

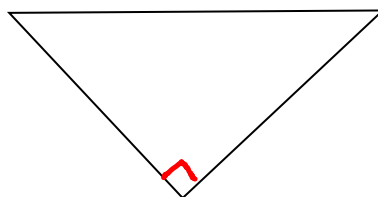
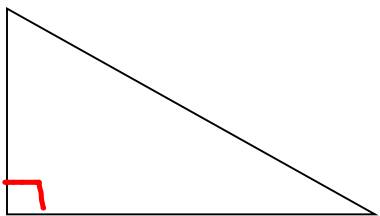
Pythagorean Theorem

I. Pythagorean Theorem

A. Identifying the Parts of a Right Triangle

- A **right triangle** is a triangle that contains a right angle.

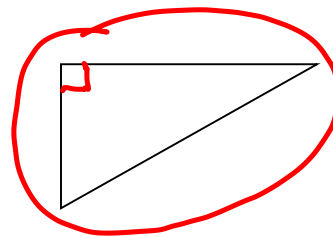
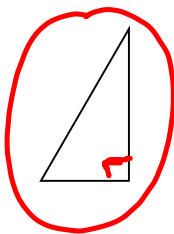
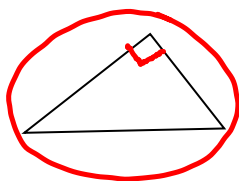
Here are two examples of right triangles:



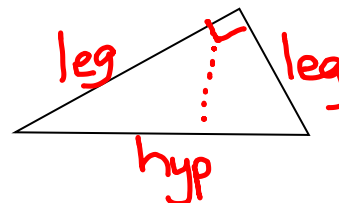
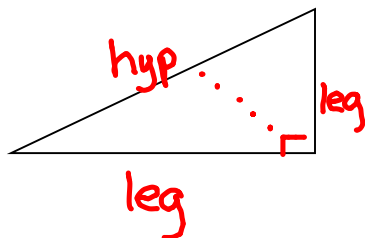
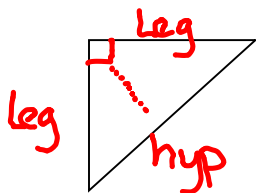
- The longest side of the right triangle is called the hypotenuse. It is **always** opposite the right angle.
- The two shortest sides of the triangle are called the legs.

Examples

Directions: Please circle the right triangles.

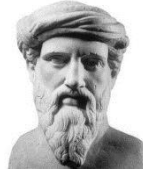


Directions: Please label the legs and hypotenuse of each right triangle.



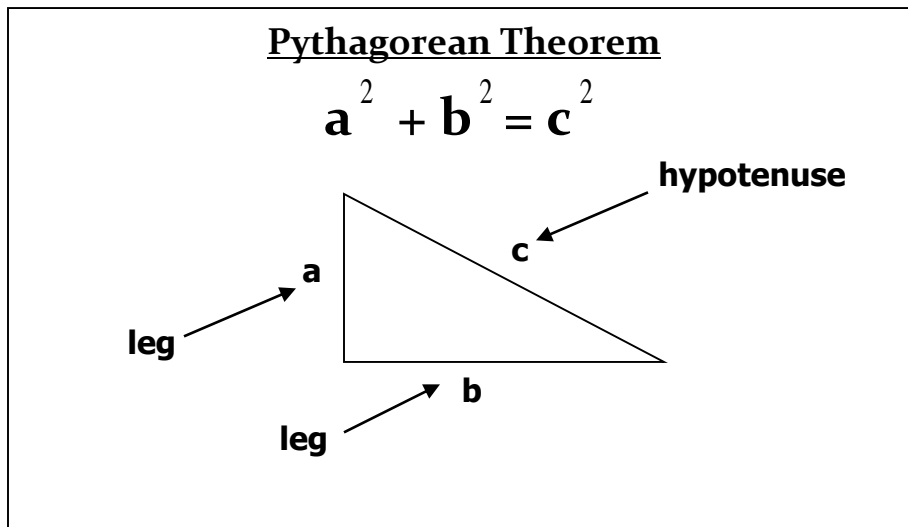
B. Introducing the Pythagorean Theorem

- A **theorem** is a mathematical statement that can be proven true using other statements that have already been proven true.



