Lesson 22

Area of Polygons

Name: _____

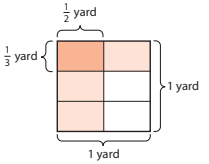
Prerequisite: Multiply Fractions

Study the example problem showing how to multiply fractions using an area model. Then solve problems 1–7.

Example

Ben has a piece of plywood that measures 1 yard on each side. He cuts the wood into 6 equal pieces. Each piece is $\frac{1}{3}$ yard wide and $\frac{1}{2}$ yard long. What is the area of each piece that Ben cuts?

You can use a model to help you understand the problem. Start by drawing a square that is 1 yard on each side and then divide it as described in the problem. Use your model to solve the problem.



area of one piece $= \frac{1}{2} \times \frac{1}{3} = \frac{1 \times 1}{2 \times 3} = \frac{1}{6}$

The area of each piece of plywood is $\frac{1}{6}$ square yard.

B 1 Explain how the product $\frac{1}{2} \times \frac{1}{3}$ relates to the model.

Possible explanation: The area of the model is 1 square yard. The square yard is divided into thirds and then each third is divided in half, which represents $\frac{1}{2} \times \frac{1}{3}$.

B 2 How many pieces do you need to cover $\frac{1}{2}$ square yard? Explain how you know.

3 pieces; I know that the area of one piece is $\frac{1}{6}$ square yard and $3 \times \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$, so I need 3 pieces to cover $\frac{1}{2}$ square yard.

M 3 Suppose Ben cuts pieces that are $\frac{1}{3}$ yard wide but the area of each piece is $\frac{1}{12}$ square yard. What is the length of each piece? Explain how you know.

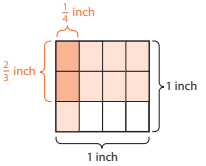
$\frac{1}{4}$ yard; I know the length times $\frac{1}{3}$ is $\frac{1}{12}$. I can multiply $\frac{1}{3}$ by $\frac{1}{4}$ to get $\frac{1}{12}$, so the length must be $\frac{1}{4}$ yard.

Solve.

Use the following situation to solve problems 4–5.

Isabel has a sticker that is $\frac{2}{3}$ inch wide and $\frac{1}{4}$ inch long.

B 4 Shade and label the area model to represent the area of the sticker.



M 5 What is the area of the sticker?

Show your work.

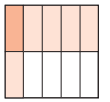
$\frac{1}{4} \times \frac{2}{3} = \frac{1 \times 2}{4 \times 3}$

$= \frac{2}{12}$ or $\frac{1}{6}$

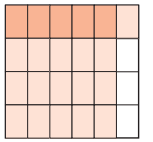
Solution: **The area of the sticker is $\frac{1}{6}$ square inch.**

M 6 Fill in the missing numbers to make the equation true. Then divide and shade the model to check your answer.

$\frac{1}{5} \times \frac{\boxed{1}}{\boxed{2}} = \frac{1}{10}$



C 7 A student uses this model to represent the product of two fractions. What are two possible fractions that the student could have been multiplying? Find the product of those two fractions, and shade the model to represent the product.



Possible answer: $\frac{1}{4}$ and $\frac{5}{6}$; $\frac{5}{24}$

Key

B Basic **M** Medium **C** Challenge

Lesson 22

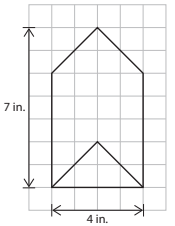
Name: _____

Area of Triangles and Parallelograms

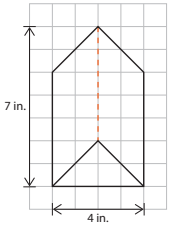
Study the example showing how to find the area of a figure by breaking it apart. Then solve problems 1–8.

Example

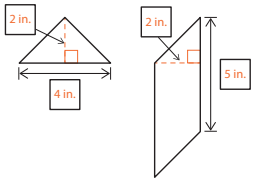
Karen drew the design shown at the right. How can she break apart her design in order to find its area?



Karen can break the design it into two parallelograms and one triangle as shown below. Then, she can find the area of the two parallelograms and the triangle to find the total area of the design.



