Area of Composite Shapes Involving Triangles

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CONCEPT 1 Area of Composite Shapes Involving Triangles

Here you'll learn to find areas of combined figures involving triangles.

Have you ever had a favorite team?

Miguel loves watching the games when the Wildcats play. He loves when they win, but he is such a fan of baseball that he doesn't even mind when they lose. Miguel cheers when the players run towards home plate.

He watched them slide in and run across it.

"Home plate is such an interesting shape," he thinks to himself one day.

He decides to do a little research on the design of home plate. Here is what he finds out.

Home plate is a pentagon which can be divided up. The base of home plate is 17 inches wide. The sides of home plate are each 8.5 inches. The distance from the tip of home plate to the base is also 17 inches.

Miguel thinks that this is very interesting information. He wonders if he can figure out the area of the figure. It is made up of a rectangle and a triangle.

As Miguel works on this, you work on it too. You know how to find the area of a rectangle already, but what about a triangle?

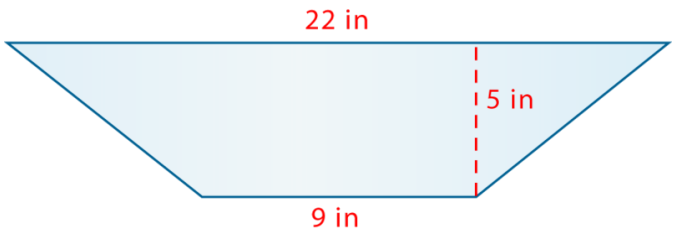
This Concept will teach you how to find the area of a triangle and add that to the rectangle. When finished, you can work on figuring out home.

Guidance

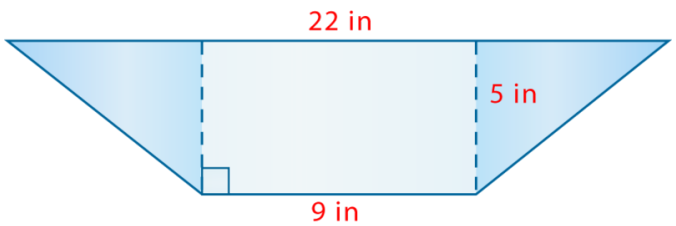
Now that you know how to find the area of a triangle, you can use that information to figure out the area of figures that are made up of more than one shape. Remember that we could divide a parallelogram into two triangles? If we know the area of the triangles, we can add their areas together to find the area of the parallelogram. We can do this for all kinds of figures. If we can divide the figure into triangles, we can find the area of each triangle and add the areas together.

Also, we have seen that we can apply the formula for finding the area of triangles to different kinds of situations. Sometimes we need to solve for the area, but other times we may need to find the height or the base. We can use information given about a larger figure whenever that information corresponds to the height, base, or area of one of the triangles contained within it. Let's try one to get a better idea of how this works.

Find the area of the figure below.



We need to find the area of the whole figure. To do so, we can divide it into shapes whose area formulas we know. We can see that one triangle has been drawn already. Can we draw another to divide the figure again?



Now we have divided the figure into a rectangle and two triangles. If we can find the area of each of these, we can add them together to find the area of the whole figure.

Let's give it a try.

First, let's calculate the area of the rectangle in the center. We know the formula for the area of rectangles is $A = lw$. Do we know the length and width of the rectangle? The width is represented by the dashed line. It is 5 inches. The length of the rectangle is the same as the top edge of the figure: 9 inches. Let's put these numbers into the formula and solve for area.

$$\begin{aligned} A &= lw \\ A &= 9(5) \\ A &= 45\ in.^2 \end{aligned}$$

Now let's find the area of one of the triangles. We know that the height is 5 inches. What is the base? Look carefully at the figure. We know that its top edge is 22 inches. We also know that the length of the rectangle in the middle is 9 inches. We need to subtract that so we don't include it as part of the bases of the triangles.

That means there are $22 - 9 = 13$ inches left of the bottom edge. If we divide this equally, we find that each triangle has a base of 6.5 inches.

