What You'll Learn

To find the area of a triangle and to relate side lengths and area

🔊 **New Vocabulary** base of a triangle, height of a triangle

© **CONTENT STANDARDS**
7.G.6

Why Learn This?

The wings of high-speed planes have a triangular shape, are usually thin, and are swept back to give the plane more lift. Engineers need to be able to calculate the area of the wings as they design such airplanes.
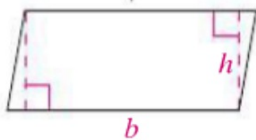
Any side of a triangle can be considered the **base of a triangle**. The **height of a triangle** is the length of the perpendicular segment from a vertex to the base opposite the vertex or to an extension of the base.
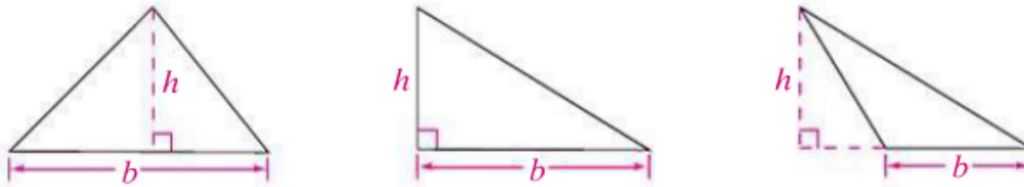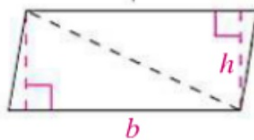
The formula for the area of a triangle follows from the formula for the area of a parallelogram.
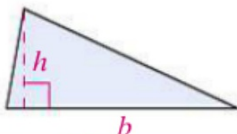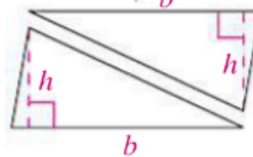
The area of a parallelogram = *bh*.

Draw one diagonal.

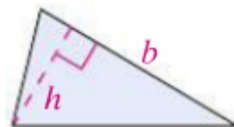Break the parallelogram into two triangles.

The area of a triangle is half the area of a parallelogram.

KEY CONCEPTS   Area of a Triangle

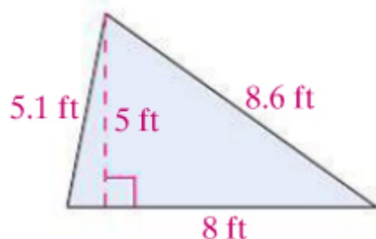The area of a triangle is equal to half the product of any base b and the corresponding height h.

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

EXAMPLE   Finding the Area of a Triangle
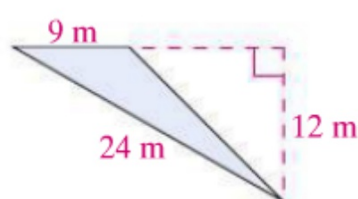
1 Find the area of each triangle.

a.

5.1 ft   5 ft   8.6 ft   8 ft

b.

9 m   24 m   12 m

$A = \tfrac{1}{2}bh$	← Use the area formula. →	$A = \tfrac{1}{2}bh$
$= \tfrac{1}{2}(8)(5)$	← Substitute. →	$= \tfrac{1}{2}(9)(12)$
$= 20$	← Simplify. →	$= 54$

The area is 20 ft².   The area is 54 m².

Examples

① **Finding the Area of a Triangle** Find the area of each triangle.

a.
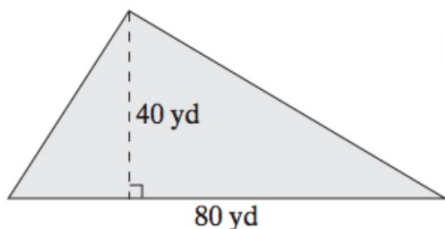
$A = \frac{1}{2} \boxed{b} \boxed{h}$ ← **Use the area formula.**

$= \frac{1}{2} \left(\boxed{80} \right) \left(\boxed{40} \right)$ ← **Substitute.**

$= \boxed{1{,}600}$ ← **Simplify.**

40 yd

80 yd

The area is $\boxed{1{,}600}$ yd².

b. The triangle has side lengths of 16.2 cm, 15.4 cm, and 2.4 cm. Draw the height going to the base of length 2.4 cm. The height is 15 cm.