- The **Pythagorean Theorem** was discovered and proven by an ancient Greek philosopher named Pythagoras.
- The **Pythagorean Theorem** states that in any right triangle, the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.
- We generally use the Pythagorean Theorem to find a missing or unknown side of a right triangle.

* Remember: The Pythagorean Theorem works ONLY for right triangles !



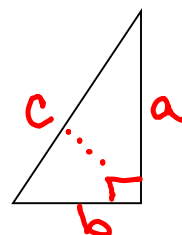
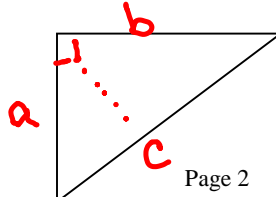
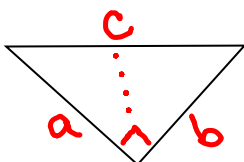
- In the Pythagorean Theorem:
 - a stands for a leg
 - b stands for a leg
 - c stands for the hypotenuse
- * Helpful Tip: When you are using the Pythagorean Theorem to find the missing side of a right triangle, make sure you first label each side of the triangle with the letters: a, b, and c.

Examples

Circle the statement that is true.

- ☒ a) The Pythagorean Theorem can be used to find the missing side of any triangle.
- ☒ b) The Pythagorean Theorem can be used to find the missing side of any polygon.
- ☒ c) The Pythagorean Theorem can be used to find the missing side of any right triangle.
- ☒ d) The Pythagorean Theorem can be used to find the missing side of any isosceles triangles.

Ex) On the right triangles below, please label the legs and hypotenuse of the triangle using the letters: a, b, and c.



Ex) Does it matter which leg you label **a** on a right triangle? Does it matter which leg you label **b** on a right triangle?

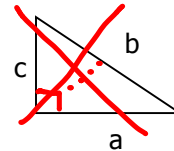
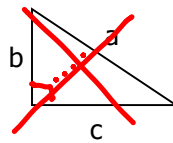
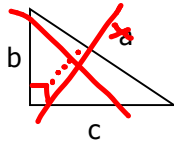
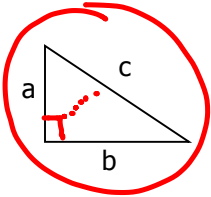
no

no

Ex) Does it matter which side you label **c** on a right triangle?

yes. "c" can only be used for the hypotenuse

Ex) Circle the right triangle with the correctly labeled sides.



C. Using the Pythagorean Theorem to Find the Hypotenuse

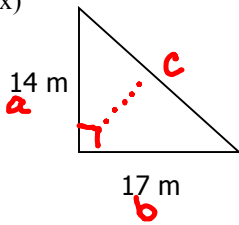
- Remember to follow the Order of Operations (PEMDAS) when you are trying to find the missing length of a right triangle!

You do exponents before you do adding or subtracting!

* square root is the inverse operation of exponent 2.

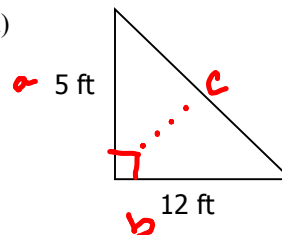
Directions: In each right triangle, find the missing length. Round to the nearest hundredth if necessary.

