

Trigonometry

Foundation and Higher tiers | Total marks: 84

Marks

- M** Method mark, for a correct method. It can be implied by a correct answer.
- A** Accuracy mark, for a correct answer. It needs the method mark before it.
- B** A mark for a correct value or statement, with or without working.
- ft** Follow through: the mark is given for using an earlier wrong answer correctly.
- oe** Or equivalent.
- [a, b]** Any value from a to b inclusive.

Questions

Q	Skill	Spec	Tier	Grade	Calculator	Marks
1	Choose the trigonometric ratio	G20	Common	4	No	1
2	Exact values of sin, cos and tan	G21	Common	5	No	3
3	Exact values in a two-step problem	G21 N8	Higher	7	No	4
4	Cosine rule with an exact value	G22 G21 N8	Higher	8	No	3
5	Cosine rule with algebra and exact values	G22 G21 G23 A18	Higher	9	No	6
6	Area when only the cosine is known, then a perpendicular	G23 G22 G20 N8	Higher	9	No	6
7	Find a side, given the hypotenuse	G20	Common	5	Yes	2
8	Find an angle, given two sides	G20	Common	5	Yes	3
9	Find the hypotenuse	G20	Common	5	Yes	3
10	Angle in context, with a decision	G20	Common	5	Yes	3
11	Isosceles triangle, split into two	G20	Common	6	Yes	3
12	Two right-angled triangles	G20	Common	6	Yes	4
13	Trigonometry with the area of a trapezium	G20 G16	Common	6	Yes	4
14	Sine rule, finding a side	G22	Higher	7	Yes	3
15	Area of a triangle, finding an angle	G23	Higher	7	Yes	3
16	Cosine rule, finding an angle	G22	Higher	7	Yes	3

Q	Skill	Spec	Tier	Grade	Calculator	Marks
17	Cosine rule: choosing the angle	G22 G3	Higher	7	Yes	3
18	Angle between a line and a plane in 3D	G20	Higher	8	Yes	4
19	Bearings with the cosine rule	G22 G15	Higher	8	Yes	4
20	Area of a segment, in reverse	G23 G18	Higher	8	Yes	4
21	Area of a quadrilateral with the cosine rule	G22 G23	Higher	9	Yes	5
22	Angle of elevation in 3D with the sine rule	G20 G22	Higher	9	Yes	5
23	Angles of elevation in 3D, forming an equation	G20	Higher	9	Yes	5
	Total					84

Question 1 G20 · Common · Grade 4 · 1 mark

Q	Answer	Mark	Comments
1	$\tan x = \frac{5}{12}$	B1	

Question 2 G21 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
2(a)	1	B1	
2(b)	$\sin 30 = \frac{x}{18}$ or $18 \times \sin 30$ or $18 \times \frac{1}{2}$	M1	oe
	9	A1	

Question 3 G21 N8 · Higher · Grade 7 · 4 marks

Q	Answer	Mark	Comments
3	$BD = 16 \times \sin 30$ or $16 \times \frac{1}{2}$ or $BD = 8$	M1	oe
	$AD = 16 \times \cos 30$ or $16 \times \frac{\sqrt{3}}{2}$ or $AD = 8\sqrt{3}$	M1	oe
	$CD = 8$	M1	$\tan 45 = 1$, or triangle BCD is isosceles. ft their BD
	$8 + 8\sqrt{3}$	A1	

Question 4 G22 G21 N8 · Higher · Grade 8 · 3 marks

Q	Answer	Mark	Comments
4	$6^2 + 10^2 - 2 \times 6 \times 10 \times \cos 60$	M1	oe
	uses $\cos 60 = \frac{1}{2}$ to get $QR^2 = 76$	M1	oe, $136 - 60$
	$\sqrt{76} = \sqrt{4 \times 19} = 2\sqrt{19}$	A1	a full method with no errors

Question 5 G22 G21 G23 A18 · Higher · Grade 9 · 6 marks

Q	Answer	Mark	Comments
5(a)	$(x+4)^2 = (x-1)^2 + (2x-3)^2 - 2(x-1)(2x-3) \cos 60$	M1	oe
	uses $\cos 60 = \frac{1}{2}$ and expands: $x^2 + 8x + 16 = 5x^2 - 14x + 10 - (2x^2 - 5x + 3)$	M1	oe, at least three of the four brackets expanded correctly
	$x^2 + 8x + 16 = 3x^2 - 9x + 7$ leading to $2x^2 - 17x - 9 = 0$	A1	with no errors
5(b)	$(2x+1)(x-9) = 0$ or $x = 9$	M1	oe, rejects $x = -\frac{1}{2}$
	$\frac{1}{2} \times 8 \times 15 \times \sin 60$ or $\frac{1}{2} \times 8 \times 15 \times \frac{\sqrt{3}}{2}$	M1	oe, ft their positive x
	$30\sqrt{3}$	A1	

