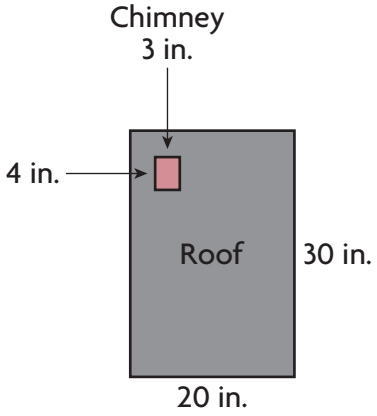
2. H.O.T. **What if** there was a square window on the wall with a side length of 2 feet? How much wallpaper would Lila need then? **Explain.**

_____

_____

_____

3. Ed is building a model of a house with a flat roof, as shown in the diagram. There is a chimney through the roof. Ed will cover the roof with square tiles. If the area of each tile is 1 square inch, how many tiles will he need? **Explain.**



_____

_____

_____

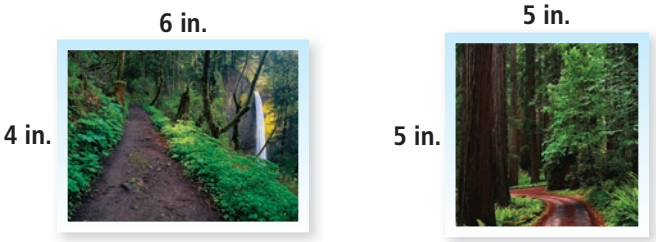
On Your Own

Choose a STRATEGY

- Act It Out
- Draw a Diagram
- Find a Pattern
- Make a Table or List
- Solve a Simpler Problem

4. H.O.T. Lia has a dog and a cat. Together, the pets weigh 28 pounds. The dog weighs 3 times as much as the cat. How much does each pet weigh?

5. Write Math Mr. Foster is framing the two pictures at the right. Does he need the same amount of framing for each picture? Does he need the same number of square inches of glass for each picture? **Explain.**



SHOW YOUR WORK

6. H.O.T. **What's the Error?** Claire says the area of a square with a side length of 100 centimeters is greater than the area of a square with a side length of 1 meter. Is she correct? **Explain.**

7. **Test Prep** A rectangular floor is 12 feet long and 11 feet wide. A rug that is 9 feet long and 7 feet wide covers part of the floor. How many square feet of the floor are NOT covered by the rug?

Ⓐ 63 square feet Ⓒ 132 square feet

Ⓑ 69 square feet Ⓓ 195 square feet

FOR MORE PRACTICE:
Standards Practice Book, pp. P255–P256

Name _____

Chapter Review/Test

Vocabulary

Choose the best term from the box.

Vocabulary
area
formula
perimeter

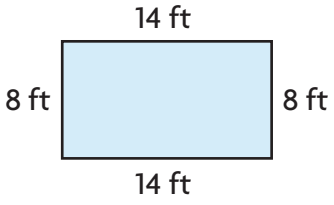
1. The number of square units needed to cover a flat surface is the _____. (p. 501)

2. The distance around a shape is the _____. (p. 497)

Concepts and Skills

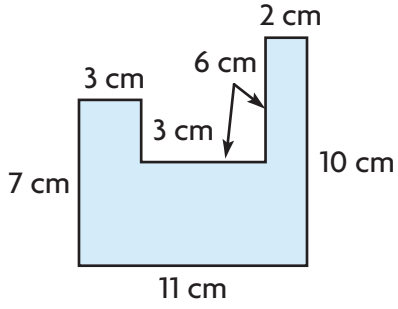
Find the area of the rectangle or combined rectangles.

3.



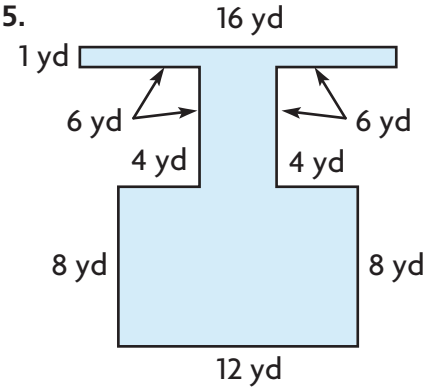
_____

4.



_____

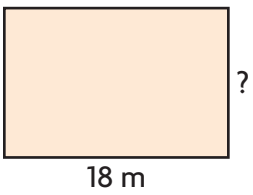
5.



_____

Find the unknown measure of the rectangle.

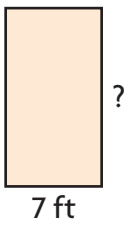
6.



Perimeter = 60 meters

width = _____

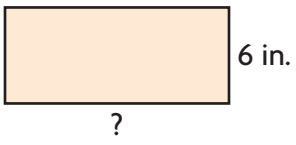
7.



Area = 91 square feet

height = _____

8.



Area = 60 square inches

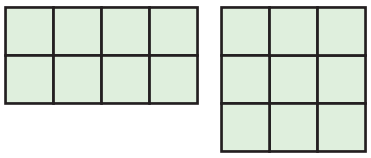
base = _____

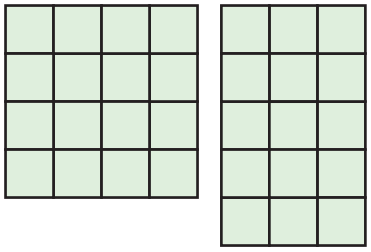
9. What is the perimeter of a rectangle with a length of 13 feet and a width of 9 feet? _____.