$A = \boxed{\frac{1}{2}} \boxed{bh}$ ← **Use the area formula.**

$= \boxed{\frac{1}{2}} \boxed{2.4} \boxed{15}$ ← **Substitute.**

$= \boxed{18}$ ← **Simplify.**

16.2 cm   15.4 cm   2.4 cm

15 cm

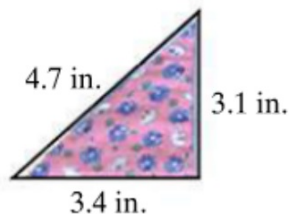The area is $\boxed{18}$ cm².
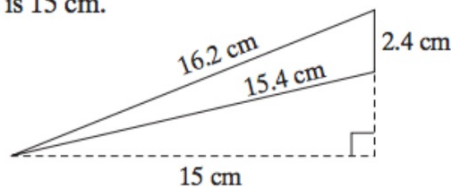
EXAMPLE   **Relating Side Lengths and Area**

② **Crafts** A quilt has a design of small and large triangles. A small triangle is shown at the right. A large triangle has the same shape, but the sides are twice as long as the sides in a small triangle. How does the area of a large triangle compare to the area of a small triangle?

4.7 in.   3.1 in.   3.4 in.

Small triangle
$b = 3.4$ in., $h = 3.1$ in.
$A = \frac{1}{2}(3.4)(3.1)$
$= 5.27$

Large triangle
$b = 6.8$ in.; $h = 6.2$ in.
$A = \frac{1}{2}(6.8)(6.2)$
$= 21.08$

The area of a large triangle is 21.08 in.². The area of a triangle is 5.27 in.². So, the area of a large triangle is about 4 times as great as the area of a small triangle.

❷ Relating Side Lengths and Area Triangle A below has sides three times as long as the sides of Triangle B. How does the area of Triangle A compare to the area of Triangle B?

Triangle A

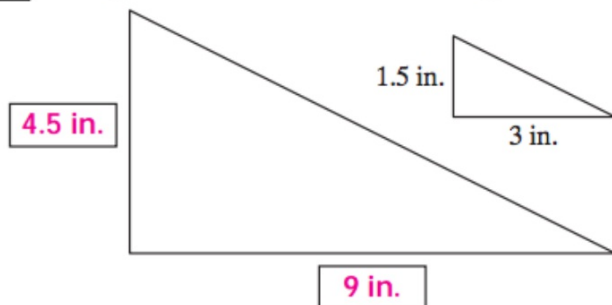$b =$ 9 in., $h =$ 4.5 in.

$A = \frac{1}{2}($ 9 $)($ 4.5 $)$

$=$ 20.25

Triangle B

$b =$ 3 in.; $h =$ 1.5 in.

$A = \frac{1}{2}($ 3 $)($ 1.5 $)$

$=$ 2.25
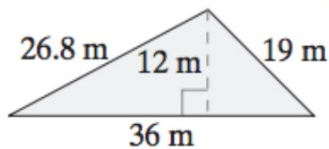
The area of Triangle A is 20.25 in². The area of Triangle B is 2.25 in². So, the area of Triangle A is 9 times greater than the area of Triangle B.

1.5 in.

4.5 in.

3 in.
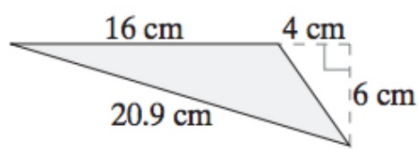
9 in.

Quick Check

1. Find the area of each triangle.

a.

26.8 m 12 m 19 m

36 m

b.

16 cm   4 cm

20.9 cm   6 cm

2. What is the unknown side length of the triangle?

15 cm

area:
54 cm²

12 cm
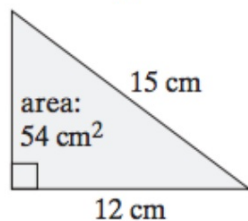
1. Vocabulary A triangle that has a 90° angle is a(n) __?__ triangle.

Use the triangle at the right. Fill in the blank.

2. $b = \blacksquare$ m

3. $h = \blacksquare$ m

12 m

8 m

10 m

3 m   6 m
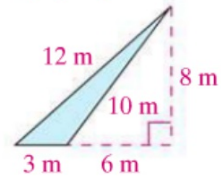
Find the area of each triangle.

4. $b = 4$ cm, $h = 5$ cm

5. $b = 2$ in., $h = 7$ in.

6. A carpenter has blueprints for a wooden, triangular patio. The base is 5 m and the height is 7 m. What is the area of the patio?