In this activity you will use Pythagoras' Theorem to solve real-life problems.

Information sheet

There is a formula relating the three sides of a **right-angled** triangle.

It can be used to mark out right angles on sports pitches and buildings.

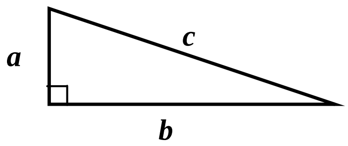
If the length of the hypotenuse of a right-angled triangle is c

and the lengths of the other sides are a and b:

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

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

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



To find the **hypotenuse**, ***add*** the squares of the other sides, then take the square root.

To find a **shorter side*, subtract*** the squares of the other sides, then take the square root.

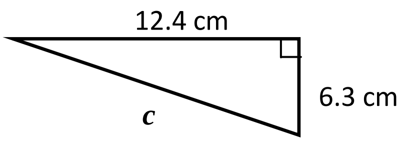
Think about …

How do you decide which sides to call a, b and c?

How do you decide whether to add or subtract?

Finding the length of the hypotenuse: example

Find c.



How to do it ….

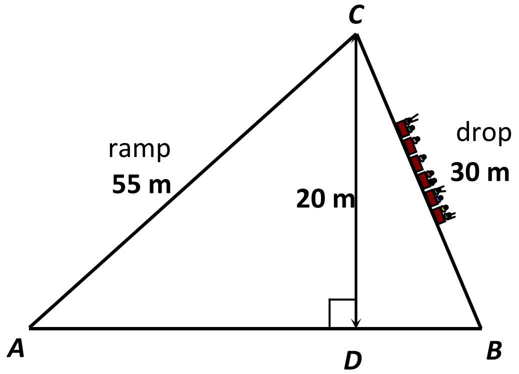
Using Pythagoras gives $c^2 = 6.3^2 + 12.4^2$

$c^2 = 39.69 + 153.76 = 193.45$

$c = \sqrt{193.45} = 13.9086\ldots$

$\boldsymbol{c}$ **= 13.9 cm (to 1 dp)**

Rollercoaster example



The sketch shows part of a rollercoaster ride between two points, *A* and *B* at the same horizontal level.

The highest point *C* is 20 metres above *AB*, the length of the ramp is 55 metres, and the length of the drop is 30 metres.

Find the horizontal distance between *A* and *B*.

How to do it ….

Using Pythagoras in triangle *ACD* gives

$AD^2 = 55^2 - 20^2$ (*AD* is one of the short sides of the triangle, so subtract)

$AD^2 = 3025 - 400 = 2625$

$AD = \sqrt{2625} = 51.23\ldots$ (it is useful to save this in a calculator's memory)

Using Pythagoras in triangle *BCD* gives

$DB^2 = 30^2 - 20^2$ (*BD* is one of the short sides of the triangle)

$DB^2 = 900 - 400 = 500$

$DB = \sqrt{500} = 22.36\ldots$

$AB = AD + DB = 51.23\ldots + 22.36\ldots = 73.59\ldots$

The horizontal distance between *A* and *B* is 74 metres (nearest metre)

Think about…

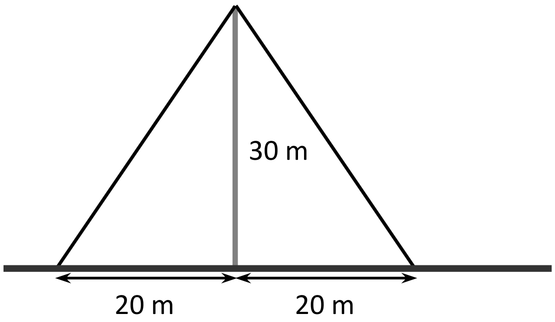
How do you decide whether to add or subtract?

Why might it be useful to draw your own diagram?

Try these

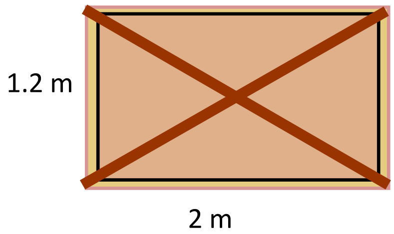
1 A mast is supported by two cables attached to the top, and to points on the ground 20 metres from its base. The height of the mast is 30 metres.

Calculate the length of each cable.



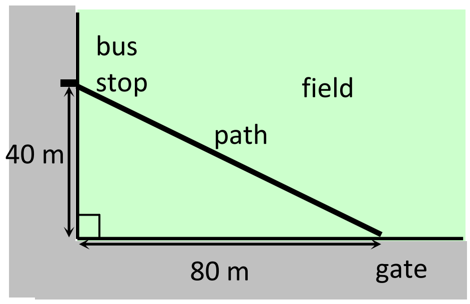
2 A gate is strengthened by fixing a strut along each of its diagonals. The gate is 2 metres long and 1.2 metres high.

Find the length of each strut.



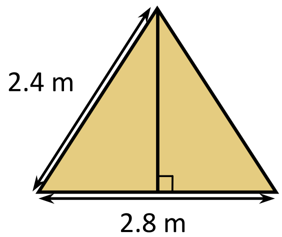
3 Ken takes a shortcut along the path from the gate to the bus stop.

Calculate how much further it would have been if he had walked around the edges of the field instead.



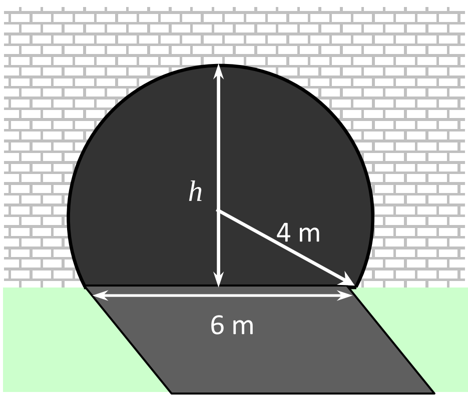
4 A tent is 2.8 metres wide. Its sloping sides are 2.4 metres long.

Calculate the height of the tent correct to 2 decimal places.



5 The cross-section of a road tunnel is part of a circle of radius 4 metres. The width of the tunnel at road level is 6 metres.

Calculate its height, h, correct to 2 decimal places.

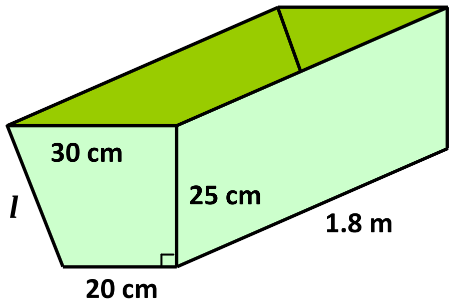


6 Each end of the window-box shown in the sketch is a trapezium. The other three sides are rectangles.

Calculate:

a the length of the edge l, giving your answer in cm.

b the total area of the five sides of the window box, giving your answer in square metres to 2 decimal places.



At the end of the activity

- When do you add and when do you subtract?
- Where there is more than one right-angled triangle, how do you decide which one to work on first?
- Why is it useful to draw your own diagram?
- In which questions did you have to do a calculation before you could use Pythagoras' Theorem?
- In which questions did you have to 'think backwards' to solve the problem?
- What do you have to do if there do not seem to be any right-angled triangles in the diagram?