B 1 Label the dimensions of the triangle and one of the parallelograms from Karen's design.



B 2 What is the area of one of the parallelograms? Use the formula: Area of a parallelogram = bh.

10 sq in.; Area of a parallelogram = bh = (5)(2) = 10

B 3 What is the area of the triangle? Use the formula:

Area of a triangle = $\frac{1}{2}bh$.

4 sq in.; Area of a triangle = $\frac{1}{2}bh = \frac{1}{2}(4)(2) = 4$

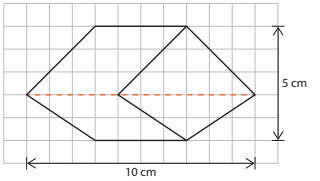
B 4 What is the area of the design? Explain how you know.

24 sq in.; I added the area of the triangle and the areas of the two parallelograms:

4 sq in. + 10 sq in. + 10 sq in. = 24 sq in.

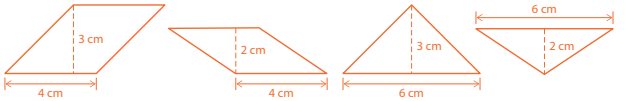
Solve.

M 5 Brie and Lisa want to find the area of this figure. They agree to separate the figure as shown, but they disagree about what to do next. Lisa wants to add the areas of all four shapes in the figure. Brie wants to find the sum of the areas of one parallelogram and one triangle and then multiply that sum by 2. Who is correct? Explain.



Lisa; Possible explanation: Brie is correct only if the parallelograms have the same area and the triangles have the same area. But each of the four shapes has a different area, so the sum of four areas must be found.

M 6 Draw each parallelogram and each triangle that you need to find the area of in problem 5. Then label the dimensions on each figure.



M 7 What is the area of the figure?

Show your work.

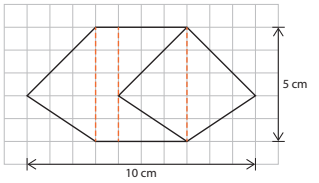
Area of a parallelogram = bh = (4)(3) = 12; Area of a parallelogram = bh = (4)(2) = 8;

Area of a triangle = $\frac{1}{2}bh = \frac{1}{2}(6)(3) = 9$; Area of a triangle = $\frac{1}{2}bh = \frac{1}{2}(6)(2) = 6$

12 + 8 + 9 + 6 = 35

Solution: The area of the figure is 35 square centimeters.

C 8 Show a different way to separate the figure into shapes. You may draw more than one line. Explain how to find the area of the figure using those shapes.



Possible answer: Multiply the area of one of the largest triangles by 3. Add the product to the area of the rectangle and the areas of the two smaller triangles.

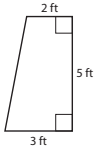
Name: _____

Area of Trapezoids

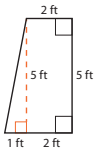
Study the example problem showing how to find the area of a trapezoid. Then solve problems 1–7.

Example

Roberta is making a sign in the shape of the trapezoid shown. What is the area of the sign?



Separate the trapezoid into a triangle and a rectangle, and label the dimensions as shown below. Then find the combined area of the triangle and the rectangle.



Area of a triangle $= \frac{1}{2}bh = \frac{1}{2}(1)(5) = 2.5$ square feet

Area of a rectangle $= bh = (2)(5) = 10$ square feet

2.5 square feet + 10 square feet = 12.5 square feet

The area of the sign is 12.5 square feet.

B 1 Why is the trapezoid separated into a triangle and a rectangle?

Possible answer: I know how to find the area of a triangle and a rectangle, so I can add the areas of those shapes to find the area of the trapezoid.

B 2 How do you find the base of the triangle?

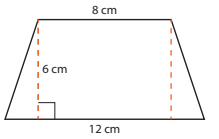
Possible answer: Subtract the shorter base of the trapezoid from the longer base.

B 3 Which measure do you use to find both the area of the triangle and the area of the rectangle? Explain.

5; You use the height of 5 feet to find the area of both shapes.

Solve.

Use the trapezoid at the right to solve problems 4–6.



M 4 Draw lines to separate the trapezoid into a rectangle and two identical triangles. What are their dimensions?

