

Lesson 1: Trigonometry in engineering and manufacturing

QA worksheet – Answers

Trigonometry

Various mathematical principles are used in engineering and manufacturing. One area that frequently arises is trigonometry.

Engineering and manufacturing use trigonometry for a variety of purposes.

A classic example would be calculating the amount of light falling on a surface. Here trigonometry is needed to find missing sides and angles.

Starter activity

Give **two** examples of where trigonometry is used in engineering or manufacturing.

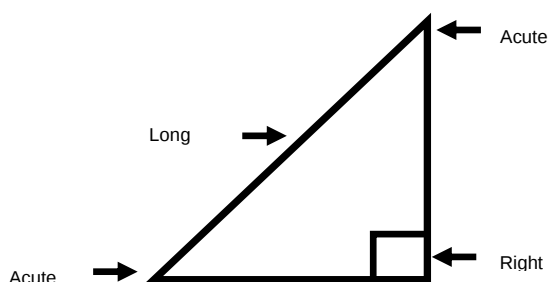
- i) Calculating the lengths of sides for trusses in a building
- ii) Calculating the angles for the sides of a venturi intake

Activity 1

Trigonometry facts

A right-angled triangle is one that has two short sides _____ and one long side _____.

A right-angled triangle has two acute angles ($< 90^\circ$) and one right angle ($= 90^\circ$).



Trigonometry facts

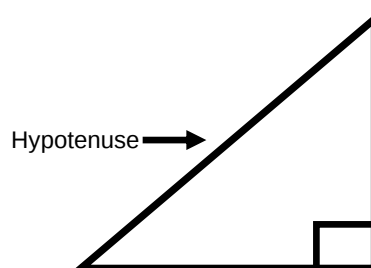
The sides of a right-angled triangle are called the following:

Opposite – this is the side that is opposite the angle in question.

Adjacent - this is the side that is next to the angle in question.

* Note the sides can swap over depending on which angle is in question.

Hypotenuse – just for fun, this comes from two Greek words meaning to stretch, hence the hypotenuse is the longest side.



Activity 2

Name the sides of a right-angled triangle. **Hypotenuse, opposite, adjacent**

What are the angles called? **Acute, right angle**

Which angles are less than 90° ? **acute**

Which angles are 90° ? **Right angle**

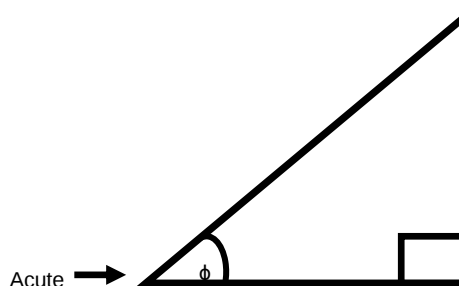
Trigonometry facts

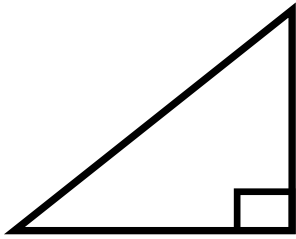
Working with our acute angle 1

There are two short sides:

one which is opposite our angle and

one which is adjacent (next to) our angle.





