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GCSE MATHEMATICS • GEOMETRY

Trigonometry

Worked Solutions

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator allowed

Full worked solutions for the free Trigonometry worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Trigonometry worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

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A**Your turn answers**

Compare each line of your working with the solution. Answers are to 1 decimal place unless they are exact.

FOUNDATION

A1 x is adjacent to 50° ; 12 is the hypotenuse: use cos. $x = 12 \cos 50^\circ = 7.713\dots$ **$x = 7.7$**

A2 9 is adjacent to 28° ; x is the hypotenuse. $x = \frac{9}{\cos 28^\circ} = 10.193\dots$ **$x = 10.2$**

A3 Opposite 6, hypotenuse 11: $\sin x = \frac{6}{11}$ $x = \sin^{-1}\left(\frac{6}{11}\right) = 33.05\dots$ **$x = 33.1$**

HIGHER

A4 $\frac{x}{\sin 52^\circ} = \frac{12}{\sin 71^\circ}$ $x = \frac{12 \sin 52^\circ}{\sin 71^\circ} = 10.001\dots$ **$x = 10.0$**

A5 $x^2 = 6^2 + 10^2 - 2 \times 6 \times 10 \times \cos 110^\circ = 177.04\dots$ $x = 13.305\dots$ **$x = 13.3$**

A6 The largest angle is opposite 11 cm: $\cos \theta = \frac{6^2 + 8^2 - 11^2}{2 \times 6 \times 8} = -0.21875$ **102.6°**

A7 $\frac{1}{2} \times 9 \times 14 \times \sin 125^\circ = 51.60\dots$ **51.6** cm²

B**Fluency solutions**

One mark for each correct part. The notes in *italics* explain why each sequence was chosen.

FOUNDATION

B1 (a) $15 \sin 42^\circ = 10.03\dots$: **10.0** (b) $15 \cos 42^\circ = 11.14\dots$: **11.1** (c) $8 \tan 55^\circ = 11.42\dots$: **11.4**
 (d) $\frac{6}{\tan 30^\circ} = 10.39\dots$: **10.4**

Label the sides opposite, adjacent and hypotenuse first, then choose the ratio.



B2 (a) $\frac{5}{\sin 25^\circ} = 11.83 \dots$: **11.8** (b) $\frac{12}{\cos 60^\circ} =$ **24** (c) $\frac{9}{\tan 70^\circ} = 3.27 \dots$: **3.3** (d) $\frac{4.5}{\cos 38^\circ} = 5.71 \dots$: **5.7**

When x is on the bottom of the ratio, divide.

B3 (a) $\tan^{-1} \frac{4}{7}$: **29.7°** (b) $\sin^{-1} \frac{4}{7}$: **34.8°** (c) $\cos^{-1} \frac{4}{7}$: **55.2°** (d) $\tan^{-1} \frac{7}{4}$: **60.3°**

B4 (a) **$\frac{1}{2}$** (b) **$\frac{\sqrt{2}}{2}$** (c) **$\sqrt{3}$** (d) $10 \sin 30^\circ = 10 \times \frac{1}{2} =$ **5** cm

B5 (a) $\tan^{-1} \frac{12}{20} = 30.96 \dots$: **31.0°** (b) $\frac{50}{\tan 24^\circ} = 112.30 \dots$: **112.3** m (c) $30 \sin 55^\circ = 24.57 \dots$: **24.6** m

B6 Half the base is 7 cm. (a) $\cos^{-1} \frac{7}{9} = 38.94 \dots$: **38.9°** (b) $180 - 2 \times 38.94 \dots = 102.11 \dots$: **102.1°**
(c) $\sqrt{9^2 - 7^2} = \sqrt{32} = 5.656 \dots$: **5.7** cm (d) $7 \times 5.656 \dots = 39.59 \dots$: **39.6** cm²

HIGHER

B7 (a) $\frac{6 \sin 70^\circ}{\sin 35^\circ} = 9.83 \dots$: **9.8** (b) $\frac{10 \sin 62^\circ}{\sin 48^\circ} = 11.88 \dots$: **11.9**
(c) $\sin B = \frac{12 \sin 40^\circ}{9} = 0.857 \dots$: **59.0°** (d) $\sin C = \frac{11 \sin 100^\circ}{15} = 0.722 \dots$: **46.2°**