Now we have the height and base of each triangle (they have the same height and base), so we can calculate the area.

$$\begin{aligned} A &= \frac{1}{2}bh \\ A &= \frac{1}{2}6.5(5) \\ A &= \frac{1}{2}(32.5) \\ A &= 16.25\ in.^2 \end{aligned}$$

Great! Now we have the area of each shape within the figure. All we have to do is add these together to find the area of the whole figure.

triangle 1		rectangle		triangle 2		whole figure
$16.25\ in.^2$	$+$	$45\ in.^2$	$+$	$16.25\ in.^2$	$=$	$77.5\ in.^2$

The area of the whole figure is 77.5 square inches.

Now it's time for you to try a few on your own.

Example A

A figure is made up of three triangles. Each triangle has a base of 6 inches and a height of 4 inches. What is the combined area of all three triangles?

Solution: $36\ in^2$

Example B

A figure is made up of two triangles and one rectangle. Each triangle has a base of 5 inches and a height of 3 inches. The rectangle has a length of 4 inches and a width of 3 inches. What is the total area of the figure?

Solution: $27\ in^2$

Example C

A figure is made up of one triangle and one square. The square and the triangle have the same base length of 8 feet. The height of the triangle is 7 feet. What is the total area of the figure?

Solution: $92\ ft^2$

Here is the original problem once again.

Miguel loves watching the games when the Wildcats play. He loves when they win, but he is such a fan of baseball that he doesn't even mind when they lose. Miguel cheers when the players run towards home plate.

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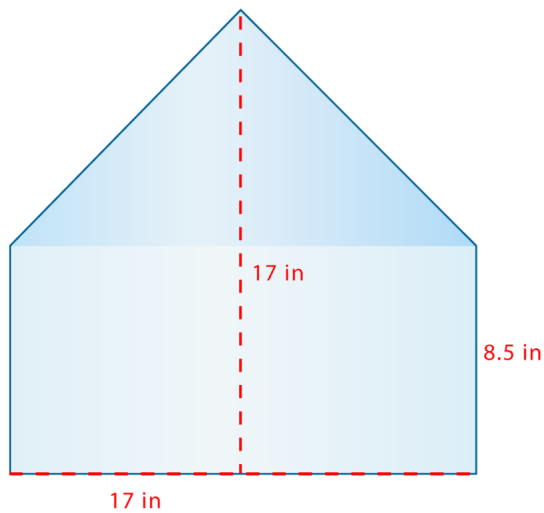
"Home plate is such an interesting shape," he thinks to himself one day.

He decides to do a little research on the design of home plate. Here is what he finds out.

Home plate is a pentagon which can be divided up. The base of home plate is 17 inches wide. The sides of home plate are each 8.5 inches. The distance from the tip of home plate to the base is 17 inches.

Miguel thinks that this is very interesting information. He wonders if he can figure out the area of the figure. It is made up of a rectangle and a triangle.

Here is a drawing of home plate with its dimensions.



Now, we can begin by figuring out the area of the rectangle.

The length of the rectangle is 17 inches, the width is 8.5

$$A = 17(8.5)$$
$$A = 144.5$$

The area of the rectangle is 144.5 square inches.

Now let's look at the triangle. We know that the base of the triangle is 17". The height of the whole plate is 17 inches, but that includes the rectangle width too. We need to subtract that from the total.

17 – 8.5 = 8.5 inches

Let's use our formula to find the area of the triangle.

$$A = \frac{1}{2}bh$$
$$A = \frac{1}{2}(17)(8.5)$$
$$A = \frac{1}{2}(144.5)$$
$$A = 72.25$$

Now we add up the two areas.

$144.5 + 72.25 = 216.75$ *square inches*

This is the approximate measure of home plate.

You can read more about home plate at http://wiki.answers.com/Q/What_are_the_dimensions_of_home_plate

Vocabulary

Here are the vocabulary words in this Concept.

Triangle
a figure with three sides and three angles.

Area
the space enclosed inside a two-dimensional figure.

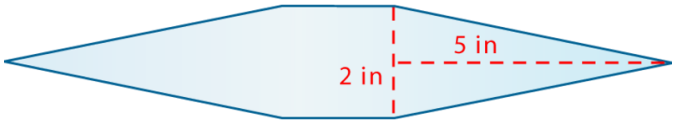
Base
the bottom part of the triangle

Height
the length of the triangle from the base to the vertex

Guided Practice

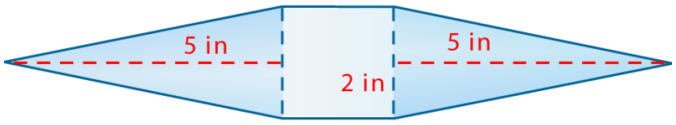
Here is one for you to try on your own.