Acute angle 2

Trigonometry facts

Working with our acute angle 2

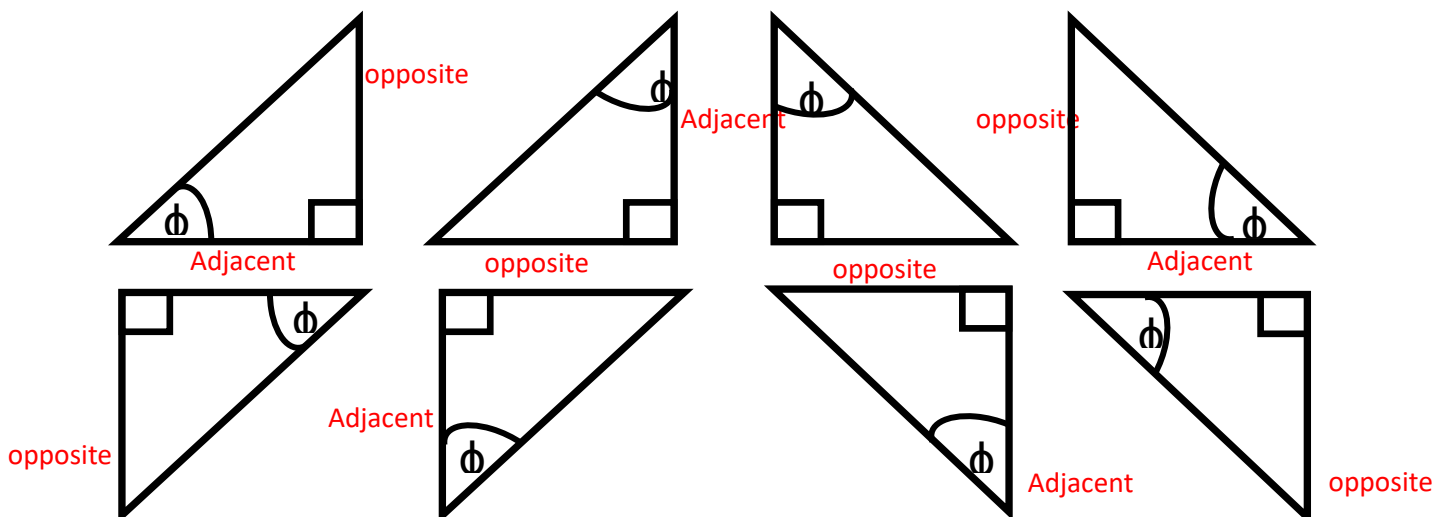
There are two short sides, one which is opposite our angle and one which is adjacent (next to) our angle.

I have shown this on the diagram.

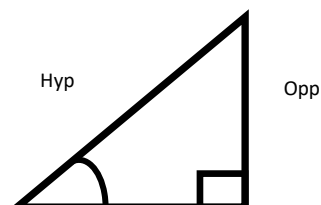
The amazing thing is that the hypotenuse is still the longest side.

Activity 3

For the triangles shown, identify the sides in relation to the acute angle given.

