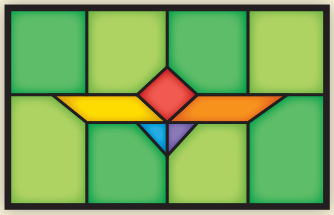
Area of Polygons

Use What You Know

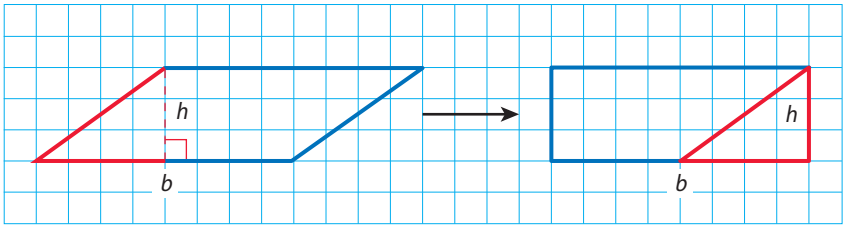
You know how to find the area of a rectangle. Take a look at this problem.

The design of this stained glass window includes many different shapes. How much glass is needed to cover one of the parallelograms if its height measures 3 inches and its base measures 8 inches?



Use the math you already know to solve this problem.

a. You can draw the parallelogram on grid paper. Imagine cutting the parallelogram along the dotted line and moving the triangle you just cut off to the other side as shown.



b. What kind of shape do you get? _____

c. How do you find the area of the new shape? _____

d. If the base is 8 inches and the height is 3 inches, what is the area of the rectangle?

_____

e. Is the area of the parallelogram the same as the area of the rectangle? Explain your reasoning.

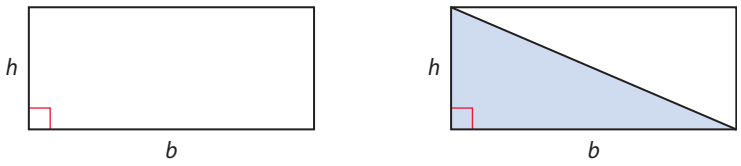
_____

f. How could you find the area of the parallelogram? _____

Find Out More

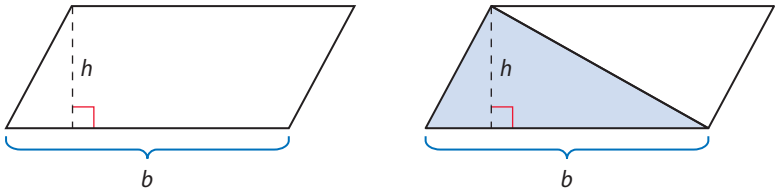
You saw that the formula for the area of a parallelogram is $A = bh$.

You can figure out how to find the area of a triangle in much the same way. Start with a rectangle. Then, draw a diagonal to split the rectangle in half.



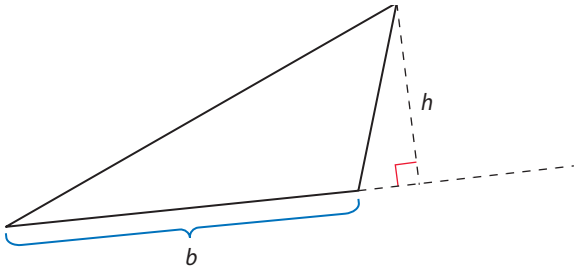
The sides of a rectangle are perpendicular to each other, so the triangles you get are right triangles. The area of one of the right triangles is $\frac{1}{2}$ the area of the rectangle.

What about other types of triangles? Start with a parallelogram. Drawing a diagonal splits the parallelogram in half.



The area of the parallelogram is $A = bh$. The area of the triangle is $\frac{1}{2}$ the area of the parallelogram.

The base is always one of the sides of a triangle. It doesn't have to be the side the triangle is sitting on. The height to the base is always a perpendicular segment drawn to the base. Sometimes the height is drawn outside the triangle.



You can always put two triangles together to make a parallelogram.