Ex)



$$\begin{aligned} a^2 + b^2 &= c^2 \\ 14^2 + 17^2 &= c^2 \\ 196 + 289 &= c^2 \\ \sqrt{485} &= c \\ \boxed{22.02 \text{ m} = c} \end{aligned}$$

Ex)



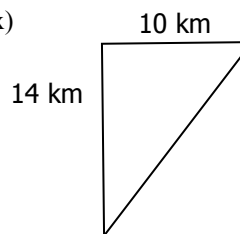
$$\begin{aligned} a^2 + b^2 &= c^2 \\ 5^2 + 12^2 &= c^2 \\ 25 + 144 &= c^2 \\ \sqrt{169} &= c \\ \boxed{13 \text{ ft.} = c} \end{aligned}$$

Ex)



$$\begin{aligned} a^2 + b^2 &= c^2 \\ 6^2 + 9^2 &= c^2 \\ 36 + 81 &= c^2 \\ \sqrt{117} &= c \\ \boxed{c = 10.82 \text{ cm}} \end{aligned}$$

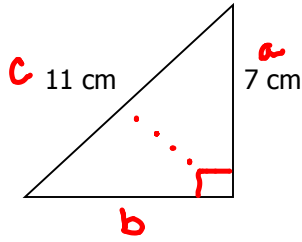
Ex)



D. Using the Pythagorean Theorem to Find A Missing Leg

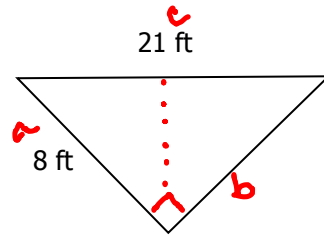
Directions: In each right triangle, find the missing length. Round to the nearest hundredth if necessary.

Ex)



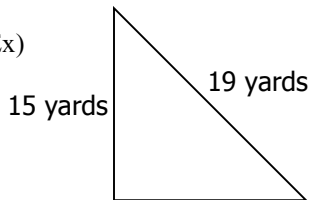
$$\begin{aligned} a^2 + b^2 &= c^2 \\ 7^2 + b^2 &= 11^2 \\ 49 + b^2 &= 121 \\ -49 & \\ b^2 &= 72 \\ b &= \sqrt{72} \\ b &= 8.49 \text{ cm} \end{aligned}$$

Ex)

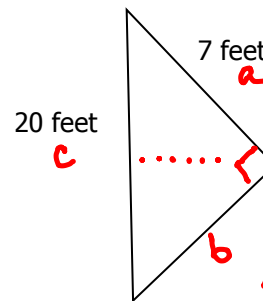


$$\begin{aligned} a^2 + b^2 &= c^2 \\ 8^2 + b^2 &= 21^2 \\ 64 + b^2 &= 441 \\ -64 & \\ b^2 &= 377 \\ b &= \sqrt{377} \\ b &= 19.42 \text{ ft} \end{aligned}$$

Ex)



Ex)



$$\begin{aligned} a^2 + b^2 &= c^2 \\ 7^2 + b^2 &= 20^2 \\ 49 + b^2 &= 400 \\ -49 & \\ b^2 &= 351 \\ b &= \sqrt{351} \\ b &= 18.73 \text{ ft} \end{aligned}$$

Directions: The lengths of a right triangle are given. Find the length of the missing side. Round to the nearest hundredths where necessary.

Ex) legs: 12 inches and 16 inches = c?

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 12^2 + 16^2 &= c^2 \\ 144 + 256 &= c^2 \\ 400 &= c^2 \\ \sqrt{400} &= \sqrt{c^2} \\ c &= 20 \text{ in} \end{aligned}$$

Ex) legs: 21 feet and 28 feet

Ex) leg: 48 miles; hypotenuse: 50 miles = b?

Ex) hypotenuse: 55 cm; leg: 33 cm

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 48^2 + b^2 &= 50^2 \\ 2304 + b^2 &= 2500 \\ -2304 & \\ b^2 &= 196 \\ b &= \sqrt{196} \\ b &= 14 \text{ mi} \end{aligned}$$

Directions: Can you form a right triangle with the three lengths given? Explain or show your work.

Ex) 5 ft, 6 ft, 10 ft

Ex) 5 cm, 12 cm, 13 cm

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 5^2 + 6^2 &= 10^2 \\ 25 + 36 &= 100 \\ 61 &\neq 100 \quad \text{No} \end{aligned}$$

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 5^2 + 12^2 &= 13^2 \\ 25 + 144 &= 169 \\ 169 &= 169 \quad \text{yes} \end{aligned}$$