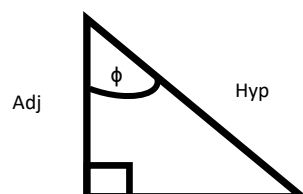


Example



$$\sin = \frac{\text{Opp}}{\text{Hyp}}$$

Hyp

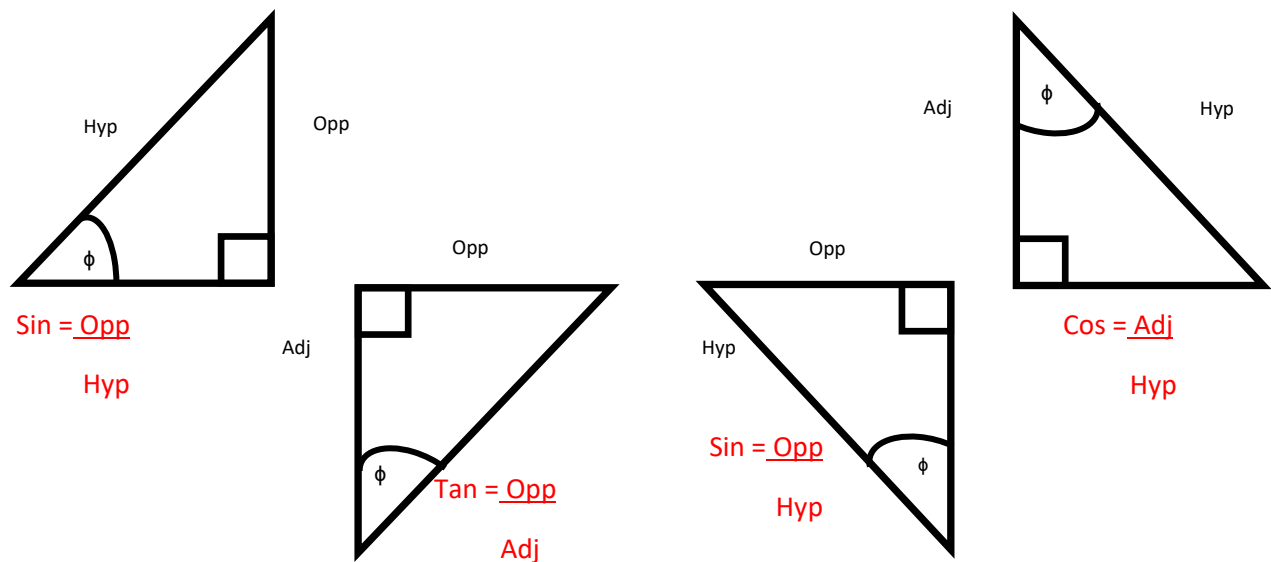


$$\cos = \frac{\text{Adj}}{\text{Hyp}}$$

Hyp

Activity 4

Show the correct formula (ratio) for the following:



Activity 5

Convert the following given decimals into angles and angles into decimal numbers.

- 0.75
- 0.45
- 0.25
- 0.19
- 0.90
- 45°
- 90°
- 0°
- 75°
- 19°

- 41.41°
- 63.26°
- 75.52°
- 79.04°
- 25.84°
- 0.707
- 0
- 1
- 0.26
- 0.95

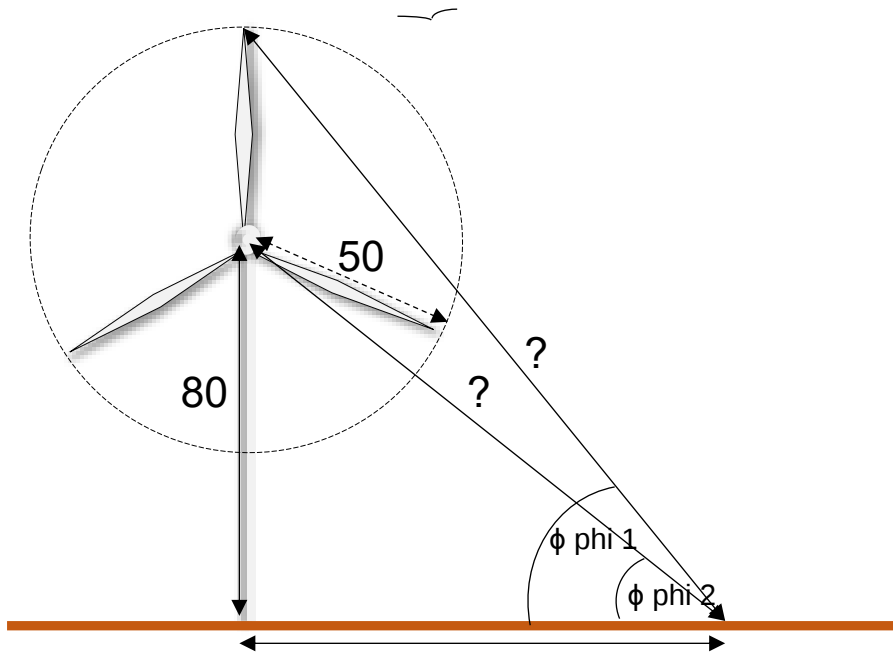
Activity: plenary

An engineer has been asked to carry out a service and to check the efficiency of a wind turbine. You have been asked to assist with some calculations.

The wind turbine stands 80m tall. The length of the blades is 50m.

From a position 100m from the base of the turbine:

- determine the angles to the top of the turbine and to the top of a blade when vertical
- calculate the length of the hypotenuse to the top of the turbine and to the top of a blade when vertical.



To the top of turbine

$$\tan \phi = \frac{\text{opp}}{\text{adj}} = 0.8 \quad \tan^{-1}(0.8) = 38.66$$

Hypotenuse = H

$$H^2 = 100^2 + 80^2 = 16400 \quad H = \sqrt{16400} = 128.06m$$

To the top of the blade when Vertical

$$\tan \phi = \frac{\text{opp}}{\text{adj}} = 1.3 \quad \tan^{-1}(1.3) = 52.43$$

Hypotenuse = H

$$H^2 = 100^2 + 130^2 = 26900 \quad H = \sqrt{26900} = 164.012m$$



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