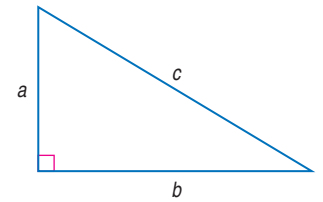


Pythagorean Theorem

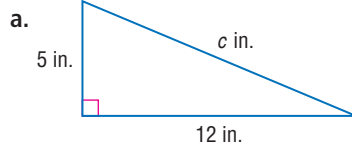
The **Pythagorean Theorem** states that in a right triangle, the square of the length of the hypotenuse c is equal to the sum of the squares of the lengths of the legs a and b .

That is, in any right triangle, $c^2 = a^2 + b^2$.

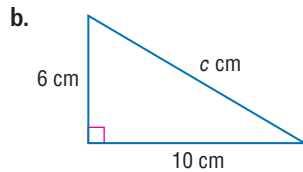


EXAMPLE

1 Find the length of the hypotenuse of each right triangle.



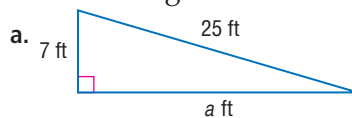
$$\begin{aligned}c^2 &= a^2 + b^2 && \text{Pythagorean Theorem} \\c^2 &= 5^2 + 12^2 && \text{Replace } a \text{ with 5 and } b \text{ with 12.} \\c^2 &= 25 + 144 && \text{Simplify.} \\c^2 &= 169 && \text{Add.} \\c &= \sqrt{169} && \text{Take the square root of each side.} \\c &= 13 && \text{The length of the hypotenuse is 13 inches.}\end{aligned}$$



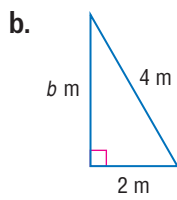
$$\begin{aligned}c^2 &= a^2 + b^2 && \text{Pythagorean Theorem} \\c^2 &= 6^2 + 10^2 && \text{Replace } a \text{ with 6 and } b \text{ with 10.} \\c^2 &= 36 + 100 && \text{Simplify.} \\c^2 &= 136 && \text{Add.} \\c &= \sqrt{136} && \text{Take the square root of each side.} \\c &\approx 11.7 && \text{Use a calculator. To the nearest tenth, the length of the} \\ & && \text{hypotenuse is 11.7 centimeters.}\end{aligned}$$

EXAMPLE

2 Find the length of the missing leg in each right triangle.



$$\begin{aligned}c^2 &= a^2 + b^2 && \text{Pythagorean Theorem} \\25^2 &= a^2 + 7^2 && \text{Replace } c \text{ with 25 and } b \text{ with 7.} \\625 &= a^2 + 49 && \text{Simplify.} \\625 - 49 &= a^2 + 49 - 49 && \text{Subtract 49 from each side.} \\576 &= a^2 && \text{Simplify.} \\ \sqrt{576} &= a && \text{Take the square root of each side.} \\24 &= a && \text{The length of the leg is 24 feet.}\end{aligned}$$



$$c^2 = a^2 + b^2$$

Pythagorean Theorem

$$4^2 = 2^2 + b^2$$

Replace c with 4 and a with 2.

$$16 = 4 + b^2$$

Simplify.

$$12 = b^2$$

Subtract 4 from each side.

$$\sqrt{12} = b$$

Take the square root of each side.

$$3.5 \approx b$$

Use a calculator to find the square root of 12.
Round to the nearest tenth.

To the nearest tenth, the length of the leg is 3.5 meters.

EXAMPLE

- 3** The lengths of the three sides of a triangle are 5, 7, and 9 inches. Determine whether this triangle is a right triangle.

Since the longest side is 9 inches, use 9 as c , the measure of the hypotenuse.

$$c^2 = a^2 + b^2$$

Pythagorean Theorem

$$9^2 \stackrel{?}{=} 5^2 + 7^2$$

Replace c with 9, a with 5, and b with 7.

$$81 \stackrel{?}{=} 25 + 49$$

Evaluate 9^2 , 5^2 , and 7^2 .

$$81 \neq 74$$

Simplify.

Since $c^2 \neq a^2 + b^2$, the triangle is *not* a right triangle.