Question 6 G23 G22 G20 N8 · Higher · Grade 9 · 6 marks

Q	Answer	Mark	Comments
6(a)	$\sin PQR = \frac{\sqrt{8}}{3}$ or $\frac{2\sqrt{2}}{3}$	M1	oe, e.g. from a right-angled triangle with adjacent 1 and hypotenuse 3, the opposite side $\sqrt{(3^2 - 1^2)}$
	$\frac{1}{2} \times 6 \times 9 \times \text{their } \frac{2\sqrt{2}}{3}$	M1	oe
	$18\sqrt{2}$	A1	
6(b)	$PR^2 = 6^2 + 9^2 - 2 \times 6 \times 9 \times \frac{1}{3}$	M1	oe, $PR^2 = 81$
	$\frac{1}{2} \times \text{their } 9 \times h = \text{their } 18\sqrt{2}$	M1	oe, or $2 \times \text{their area} \div \text{their PR}$
	$4\sqrt{2}$	A1	accept $\sqrt{32}$

Question 7 G20 · Common · Grade 5 · 2 marks

Q	Answer	Mark	Comments
7	$\sin 38 = \frac{BC}{12.6}$ or $12.6 \times \sin 38$	M1	oe
	7.8	A1	accept 7.8 or [7.75, 7.76]

Question 8 G20 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
8	$\tan x = \frac{7.5}{11}$	M1	oe
	$\tan^{-1}(\frac{7.5}{11})$	M1	oe, or 34.28...
	34.3	A1	accept 34.3 or [34.28, 34.29]

Question 9 G20 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
9	$\cos 41 = \frac{6.8}{y}$	M1	oe
	$6.8 \div \cos 41$	M1	oe
	9.0	A1	accept 9.0 or [9.01, 9.02]

Question 10 G20 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
10	$\tan x = \frac{9.6}{31}$	M1	oe, or finds the wire length $\sqrt{(9.6^2 + 31^2)}$ and uses sin or cos
	$\tan^{-1}(\frac{9.6}{31})$	M1	oe. Alternative: $31 \times \tan 15 = 8.31$ (M2)
	No and 17.2	A1	accept 17.2 or [17.20, 17.21]. Alternative: No as $9.6 > 8.3$

Question 11 G20 · Common · Grade 6 · 3 marks

Q	Answer	Mark	Comments
11	$\cos x = \frac{6}{9.5}$	M1	oe. Uses half of 12 in a right-angled triangle
	$\cos^{-1}(\frac{6}{9.5})$	M1	oe
	50.8	A1	accept 50.8 or [50.83, 50.84]

Question 12 G20 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
12	$BD = 14 \times \sin 35$	M1	oe, $BD = 8.03...$
	$\tan 52 = \frac{BD}{CD}$	M1	oe, ft their BD
	their $BD \div \tan 52$	M1	oe
	6.3	A1	accept 6.3 or [6.27, 6.28]

Question 13 G20 G16 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
13	$(9.4 - 5) \div 2$ or 2.2	M1	
	$2.2 \times \tan 62$ or 4.138...	M1	oe, the depth of the canal, ft their 2.2
	$\frac{1}{2} \times (9.4 + 5) \times$ their 4.14...	M1	oe, or a rectangle and two triangles
	29.8	A1	accept 29.8 or [29.79, 29.80]

Question 14 G22 · Higher · Grade 7 · 3 marks

Q	Answer	Mark	Comments
14	$180 - 52 - 63$ or angle C = 65	M1	
	$\frac{BC}{\sin 52} = \frac{11.5}{\sin 65}$	M1	oe, ft their angle C
	10.0	A1	accept 10.0 or [9.99, 10.00]

Question 15 G23 · Higher · Grade 7 · 3 marks

Q	Answer	Mark	Comments
15	$\frac{1}{2} \times 8.5 \times 7 \times \sin x = 22$	M1	oe
	$\sin x = \frac{22}{29.75}$ or $\sin^{-1}(\frac{44}{59.5})$	M1	oe
	47.7	A1	accept 47.7 or [47.68, 47.69]