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

Reflect

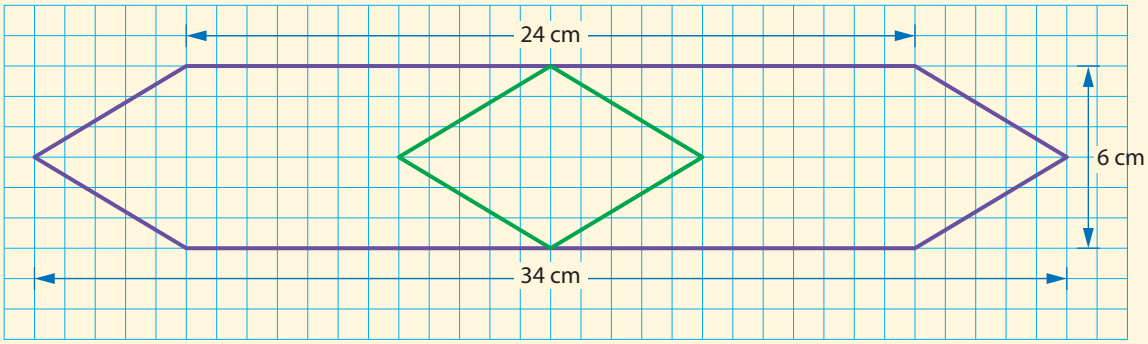
1 Describe the relationship between the area of a parallelogram and the area of a triangle that have the same base and height.

Learn About

Area of Triangles and Parallelograms

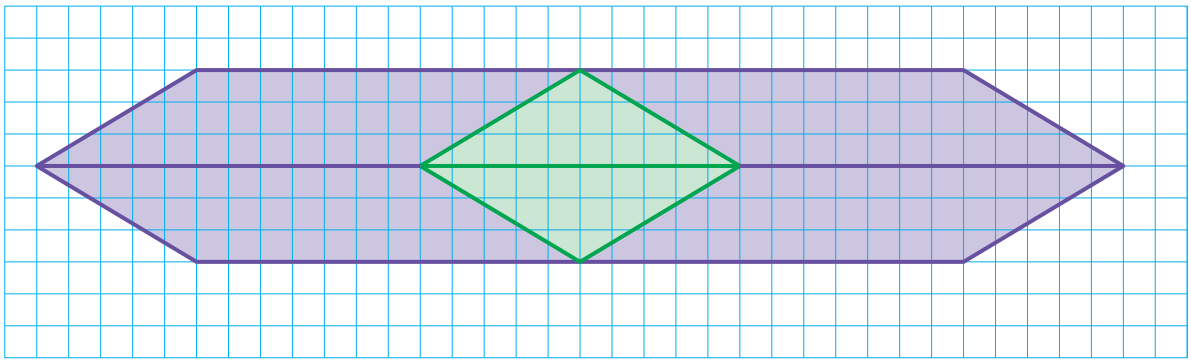
Read the problem below. Then explore how to find the area of a figure by breaking it up into triangles and parallelograms.

A part of another stained glass window design is shown below. How much glass would you need for this part of the window?



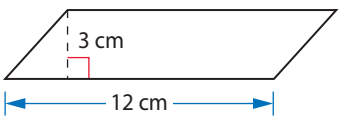
Picture It

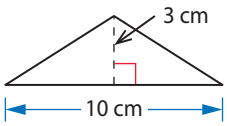
You can separate the figure into two triangles and four parallelograms.



Model It

You can draw one of the parallelograms and one of the triangles and label them with their dimensions.





Solve It

You can use formulas to find the areas of the triangles and the parallelograms to solve the problem.

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

Area of a parallelogram $= bh$

Connect It

Now you use your drawings and formulas for the area of a triangle and a parallelogram to solve the problem on the previous page.

2 Look at *Picture It*. Explain how you could find the total area of the figure.

3 What can you say about the four parallelograms? The two triangles?

4 What is the area of one of the parallelograms? What is the area of one of the triangles? Show your work.

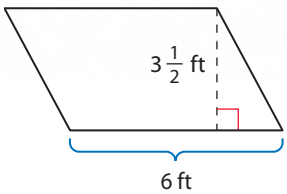
5 Calculate the amount of glass needed for the window. Show your work.

6 Explain how you can find the area of a polygon.

Try It

Use what you learned about finding the area of polygons to find the areas of the figures below. Show your work on a separate sheet of paper.