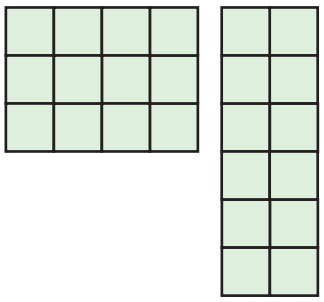
GO Online Assessment Options Chapter Test

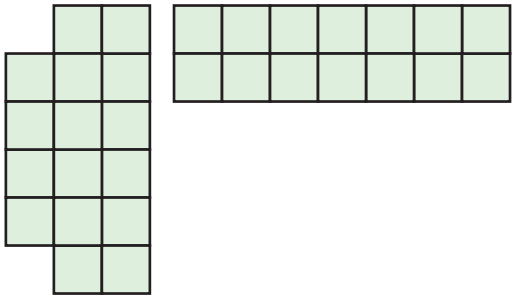
Fill in the bubble completely to show your answer.

10. Which pair of shapes has the same area?

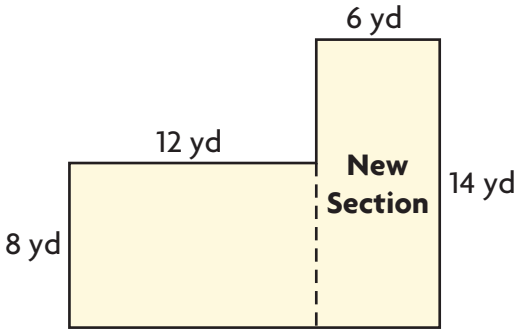
Ⓐ 

Ⓑ 

Ⓒ 

Ⓓ 

11. Jamie's mom wants to enlarge her rectangular garden by adding a new rectangular section. The garden is now 96 square yards. What will the total area of the garden be after she adds the new section?



Ⓐ 84 square yards

Ⓑ 96 square yards

Ⓒ 180 square yards

Ⓓ 192 square yards

12. A rectangular yoga studio has an area of 153 square feet. The width of the studio is 9 feet. What is the length of the studio?

Ⓐ 17 feet

Ⓑ 162 feet

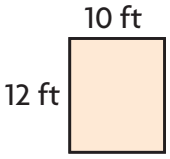
Ⓒ 324 feet

Ⓓ 1,377 feet

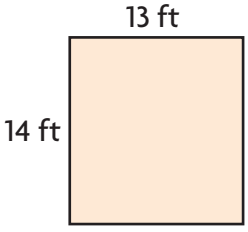
Name _____

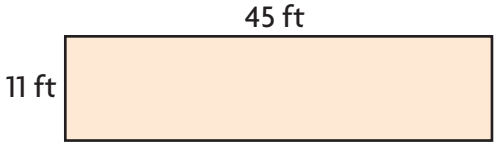
Fill in the bubble completely to show your answer.

13. Mr. Patterson had a rectangular deck with an area of 112 square feet built in his backyard. Which could be a diagram of Mr. Patterson's deck?

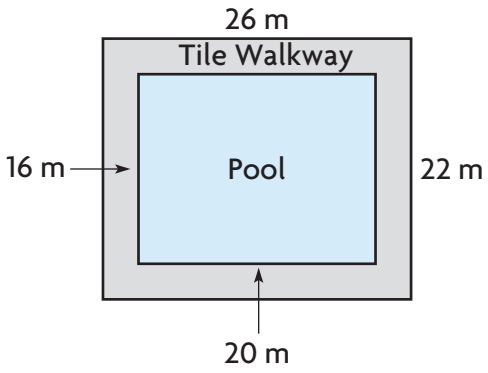
Ⓐ 

Ⓒ 

Ⓑ 

Ⓓ 

14. The town indoor pool is in a rectangular building. Marco is laying tile around the rectangular pool. How many square meters of tile will Marco need?



Ⓐ 96 square meters

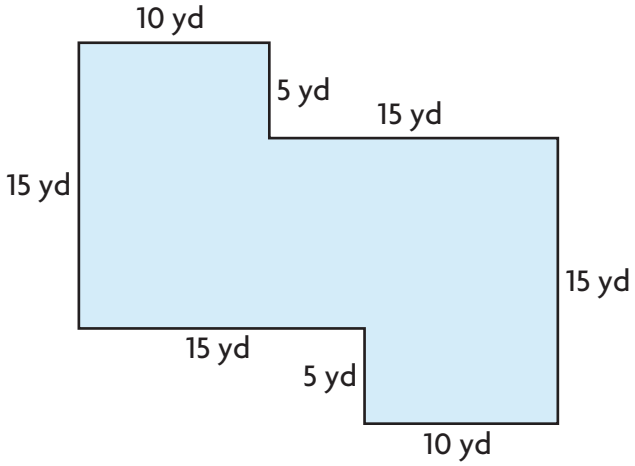
Ⓑ 252 square meters

Ⓒ 572 square meters

Ⓓ 892 square meters

Constructed Response

15. A drawing of a high school pool is shown below.



What is the area of the pool? **Explain** how you know.

Performance Task

16. Mr. Brown has 24 meters of fencing. He wants to build a rectangular pen for his rabbits.

A Draw two different rectangles that Mr. Brown could build. Use only whole numbers for the lengths of the sides of each rectangle. Label the length of each side.

B Find the area in square meters of each rabbit pen you made in Part A. Show your work.

C If you were Mr. Brown, which of the two pens above would you construct for your rabbits? Explain why.