

Pythagorean Relationship Applications

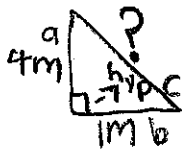
**Steps:** "I" know/want to know

- ① draw and label (hyp,  $a$ ,  $b$ ,  $A$ ,  $B$ )
- ② write out formula ( $a^2 + b^2 = c^2$ ,  $a^2 + c^2 = b^2$ )
- ③ plug in values and solve
- ④ ∴ Statment

**Example 1:**

A rope needs to be tied to a newly planted tree at the top so that it grows straight. If the new tree is 4m high and the rope is to be placed 1m from the base of the tree, what length of rope is needed?

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 4^2 + 1^2 &= c^2 \\ 16 + 1 &= c^2 \\ \sqrt{17} &= \sqrt{c^2} \\ 4.1 &= c \end{aligned}$$



∴ the length of rope needed is 4.1 meters

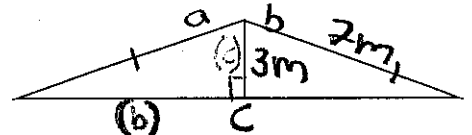
**Example 2:**

The roof of a house is an isosceles triangle that has a height of 3 m. The sloping sides measure 7 m from the peak to the eaves.

a) Find the width of the roof, to the nearest tenth of a metre.

$$\begin{aligned} c^2 - a^2 &= b^2 \\ 7^2 - 3^2 &= b^2 \\ 49 - 9 &= b^2 \\ \sqrt{40} &= \sqrt{b^2} \\ 6.3 &= b \end{aligned}$$

width of  
roof =  $b \times 2$   
 $6.3 \times 2$   
 $= 12.6$



∴ the width of the roof is 12.6 rounded to the nearest 10th

b) What is the area of the roof? (Hint: area of a triangle)

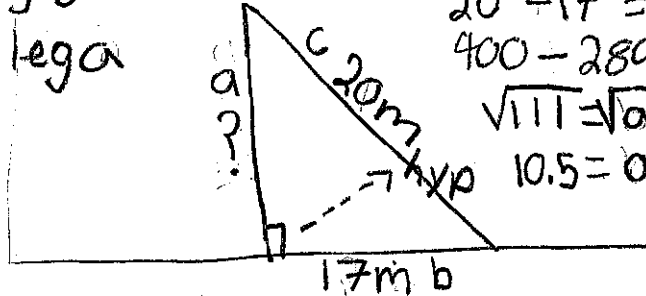
$$\begin{aligned} A &= \frac{b \times h}{2} \\ &= \frac{12.6 \times 3}{2} \\ &= \frac{38}{2} \\ &= 19 \text{ m}^2 \end{aligned}$$

∴ the area is  $76 \text{ m}^2$

**Example 3:**

Tony has got his kite stuck at the top of a very tall tree. He knows the string on his kite is 20 m long. When he pulls the string tight and holds the very end on the ground it touches 17 m from the bottom of the tree. If the ground is flat, how tall is the tree?

Know: the hyp  
and leg b  
want: leg a



$$c^2 - b^2 = a^2$$

$$20^2 - 17^2 = a^2$$

$$400 - 289 = a^2$$

$$\sqrt{111} = \sqrt{a^2}$$

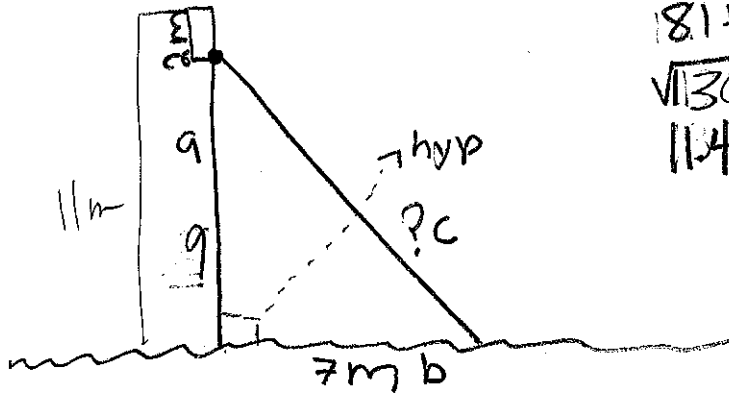
$$10.5 = a$$

∴ the height  
of the tree  
is 10.5 m long.

**Example 4:**

The guy wires holding up an 11m radio transmitter join 2m from the top of the aerial, and are anchored to the ground 7m from the base of the aerial. How long are the guy wires?

Know: the leg  
lengths (a, b)  
want: the hyp (c)



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

$$9^2 + 7^2 = c^2$$

$$81 + 49 = c^2$$

$$\sqrt{130} = \sqrt{c^2}$$

$$11.4 = c$$

∴ the guy  
wires is 11.4 m  
long (hyp)

**Work: Questions below, then page 71 # 9, 10, 11, 8, 13, 12**

- Susan is making a jump to ride her bike over. She uses a 1m plank of wood to make the jump, and raises the end 50 cm off the ground with a second piece of wood. How far along the ground from the end of the plank that touches the ground is the second piece of wood?
- Robert is using a 5m ladder to climb in his upstairs bedroom window. He finds that if he puts the base of the ladder 3.3m from the wall the top leans on the windowsill. How high from the ground is the windowsill?
- Tim is standing across a river from Mary. They discover that if they stand exactly opposite each other they can each hold one end of a 5m rope. How long would the rope have to be to reach if Tim moved 8m downstream?