7



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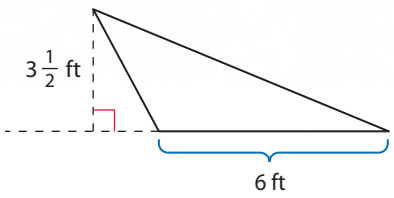
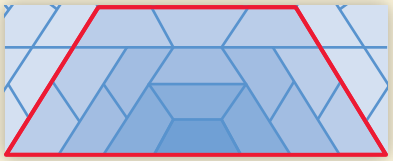


Learn About Area of Trapezoids

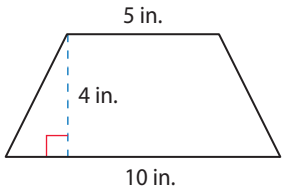
Read the problem below. Then explore one way to find the area of a trapezoid.

In art class, Swati created a trapezoid made up of smaller trapezoids that are all the same size and shape. If the height of the large trapezoid is 4 inches and the bases measure 5 inches and 10 inches, what is the area of the large trapezoid? What is the area of one of the small trapezoids?



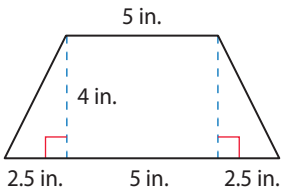
Picture It

You can draw the large trapezoid and label it with the information you know.



Model It

You can separate the trapezoid into two triangles and one rectangle and label their dimensions.



Solve It

You can find the areas of the triangles and the rectangle to help you solve the problem.

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

Area of a rectangle $= bh$

Connect It Now you will solve the problem by finding the areas of the triangles and the rectangle.

9 Look at *Model It*. What can you say about the two triangles that are part of the trapezoid?

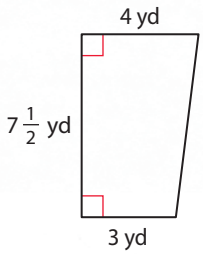
10 How do you know that one of the sides of the right triangles is 2.5 inches?

11 Explain how to calculate the area of the large trapezoid. Show your work.

12 What is the area of one of the small trapezoids? Show your work and explain your reasoning.

Try It Use what you just learned about finding the area of a trapezoid to find the areas of the trapezoids below. Show your work on a separate sheet of paper.

13



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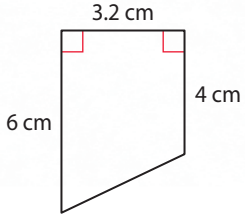
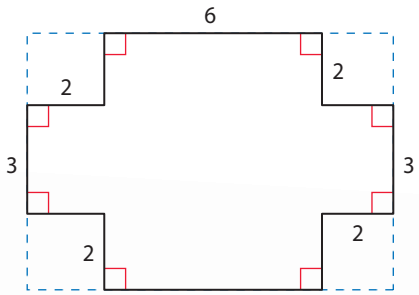


Practice Finding the Area of Polygons

Study the example below. Then solve problems 15–17.

Example

Find the area of this polygon.



Look at how you could show your work.

The large rectangle is 10 by 7. The area is $10(7) = 70$.

The area of a small square at a corner is $2(2) = 4$. There is a square at each corner so the total area of the squares is 16.

The area of the polygon is $70 - 16$ or 54.

Solution 54 square units

The student drew a large rectangle around the polygon and subtracted the areas of the four small squares from the area of the large rectangle.

Pair/Share
Could you solve this problem another way?

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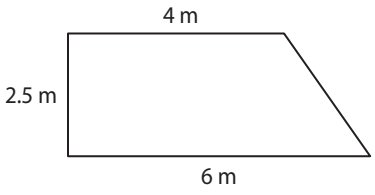
15 Mr. Millar's garden is in the shape of a trapezoid shown below. What is the area of his garden?



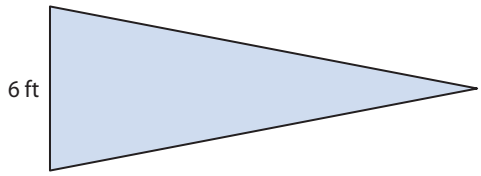
Show your work.

Solution _____

How can you separate the trapezoid into other shapes?

Pair/Share
How could you check to see if your answer makes sense?

