UNIT 34 *Pythagoras' Theorem and Trigonometric Ratios* Introduction to SIM

Learning objectives

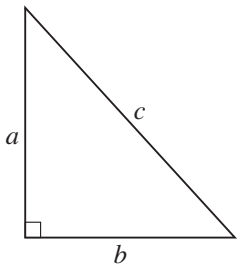
This is the first of five units on Trigonometry and related topics; Pythagoras' Theorem is an important topic with many applications in design, architecture, surveying, navigation, etc. After completing this unit of STUDENT INSTRUCTIONAL MATERIAL (SIM) you should

- understand and be able to use Pythagoras' Theorem in right angled triangles
- be able to apply Pythagoras' Theorem when finding the length of an unknown side in a right angled triangle
- understand how to calculate the trigonometric functions, sine, cosine and tangent, in a right angled triangle
- be able to find the length of a side in a right angled triangle, given one side and one angle.

Key points and principles

- *Pythagoras' Theorem* states that:

> In any right angled triangle, the area of the square on the hypotenuse (the side opposite the right angle) is equal to the sum of the areas of the squares on the other two sides (the two sides that meet at the right angle).



Note that a right angle is indicated by a small 'box' at an angle which is $90°$.

- In a right angled triangle, you can use Pythagoras Theorem,

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

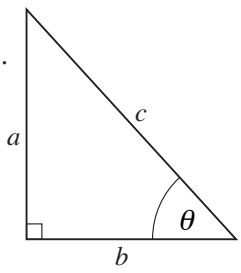
to find the length of c, the hypotenuse,

and

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

(or $b^2 = c^2 - a^2$)

to find the length of a (or b), given the lengths of b and c (or c and a).



- In a right angled triangle, the side opposite the marked angle is the *opposite* (opp), a in the diagram; the h*ypotenuse* (hyp) is the longest side, c, and the other side is the *adjacent* side (adj), b in the diagram.

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- In a right angled triangle, given an angle θ and the length of one side, you can use

$$\sin\theta = \frac{\text{opp}}{\text{hyp}} = \frac{a}{c}$$

$$\cos\theta = \frac{\text{adj}}{\text{hyp}} = \frac{b}{c}$$

or

$$\tan\theta = \frac{\text{opp}}{\text{adj}} = \frac{a}{b}$$

to find the lengths of the other two sides and to find angles, using the SHIFT button on a calculator
(opp : opposite; hyp : hypotenuse; adj : adjacent)

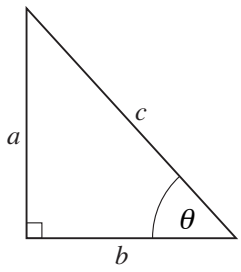
[Note that calculators should be in *degree mode* for trigonometric calculations.]

For example, (i) given c, $a = c\sin\theta$, $b = c\cos\theta$

(ii) given a, $c = \dfrac{a}{\sin\theta}$, $b = \dfrac{a}{\tan\theta}$, etc.

Facts to remember

- $a^2 + b^2 = c^2$ in a right angled triangle (Pythagoras' Theorem)



- in the right angled triangle shown, $\sin\theta = \dfrac{\text{opp}}{\text{hyp}} = \dfrac{a}{c}$

$$\cos\theta = \frac{\text{adj}}{\text{hyp}} = \frac{b}{c}$$

$$\tan\theta = \frac{\text{opp}}{\text{adj}} = \frac{a}{b}$$

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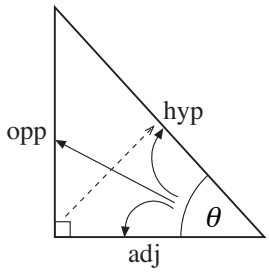
Glossary of terms

- opposite (opp), adjacent (adj) and hypotenuse (hyp) in right angled triangles defined for angle θ, as in the diagram

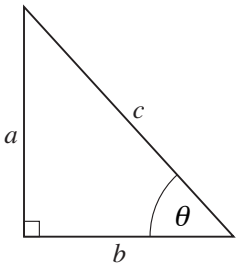


  Remember: the hypotenuse is always the side *opposite* the right angle, and is the longest side

- $\sin\theta = \frac{a}{c} \quad \left(= \frac{\text{opp}}{\text{hyp}}\right)$

  $\cos\theta = \frac{b}{c} \quad \left(= \frac{\text{adj}}{\text{hyp}}\right)$

  $\tan\theta = \frac{a}{b} \quad \left(= \frac{\text{opp}}{\text{adj}}\right)$



  in right angled triangles