B8 (a) $25 + 64 - 80 \times \frac{1}{2} = 49$: **7** (b) $244 - 240 \cos 35^\circ = 47.40 \dots$: **6.9**
(c) $\cos C = \frac{49 + 64 - 169}{112} = -\frac{1}{2}$: **120°** (d) opposite 4: $\cos A = \frac{36 + 49 - 16}{84} = 0.821 \dots$: **34.8°**

B9 (a) $\frac{1}{2} \times 7 \times 9 \times \sin 50^\circ = 24.13 \dots$: **24.1** cm² (b) $\frac{1}{2} \times 10 \times x \times \frac{1}{2} = 40$: **$x = 16$**
(c) $\frac{1}{2} \times 8 \times 6 \times \sin C = 20$, $\sin C = \frac{5}{6}$: **56.4°** (d) $\frac{1}{2} \times 6 \times 6 \times \frac{\sqrt{3}}{2} =$ **$9\sqrt{3}$** cm²

B10 (a) $\sqrt{8^2 + 6^2} =$ **10** cm (b) $\sqrt{10^2 + 5^2} = 11.18 \dots$: **11.2** cm
(c) $\tan^{-1} \frac{5}{10} = 26.56 \dots$: **26.6°** (d) $\cos^{-1} \frac{8}{11.18 \dots} = 44.28 \dots$: **44.3°**



C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

C1 8 cm is the adjacent side, not the hypotenuse, so Tom should use $\tan$: $x = 8 \tan 40^\circ = 6.71 \dots$ **6.7** cm

C2 The calculator is set to radians, not degrees. In degree mode, $\sin 30^\circ = 0.5$

C3 $\sin x = \frac{\text{opposite}}{\text{hypotenuse}}$, and the hypotenuse is the longest side, so the fraction is always less than 1

C4 Take equal shorter sides of 1: the angles are 45° and the hypotenuse is $\sqrt{2}$ $\tan 45^\circ = \frac{1}{1} = 1$ $\sin 45^\circ = \frac{1}{\sqrt{2}}$

HIGHER

C5 Only the $2bc$ term is multiplied by $\cos A$: $a^2 = 25 + 36 - 60 \cos 70^\circ = 40.47 \dots$ $a = 6.36 \dots$ **6.4** cm

C6 The sine rule needs an angle and its opposite side. With only three sides, start with the cosine rule to find an angle.

C7 Each angle is 60° : $\text{area} = \frac{1}{2} \times a \times a \times \sin 60^\circ = \frac{1}{2} a^2 \times \frac{\sqrt{3}}{2} = \frac{\sqrt{3}}{4} a^2$

C8 (a) $\sin C = \frac{10 \sin 35^\circ}{7} = 0.819 \dots$ $C = 55.0^\circ$, or $C = 180^\circ - 55.0^\circ$ **55.0°** and **125.0°**

Both work, because $35^\circ + 125.0^\circ < 180^\circ$

(b) $\sin C = \sin(180^\circ - C)$, so an acute and an obtuse angle have the same sine.



D**Problem solving solutions**

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

D1 $\tan^{-1} \frac{0.5}{5.5} = 5.19 \dots^\circ$ 5.2° , more than 5° , so the ramp is not allowed

D2 Each end sticks out $(14 - 8) \div 2 = 3$ cm. Height = $3 \tan 50^\circ = 3.575 \dots$ cm
 Area = $\frac{1}{2}(8 + 14) \times 3.575 \dots = 39.32 \dots$ 39.3 cm²

D3 $3000 \sin 12^\circ = 623.7 \dots$ 624 m

D4 Adjacent to 60° : $8 \cos 60^\circ = 8 \times \frac{1}{2} =$ 4 cm Opposite: $8 \sin 60^\circ = 8 \times \frac{\sqrt{3}}{2} =$ $4\sqrt{3}$ cm