16 A triangular flag has the same area as a rectangle that is 6 ft by 7 ft. If the length of the base of the flag is 6 ft, what is the height of the flag?



Show your work.

What do you need to find first to solve this problem?

Pair/Share
How is this problem different from ones you have seen before in this lesson?

Solution _____

17 If you double the lengths of each side of a rectangle, what can you say about the area of the new rectangle?

A The area of the new rectangle is half the original area.

B The area of the new rectangle is double the original area.

C The area of the new rectangle is four times the original area.

D The area of the new rectangle is eight times the original area.

Manuel chose **B** as the correct answer. How did he get that answer?

_____

_____

_____

_____

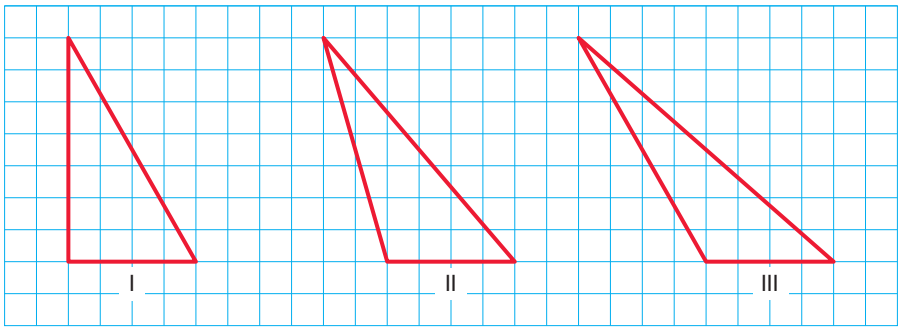
Would drawing a diagram and trying different cases help?

Pair/Share
How could you help Manuel answer the question?

Practice Finding the Area of Polygons

Solve the problems.

1 Which triangle below has the greatest area?



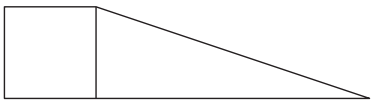
A Triangle I

B Triangle II

C Triangle III

D They all have the same area.

2 The trapezoid below is made up of a square and a triangle. The total area of the trapezoid is 57.5 square meters. The area of the triangle is 32.5 square meters. What is the length of a side of the square?



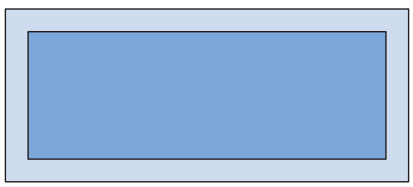
A 5 meters

B 25 meters

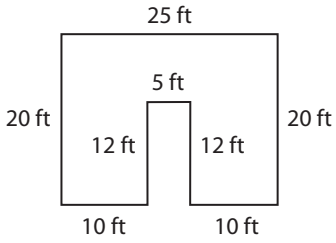
C 90 meters

D Not enough information is given.

3 The diagram below shows an 18-foot by 40-foot pool surrounded by a 4-foot wide walkway. What is the area of the walkway? ☐ square feet



4 Max needs to paint a wall surrounding a door. The dimensions on his blueprint are shown below.



Which expression can he use to find the area of the wall? Select all that apply.

A $(20 \times 25) - (5 \times 12)$

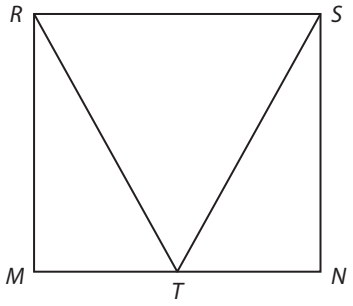
B $10 \times 12 + 10 \times 12 + 8 \times 25$

C $10 \times 20 + 10 \times 20 + 5 \times 8$

D $(20 \times 15) + (20 \times 10)$

5 Triangle *RST* is drawn inside rectangle *RSNM*. Point *T* is halfway between points *M* and *N* on the rectangle. The length of side *RS* is 9 in. and the length of side *RM* is 8 in.

Show your work.



Part A What is the area of triangle *RST*? _____

Part B What is the ratio of the area of triangle *RST* to the area of triangle *RMT*?

Part C What is the ratio of the area of rectangle *RSNM* to the area of triangle *TSN*?

Self Check **Go back and see what you can check off on the Self Check on page 219.**