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Trigonometry

Solutions & Answer Key

Full worked solutions, marking scheme & answer key

IGCSE Mathematics

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Prepared by

Nikolas Agisilaou

Companion to the *Student Worksheet*

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Note

About this booklet. These are the complete solutions to every question in the *Trigonometry — Student Worksheet*. Question numbers match exactly: labelling and ratio choice L1–L4, missing sides S1–S7, missing angles N1–N6, exact values X1–X6, elevation and depression E1–E6, bearings B1–B5, 2D shapes D1–D6, 3D problems T1–T5, choosing the right tool C1–C3, the Mixed Review MR1–MR10, and the examination questions Q1–Q8 of Part III.
Each solution labels O, A and H, names the ratio, and shows the rearrangement before the calculator work. Part V collects the common mistakes to watch for, and Part VI is a quick answer key for fast marking.
A note on rounding. All working keeps full calculator accuracy and rounds only at the final step. Where an intermediate value is quoted (for example $\tan 62° = 1.8807\ldots$) the dots indicate that the unrounded value stayed in the calculator. A student who rounds an intermediate value may be one or two units out in the last digit — allow this, provided the method is correct.

4 Part IV — Complete Solutions

Note

Each solution names the ratio being applied and shows the steps in order, exactly as the notes recommend. Depth is scaled to difficulty — brief for basic questions, fuller for the harder ones.

4.1 Solutions — Labelling Sides and Choosing a Ratio

Solution L1

The right angle is at B, so the side opposite it is AC.

$$\boxed{\text{Hypotenuse} = AC, \quad \text{Opposite} = BC, \quad \text{Adjacent} = AB}$$

BC faces the angle at A, and AB runs alongside it without being the hypotenuse.

Solution L2

Working from angle C instead:

$$\boxed{\text{Hypotenuse} = AC, \quad \text{Opposite} = AB, \quad \text{Adjacent} = BC}$$

The Opposite and Adjacent have swapped over, but $\boxed{\text{the Hypotenuse is unchanged}}$

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— it is fixed by the right angle, not by which acute angle you choose.

Solution L3

The right angle is at Q, so PR is the hypotenuse. Relative to angle P:

$$\boxed{\text{Opposite} = QR = 12 \text{ cm}, \quad \text{Adjacent} = PQ = 9 \text{ cm}, \quad \text{Hypotenuse} = PR = 15 \text{ cm}}$$

(These sides form the 3, 4, 5 triple multiplied by 3.)

Solution L4

(a) O and H $\Rightarrow$ $\boxed{\text{sine}}$, no inverse needed.
(b) O and A $\Rightarrow$ $\boxed{\text{tangent}}$, no inverse needed.
(c) O and A, but the *angle* is unknown $\Rightarrow$ $\boxed{\tan^{-1}}$ — an inverse is needed.
(d) A and H $\Rightarrow$ $\boxed{\text{cosine}}$, no inverse needed (the unknown is on the bottom, so this one ends in a division).

4.2 Solutions — Finding Missing Sides

Solution S1

Relative to 34°: the 11 cm side is the Hypotenuse and the unknown is the Opposite, so use **SOH**.

$$\sin 34^\circ = \frac{x}{11}$$

$$x = 11 \times \sin 34^\circ = 11 \times 0.5591\ldots = 6.151\ldots$$

$$\boxed{x = 6.15 \text{ cm (3 s.f.)}}$$

Solution S2

Hypotenuse known, Adjacent wanted $\Rightarrow$ **CAH**.

$$\cos 27^\circ = \frac{x}{14.5}$$

$$x = 14.5 \times \cos 27^\circ = 14.5 \times 0.8910\ldots = 12.91\ldots$$

$$\boxed{x = 12.9 \text{ cm (3 s.f.)}}$$

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Solution S3

Adjacent known, Opposite wanted ⇒ **TOA**.

$$\tan 62^\circ = \frac{x}{6.8}$$

$$x = 6.8 \times \tan 62^\circ = 6.8 \times 1.8807\ldots = 12.78\ldots$$

$$\boxed{x = 12.8 \text{ cm (3 s.f.)}}$$

Sense check: 62° is more than 45°, so the opposite side should be longer than the adjacent one. ✓

Solution S4

Opposite known, Hypotenuse wanted ⇒ **SOH**. This time the unknown is on the *bottom*:

$$\sin 39^\circ = \frac{9.6}{h}$$

$$h = \frac{9.6}{\sin 39^\circ} = \frac{9.6}{0.6293\ldots} = 15.25\ldots$$

$$\boxed{h = 15.3 \text{ cm (3 s.f.)}}$$

Sense check: the hypotenuse is the longest side, so it must exceed 9.6 cm. ✓

Solution S5

Adjacent known, Hypotenuse wanted ⇒ **CAH**, with the unknown on the bottom:

$$\cos 71^\circ = \frac{5.4}{h}$$

$$h = \frac{5.4}{\cos 71^\circ} = \frac{5.4}{0.3255\ldots} = 16.58\ldots$$

$$\boxed{h = 16.6 \text{ cm (3 s.f.)}}$$

Solution S6

Opposite known, Adjacent wanted ⇒ **TOA**, with the unknown on the bottom:

$$\tan 24^\circ = \frac{7.5}{x}$$

$$x = \frac{7.5}{\tan 24^\circ} = \frac{7.5}{0.4452\ldots} = 16.84\ldots$$

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$$\boxed{x = 16.8 \text{ cm (3 s.f.)}}$$

Solution S7

The right angle is at Q, so $PR = 18.2\,\text{cm}$ is the hypotenuse.
(a) PQ is Adjacent to angle $P \Rightarrow$ **CAH**:

$$PQ = 18.2 \times \cos 47^\circ = 18.2 \times 0.6819\ldots = 12.41\ldots$$

$$\boxed{PQ = 12.4 \text{ cm (3 s.f.)}}$$

(b) QR is Opposite angle $P \Rightarrow$ **SOH**:

$$QR = 18.2 \times \sin 47^\circ = 18.2 \times 0.7313\ldots = 13.31\ldots$$

$$\boxed{QR = 13.3 \text{ cm (3 s.f.)}}$$

(c) Check with Pythagoras, using the unrounded values:

$$12.412\ldots^2 + 13.310\ldots^2 = 154.06\ldots + 177.17\ldots = 331.24 = 18.2^2 \checkmark$$

Common Mistake

Decide *before* calculating whether the unknown sits on the top or the bottom of the fraction. Top $\Rightarrow$ multiply; bottom $\Rightarrow$ divide.

4.3 Solutions — Finding Missing Angles

Solution N1

O and H are known $\Rightarrow$ **SOH**, then apply the inverse:

$$\sin\theta = \frac{7}{12} = 0.5833\ldots$$

$$\theta = \sin^{-1}(0.5833\ldots) = 35.68\ldots$$

$$\boxed{\theta = 35.7^\circ \text{ (1 d.p.)}}$$

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