What is the area of the figure below?



Answer

This time we need to divide the figure into smaller shapes ourselves. Can you draw any lines to make triangles inside the figure?



Now we have two triangles and a square. Let's see if we have all the measurements we need to use the area formulas for these two shapes.

We know that all of the sides of a square are congruent, so we can fill in the measurements for the other two sides, which must also be 2 inches. This gives us the base of each triangle. Do we know their height? Each is 5 inches. We have all the information we need to solve for the areas of the triangles and the square. Let's calculate the area of each smaller shape.

Square	Triangle 1	Triangle 2
$A = s^2$	$A = \frac{1}{2}bh$	$A = \frac{1}{2}bh$
$A = 2^2$	$A = \frac{1}{2}2(5)$	$A = \frac{1}{2}2(5)$
$A = 4\ in.^2$	$A = \frac{1}{2}(10)$	$A = \frac{1}{2}(10)$
	$A = 5\ in.^2$	$A = 5\ in.^2$

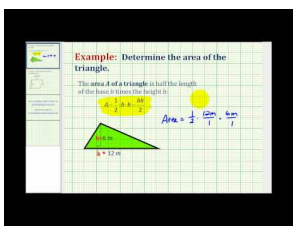
Great! We have found the area of each smaller shape. Let's add them together to find the area of the whole figure.

square		triangle 1		triangle 2		whole figure
$4\ in.^2$	$+$	$5\ in.^2$	$+$	$5\ in.^2$	$=$	$14\ in.^2$

The area of the whole figure is 14 square inches.

Video Review

Here is a video for review.



MEDIA

Click image to the left for more content.

- This is a James Sousa video onfindingthearea ofa triangle.It is asupporting video for this Concept.

Practice

Directions: Find the area of each combined figure.

1. A figure is made up of a triangle and a square. The square and the triangle have the same base of 7 inches. The triangle has a height of 5 inches, what is the total area of the figure?

2. A figure is made up of a triangle and a rectangle. The triangle has a height of 8 inches and a base of 9 inches. The rectangle has dimensions of 7 inches x 9 inches. What is the area of the figure?

3. A figure is made up of four triangles. Each triangle has a base of 7 inches and a height of 9 inches. What is the total area of the figure?

4. A figure is made up of three triangles. Each triangle has a base of 5 feet and a height of 4.5 feet. What is the total area of the figure?

5. A figure is made up of two triangles and a square. The triangles and the square have the same base length of 5 feet. The triangles have a height of 4 feet. What is the total area of the figure?

6. A figure is made up of two triangles and a square. The triangles and the square have the same base length of 8 feet. The triangles have a height of 7 feet. What is the total area of the figure?

7. A figure is made up of one square and one triangle. The square has a side length of 9 feet. The triangle has a base of 7 feet and a height of 6 feet. What is the total area of the figure?

8. A figure is made up of two triangles. The triangles have the same base of 15 inches. One triangle has a height of 9 inches and one has a height of 11 inches. What is the total area of the figure?

9. A figure is made up of a triangle and a rectangle. The triangle has a height of 8.5 inches and a base of 10 inches. The rectangle has dimensions of 9 inches x 10 inches. What is the area of the figure?

10. A figure is made up of a triangle and a rectangle. The triangle has a height of 11 inches and a base of 9.5 inches. The rectangle has dimensions of 12 inches x 14 inches. What is the area of the figure?

Directions: Solve each problem.

11. Julius drew a triangle that had a base of 15 inches and a height of 11 inches. What is the area of the triangle Julius drew?

12. A triangle has an area of 108 square centimeters. If its height is 9 cm, what is its base?

13. What is the height of a triangle whose base is 36 inches and area is 234 square inches?

14. Tina is painting a triangular sign.. The height of the sign is 32 feet. The base is 27 feet. How many square feet will Tracy paint?

15. Tina drew a picture of a triangle with a base of 6 inches and a height of 5.5 inches. What is the area of the triangle?