

Pythagoras' Theorem & Trigonometry

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Right-angled triangle questions are about matching the information you have to the relationship that uses it. If the question gives only side lengths, Pythagoras is usually the tool. If the question involves an angle and sides, trigonometry is usually the tool.

CSEC often tests this topic in practical contexts such as ladders, heights, ramps, shadows, and distances. Before calculating, mark the hypotenuse, opposite side, and adjacent side on the diagram. That simple labelling step turns a word problem into a method you can explain.

In any right-angled triangle:

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

Where c is the hypotenuse (longest side, opposite the right angle) and a , b are the other sides.

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```

Finding the Hypotenuse

Example

Triangle with sides 3 and 4. Find hypotenuse:

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$$c^2 = 3^2 + 4^2 = 9 + 16 = 25$$

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$$c = 5$$

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Finding a Missing Side

Example

Right triangle with hypotenuse 13 and one side 5. Find other side:

$$5^2 + b^2 = 13^2$$

$$25 + b^2 = 169$$

$$b^2 = 144$$

$$b = 12$$

Application: Distance Formula

Distance between (x_1, y_1) and (x_2, y_2) :

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

This IS Pythagoras' theorem!

Part 8: Trigonometric Ratios

Right Triangle Basics

In a right triangle with acute angle θ :

- **Opposite:** Side opposite to angle θ
- **Adjacent:** Side next to angle θ (not hypotenuse)
- **Hypotenuse:** Longest side (opposite the right angle)

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The Three Ratios

$$\sin(\theta) = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos(\theta) = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan(\theta) = \frac{\text{opposite}}{\text{adjacent}}$$

Memory aid: SOH-CAH-TOA

- Sine = Opposite/Hypotenuse
- Cosine = Adjacent/Hypotenuse
- Tangent = Opposite/Adjacent

Finding Ratios from Angles

Use a calculator:


- $\sin(30^\circ) = 0.5$
- $\cos(30^\circ) = 0.866\dots$
- $\tan(30^\circ) = 0.577\dots$

- $\sin(45^\circ) = 0.707\dots$
- $\cos(45^\circ) = 0.707\dots$
- $\tan(45^\circ) = 1$

- $\sin(60^\circ) = 0.866\dots$
- $\cos(60^\circ) = 0.5$
- $\tan(60^\circ) = 1.732\dots$

Solving Right Triangles

To find unknown side:


 **Example**

Right triangle: hypotenuse = 10, angle = 35°. Find opposite side:

$$\sin(35^\circ) = \frac{\text{opposite}}{10}$$

$$\text{opposite} = 10 \times \sin(35^\circ) = 10 \times 0.574 = 5.74$$

To find unknown angle:

 **Example**

Right triangle: opposite = 7, hypotenuse = 10. Find angle:

$$\sin(\theta) = \frac{7}{10} = 0.7$$

$$\theta = \sin^{-1}(0.7) = 44.4^\circ$$