P1 Trigonometry: exam questions

10 questions · 29 marks · full mark schemes

Name _____ Date _____ Score / 29

- Sine and cosine rules; area of a triangle = ½ab sin C; radian measure, arc length and sector area; graphs of sin, cos and tan and their symmetries; exact values.
- Try every question before you look at the mark schemes. They start after the questions: M marks for method, A marks for accuracy, B marks for a correct result on its own.
- Online, with more practice: alevelmathrevision.com/alevel-frontend/units/p1/trigonometry-questions

1. **2 marks · warm-up**

An arc of a circle has a length of 12.6 cm and subtends an angle of 1.4 radians at the centre of the circle. Calculate the radius of the circle.

2. **3 marks · warm-up**

Find the perimeter of a sector of a circle with radius 7.2 cm and a central angle of 1.5 radians.

3. **2 marks · standard**

A minor arc of a circle with radius 20 cm has a length of 8π cm. Find the exact angle subtended by the arc at the centre in radians.

4. 2 marks · standard

Prove using the cosine rule that if the sides of a triangle satisfy $a^2 = b^2 + c^2$, then the triangle is right-angled at A.

5. 3 marks · standard

The numerical value of the area of a sector of a circle is exactly twice the numerical value of its arc length. Find the radius of the circle.

6. 3 marks · standard

The point $(180°, -1)$ lies on the curve $y = \cos x$. Find the coordinates of the corresponding point on the curve $y = \cos(x + 90°) + 2$.

7. 3 marks · harder

A chord subtends an angle of 1.6 radians at the centre of a circle of radius 9 cm. Calculate the area of the minor segment bounded by this chord, to 1 decimal place.

8. 3 marks · harder

Find the angle subtended at the centre of a circle of radius 10 cm by a chord of length 12 cm, giving your answer in radians to 3 significant figures.

9. 4 marks · harder

A chord of a circle with radius 6 cm is equal in length to the radius of the circle. Find the exact area of the minor segment bounded by this chord.

10. 4 marks · harder

In triangle ABC, $BC = 10$ cm, $AC = 10\sqrt{3}$ cm, and $\angle A = 30°$. Find the two possible values for angle C.

Answers and worked solutions

Question 1 — 2 marks

1. M1 for setting up the equation $12.6 = r(1.4)$.
2. A1 for solving to find $r = 9$ cm.

Question 2 — 3 marks

1. M1 for calculating the arc length: $l = 7.2 \times 1.5 = 10.8$ cm.
2. M1 for setting up the full perimeter expression: $P = 2r + l = 2(7.2) + 10.8$.
3. A1 for evaluating to 25.2 cm.

Question 3 — 2 marks

1. M1 for using $\theta = \frac{l}{r}$ to write $\frac{8\pi}{20}$.
2. A1 for simplifying to $\frac{2\pi}{5}$ radians.

Question 4 — 2 marks

1. M1 for stating the cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$ and substituting $a^2 = b^2 + c^2$ to get $-2bc\cos A = 0$.
2. A1 for concluding that since b and c are non-zero lengths, $\cos A = 0$, which means $A = 90°$.

Question 5 — 3 marks

1. M1 for setting up the algebraic relationship: $\frac{1}{2}r^2\theta = 2(r\theta)$.
2. M1 for dividing both sides by $r\theta$ (noting $r, \theta > 0$): $\frac{1}{2}r = 2$.
3. A1 for solving to find $r = 4$.

Question 6 — 3 marks

1. M1 for applying the horizontal translation by subtracting $90°$ from the x-coordinate: $180° - 90° = 90°$.
2. M1 for applying the vertical translation by adding 2 to the y-coordinate: $-1 + 2 = 1$.
3. A1 for stating the final coordinates $(90°, 1)$.

Question 7 — 3 marks

1. M1 for using the segment area formula: $A = \frac{1}{2}(9^2)(1.6 - \sin 1.6)$.
2. M1 for ensuring calculator is in radians and evaluating $1.6 - \sin 1.6 \approx 0.6004$.
3. A1 for the final area calculation yielding $24.3\ \text{cm}^2$.

Question 8 — 3 marks

1. M1 for applying the cosine rule to the triangle formed by the chord and two radii: $\cos\theta = \frac{10^2+10^2-12^2}{2(10)(10)}$.
2. M1 for calculating $\cos\theta = \frac{200-144}{200} = \frac{56}{200} = 0.28$.
3. A1 for finding $\theta = \arccos(0.28) \approx 1.29$ radians.

Question 9 — 4 marks

1. M1 for deducing that the triangle formed by the chord and the radii is equilateral, hence the central angle is $\frac{\pi}{3}$ radians.
2. M1 for setting up the segment area formula: $A = \frac{1}{2}(6^2)(\frac{\pi}{3} - \sin\frac{\pi}{3})$.
3. M1 for substituting $\sin\frac{\pi}{3} = \frac{\sqrt{3}}{2}$ and evaluating the coefficient: $18(\frac{\pi}{3} - \frac{\sqrt{3}}{2})$.
4. A1 for expanding to get exactly $6\pi - 9\sqrt{3}\ \text{cm}^2$.

Question 10 — 4 marks

1. M1 for setting up the sine rule to find angle B: $\frac{\sin B}{10\sqrt{3}} = \frac{\sin 30°}{10}$.
2. M1 for evaluating to get $\sin B = \sqrt{3} \times 0.5 = \frac{\sqrt{3}}{2}$.
3. M1 for finding the two possible values for angle B: $60°$ and $120°$.
4. A1 for finding the corresponding values for angle C using $180° - 30° - B$: $C = 90°$ and $C = 30°$.

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