C6.2 Right-angled triangles

Name: _____ Class: _____ Date: _____ **Total: 20 marks**

KEY WORDS adjacent • triangle • right-angled triangle • opposite • hypotenuse

Objective

Use right-angled triangles to solve Core IGCSE Mathematics problems.

You must be able to:

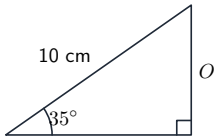
- Choose sine, cosine or tangent from the labelled sides
- Rearrange for a side or use an inverse trig function for an angle
- Interpret elevation and keep full intermediate precision

1 Key knowledge and worked examples

■ Key knowledge: Right-angled triangles

For an acute angle θ in a right triangle, $\sin\theta = O/H$, $\cos\theta = A/H$ and $\tan\theta = O/A$. Opposite and adjacent depend on the chosen angle; hypotenuse always faces the right angle. Choose the ratio containing the known and wanted sides, rearrange before substituting. Use inverse trig for an angle and degree mode. Bearings measure clockwise from north; draw the right triangle before calculating.

■ Worked example: Right-angled triangles



A right triangle has hypotenuse 10 cm and angle 35°.

- To find opposite, use $\sin\theta = O/H$, so $O = H\sin\theta = 10\sin 35° = 5.74$ cm to three significant figures.
- With $O = 6, A = 8$, use $\tan\theta = O/A$, so $\theta = \tan^{-1}(6/8) = 36.9°$ to one decimal place.
- Keep unrounded side values in later calculations.

■ Method check

Label opposite and adjacent relative to the angle you are using. A line of sight is the hypotenuse; a horizontal ground distance is the adjacent side.

2 Practice

2.1 Find the side opposite 30° in a right triangle with hypotenuse 12 cm. [2]

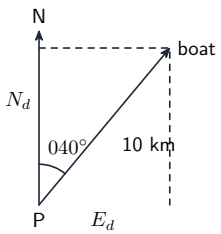
2.2 Find the adjacent side for angle 60° and hypotenuse 14 cm. [2]

2.3 Find an acute angle with opposite 5 cm and adjacent 12 cm, to one decimal place. [2]

2.4 A ramp rises 3 m over a horizontal run of 7 m. Find its angle to the horizontal. [2]

3 Exam-style questions

3.1 Apply the right-angled triangles methods below. Show working and include units where appropriate.

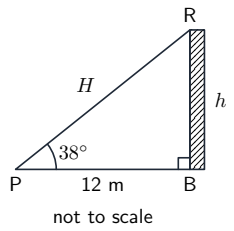


(a) A boat travels 10 km from P on bearing 040°. Find how far north of P it is, to three significant figures. [2]

(b) Find how far east of P it is, to three significant figures. [2]

(c) Find the bearing of P from the boat. [2]

3.2 A point P is 12 m horizontally from the foot B of a vertical building. The angle of elevation from P to the roof R is 38°.



(a) Find the building height to three significant figures. [3]

(b) Find the line-of-sight distance PR to three significant figures. Explain why using 12 sin 38° for the height is incorrect. [3]

Solutions

Award method and answer marks as indicated; accept equivalent correct methods.

2.1

- $O = H \sin\theta = 12 \sin 30^\circ = \mathbf{6}$ cm.

2.2

- $A = H \cos\theta = 14 \cos 60^\circ = \mathbf{7}$ cm.

2.3

- $\theta = \tan^{-1}(O/A) = \tan^{-1}(5/12) = \mathbf{22.6}^\circ$.

2.4

- $\theta = \tan^{-1}(3/7) = \mathbf{23.2}^\circ$ to one decimal place.

3.1

(a)

- Angle is from north, so north is adjacent: $N = 10 \cos 40^\circ = \mathbf{7.66}$ km.

(b)

- East is opposite: $E = 10 \sin 40^\circ = \mathbf{6.43}$ km.

(c)

- Reverse bearing: $b = 40 + 180 = \mathbf{220}^\circ$.

3.2

(a)

- Height is opposite and 12 m is adjacent, so $\tan\theta = h/d$.
- Rearrange $h = d \tan\theta$.
- $h = 12 \tan 38^\circ \approx \mathbf{9.38}$ m.

(b)

- Use $\cos\theta = d/H$, so $H = d/\cos\theta$.
- $H = 12/\cos 38^\circ \approx \mathbf{15.2}$ m.
- Sine requires the hypotenuse as its denominator; 12 m is adjacent, not hypotenuse.