Question 16 G22 · Higher · Grade 7 · 3 marks

Q	Answer	Mark	Comments
16	$\cos x = \frac{4.2^2 + 3.1^2 - 5.6^2}{2 \times 4.2 \times 3.1}$	M1	oe, the angle opposite 5.6 m
	$\cos^{-1}(\frac{-4.11}{26.04})$	M1	oe, or $\cos x = -0.157...$
	99.1	A1	accept 99.1 or [99.08, 99.09]

Question 17 G22 G3 · Higher · Grade 7 · 3 marks

Q	Answer	Mark	Comments
17	angle ABC = 116°	B1	may be on the diagram, co-interior angles
	$45^2 + 28^2 - 2 \times 45 \times 28 \times \cos 116$	M1	oe, ft their 116
	62.6	A1	accept 62.6 or [62.55, 62.56]

Question 18 G20 · Higher · Grade 8 · 4 marks

Q	Answer	Mark	Comments
18	$AC^2 = 8^2 + 5^2$ or $AC = \sqrt{89}$	M1	oe, $AC = 9.43...$
	$\tan x = \frac{3.6}{\text{their } AC}$	M1	oe, or $\sin x = \frac{3.6}{AG}$ with $AG = 10.10...$
	$\tan^{-1}(\frac{3.6}{9.43...})$	M1	oe
	20.9	A1	accept 20.9 or [20.88, 20.89]

Question 19 G22 G15 · Higher · Grade 8 · 4 marks

Q	Answer	Mark	Comments
19	angle LAB = 105	B1	may be on the diagram
	$2.6^2 + 1.8^2 - 2 \times 2.6 \times 1.8 \times \cos 105$	M1	oe, ft their angle LAB
	$LB^2 = 12.42...$	A1	
	3.5	A1	accept 3.5 or [3.52, 3.53]

Question 20 G23 G18 · Higher · Grade 8 · 4 marks

Q	Answer	Mark	Comments
20	$\frac{105}{360} \times \pi \times r^2$	M1	oe, the area of the sector
	$\frac{1}{2} \times r^2 \times \sin 105$	M1	oe, the area of triangle AOB
	$r^2 \left(\frac{105}{360} \pi - \frac{1}{2} \sin 105 \right) = 25$	M1	oe, or $r^2 = 25 \div 0.4333...$
	7.6	A1	accept 7.6 or [7.59, 7.60]

Question 21 G22 G23 · Higher · Grade 9 · 5 marks

Q	Answer	Mark	Comments
21	$BD^2 = 6.5^2 + 8.2^2 - 2 \times 6.5 \times 8.2 \times \cos 74$	M1	oe
	$BD = 8.95...$	A1	$BD^2 = 80.1...$
	$\cos C = \frac{7.4^2 + 5.8^2 - BD^2}{2 \times 7.4 \times 5.8}$	M1	oe, ft their BD. Angle C = 84.5...
	$\frac{1}{2} \times 6.5 \times 8.2 \times \sin 74 + \frac{1}{2} \times 7.4 \times 5.8 \times \sin C$	M1	oe, 25.62... + 21.36...
	47.0	A1	accept 47.0 or [46.97, 46.98]

Question 22 G20 G22 · Higher · Grade 9 · 5 marks

Q	Answer	Mark	Comments
22	$\frac{AF}{\sin 62} = \frac{85}{\sin 68}$	M1	oe, angle AFB = 68, AF = 80.94...
	FT = their AF $\times \tan 18$	M1	oe, FT = 26.30...
	$\frac{BF}{\sin 50} = \frac{85}{\sin 68}$	M1	oe, BF = 70.23...
	$\tan^{-1} \left(\frac{\text{their FT}}{\text{their BF}} \right)$	M1	oe, the angle TBF
	20.5	A1	accept 20.5 or [20.53, 20.54]

Question 23 G20 · Higher · Grade 9 · 5 marks

Q	Answer	Mark	Comments
23	$AF = \frac{h}{\tan 34}$	M1	oe, h the height of the mast
	$BF = \frac{h}{\tan 22}$	M1	oe
	$BF^2 = AF^2 + 150^2$	M1	oe, angle FAB = 90°, with their expressions
	$h^2(\frac{1}{\tan^2 22} - \frac{1}{\tan^2 34}) = 150^2$	M1	oe, or $h^2 \times 3.928... = 22\,500$
	75.7	A1	accept [75.6, 75.8]