The triangles each have a base of 2 cm and a height of 6 cm, and the rectangle has a base of 8 cm and a height of 6 cm.

M 5 What is the area of the trapezoid?

Show your work.

Possible student work:

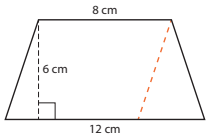
Area of one triangle: $\frac{1}{2}bh = \frac{1}{2}(2)(6) = 6$ square centimeters

Area of rectangle: $bh = (8)(6) = 48$ square centimeters

Area of total figure: $(2)(6) + 48 = 60$

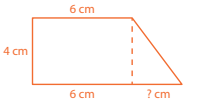
Solution: The area of the trapezoid is 60 square centimeters.

B 6 Nick says that if you separate the trapezoid into one parallelogram and one triangle, as shown, the area will change. Is he correct? Explain.



No; Possible explanation: The size of the trapezoid is the same, so the area is the same no matter how you separate it into smaller shapes.

C 7 The area of a trapezoid is 30 square centimeters. The height is 4 centimeters. The shorter base measures 6 centimeters. What is the measure of the longer base? Draw a picture of the problem. Explain your thinking.



Possible student drawing shown. 9 cm; Possible explanation: You can separate the trapezoid into one rectangle and one triangle. The area of the rectangle is $6 \cdot 4 = 24$ square cm, so the area of the triangle is $30 - 24 = 6$ square cm. You can use the formula for area of a triangle to find the measure of the base of the triangle: $6 = \frac{1}{2}(b)(4)$, $b = 3$. Add the bases: $6 + 3 = 9$.

Lesson 22

Name: _____

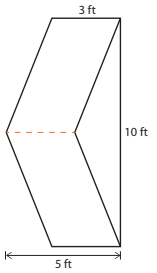
Area of Polygons

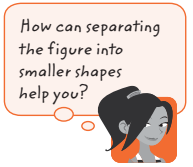
Solve the problems.

M

1 What is the area of the figure at the right? Explain how you found your answer.

Show your work.





Possible work:
I divided the figure into two congruent parallelograms and one triangle.

Area of one parallelogram:
$bh = (3)(5) = 15$

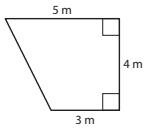
Area of triangle: $\frac{1}{2}bh = \frac{1}{2}(10)(2) = 10$

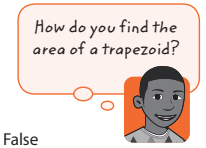
Area of total figure: $2(15) + 10 = 30 + 10 = 40$

Solution: **The area of the figure is 40 square feet.**

B

2 A kitchen floor has the shape of this trapezoid.





Tell whether each statement is *True* or *False*.

a. The height of the trapezoid measures 5 meters. ☐ True ☒ False

b. You can separate the trapezoid into a triangle and a rectangle. ☒ True ☐ False

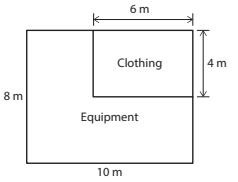
c. You can use the expression $(3 \cdot 4) + \left(\frac{1}{2} \cdot 2 \cdot 4\right)$ to find the area of the trapezoid. ☒ True ☐ False

d. The area is 12 square meters. ☐ True ☒ False

Solve.

M

3 The floor plan for a sports store is shown below.



Which statement about the floor plan is true? Select all that apply.

A The area of the equipment section is 80 square meters.

B The area of the clothing section is half the area of the equipment section.

C The area of the equipment section is 56 square meters.

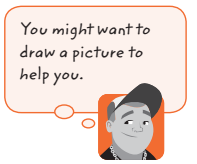
D The area of the equipment section is the area of the store minus the area of the clothing section.

Peter chose **A** as a correct answer. How did he get that answer?

Possible answer: He found the area of the whole store, not the area of the equipment section.

C

4 Students play table tennis in a rectangular room that is 15 feet by 25 feet. There is 8 feet of floor space from each end of the table to the wall and 5 feet from each side of the table to the wall. What is the area of the floor not covered by the table?



A 40 square feet

B 45 square feet

C 170 square feet

D 330 square feet