HIGHER

D5 The angle between the two legs is $180^\circ - (130^\circ - 50^\circ) = 100^\circ$
 $d^2 = 12^2 + 8^2 - 2 \times 12 \times 8 \times \cos 100^\circ = 241.34 \dots$ $d = 15.53 \dots$ 15.5 km

D6 Angle $C = 70^\circ$. $BC = \frac{10 \sin 50^\circ}{\sin 70^\circ} = 8.15 \dots$ Area = $\frac{1}{2} \times 10 \times 8.15 \dots \times \sin 60^\circ = 35.30 \dots$ 35.3 cm²

D7 AM is half the base diagonal: $\frac{1}{2} \sqrt{6^2 + 6^2} = 3\sqrt{2} = 4.24 \dots$ $\tan^{-1} \frac{8}{4.24 \dots} = 62.06 \dots$ 62.1°

D8 (a) $7^2 = x^2 + (x+3)^2 - 2x(x+3) \cos 60^\circ$ $49 = 2x^2 + 6x + 9 - x^2 - 3x$ $x^2 + 3x - 40 = 0$ as required
 (b) $(x+8)(x-5) = 0$, so $x = 5$ Area = $\frac{1}{2} \times 5 \times 8 \times \sin 60^\circ =$ $10\sqrt{3}$ cm²



E

Exam practice solutions

Marks are shown on the right of each line.

FOUNDATION

Foundation and Higher crossover

$$\begin{aligned} \text{E1} \quad x &= 14 \cos 32^\circ & M1 \\ &= 11.87 \dots & A1 \end{aligned}$$

11.9

$$\begin{aligned} \text{E2} \quad \sin x &= \frac{6.5}{9} & M1 \\ x &= \sin^{-1}(0.722 \dots) & M1 \\ &= 46.23 \dots & A1 \end{aligned}$$

46.2

$$\begin{aligned} \text{E3} \quad \sin 58^\circ &= \frac{4.8}{x} & M1 \\ x &= \frac{4.8}{\sin 58^\circ} & M1 \\ &= 5.66 \dots & A1 \end{aligned}$$

5.7

$$\begin{aligned} \text{E4} \quad (\text{a}) & \quad \mathbf{1} & B1 \\ (\text{b}) & \quad \frac{\sqrt{3}}{2} & B1 \end{aligned}$$

$$\begin{aligned} \text{E5} \quad \tan 28^\circ &= \frac{h}{25} & M1 \\ h &= 25 \tan 28^\circ & M1 \\ &= 13.29 \dots & A1 \end{aligned}$$

13.3 m

$$\begin{aligned} \text{E6} \quad \tan 30^\circ &= \frac{1}{\sqrt{3}} \text{ and } \tan 60^\circ = \sqrt{3} & B1 \\ \frac{1}{\sqrt{3}} \times \sqrt{3} &= 1 & B1 \end{aligned}$$

HIGHER

$$\begin{aligned} \text{E7} \quad \frac{x}{\sin 45^\circ} &= \frac{9.5}{\sin 72^\circ} & M1 \\ x &= \frac{9.5 \sin 45^\circ}{\sin 72^\circ} & M1 \\ &= 7.06 \dots & A1 \end{aligned}$$

7.1

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E8 $\cos x = \frac{8^2 + 10^2 - 13^2}{2 \times 8 \times 10}$ M1
 $= -0.03125$ M1
 $x = 91.79 \dots$ 91.8 A1

E9 (a) $\frac{1}{2} \times 9 \times 11 \times \sin 48^\circ$ M1
 $= 36.78 \dots$ 36.8 cm^2 A1
(b) $BC^2 = 9^2 + 11^2 - 2 \times 9 \times 11 \times \cos 48^\circ$ M1
 $= 69.51 \dots$, so $BC = 8.33 \dots$ 8.3 cm A1

E10 $AC^2 = 8^2 + 11^2 - 2 \times 8 \times 11 \times \cos 105^\circ$ M1
 $= 230.55 \dots$, so $AC = 15.18 \dots$ A1
 $AD^2 = 15.18 \dots^2 + 9^2 - 2 \times 15.18 \dots \times 9 \times \cos 40^\circ$ M1
 $= 102.18 \dots$ M1
 $AD = 10.10 \dots$ 10.1 cm A1

