1.5 Pure: Trigonometry: Test Pack

EDEXCEL 9MA0 · Calculator allowed · about 70 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Convert π/6 radians to degrees.

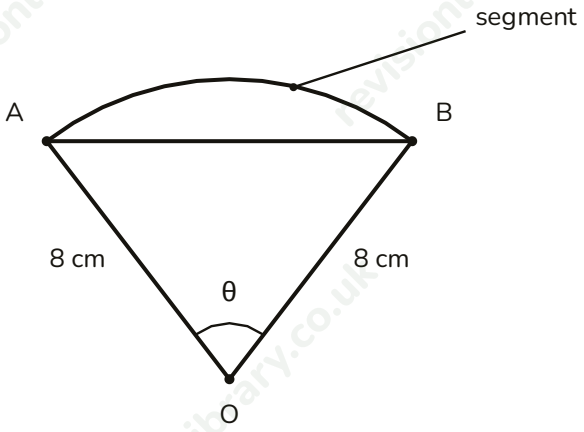
(Total for Question 1 is 1 mark)

2 Write down the exact value of tan(45 degrees).

(Total for Question 2 is 1 mark)

3 A sector OAB of a circle, centre O and radius 8 cm, has angle AOB = θ radians, where θ = 5pi/12.

Diagram NOT accurately drawn



(a) Convert θ = 5pi/12 radians to degrees. **(1)**

(b) Find the arc length AB, giving your answer as an exact multiple of π. **(2)**

(c) Find the area of the sector OAB, giving your answer to 3 significant figures. **(2)**

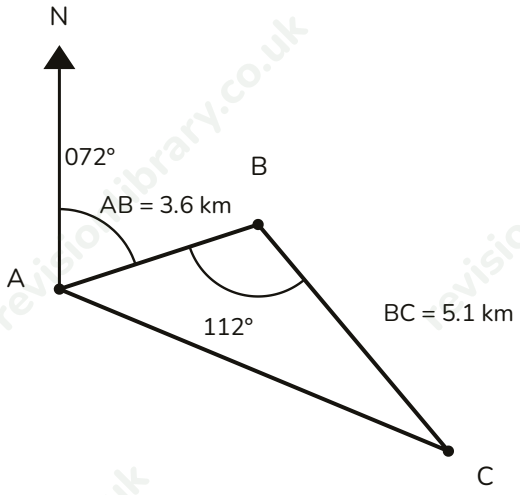
(d) Find the perimeter of the segment cut off by the chord AB, giving your answer to 3 significant figures. **(4)**

(Total for Question 3 is 9 marks)

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4 In a yacht race, three buoys A, B and C are positioned such that AB = 3.6 km, BC = 5.1 km and angle ABC = 112 degrees. The bearing of B from A is 072 degrees, and C is on a bearing greater than that of B from A.

Diagram NOT accurately drawn



(a) Calculate the distance AC, giving your answer to 3 significant figures. **(3)**

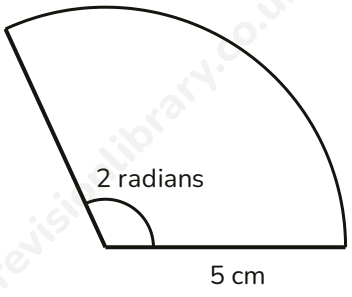
(b) Calculate angle BCA, giving your answer to 1 decimal place. **(3)**

(c) Calculate the bearing of C from A, giving your answer to the nearest degree. **(3)**

(Total for Question 4 is 9 marks)

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5 A sector has radius 5 cm and angle 2 radians at the centre. Find the arc length.



(Total for Question 5 is 1 mark)

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6 State the value of $\cos^2(\theta) + \sin^2(\theta)$ for any angle θ.

(Total for Question 6 is 1 mark)

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7 Solve $2\cos^2 x - 3\sin x - 3 = 0$ for $-180 < x \leq 180$, giving all solutions in degrees.

(a) Use $\cos^2 x = 1 - \sin^2 x$ to show that the equation can be written as a quadratic in sin x, and state that quadratic. **(3)**

(b) Hence solve the equation. **(4)**

(Total for Question 7 is 7 marks)

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8 Given $f(\theta) = 5\cos(\theta) - 12\sin(\theta)$, for 0 degrees $\leq \theta \leq$ 360 degrees.

(a) Express $f(\theta)$ in the form $R\cos(\theta + \alpha)$, where $R > 0$ and $0 < \alpha < 90$ degrees, giving α to 2 decimal places. **(3)**

(b) Hence write down the maximum value of $f(\theta)$, and find the smallest positive value of θ at which this maximum occurs, to 1 decimal place. **(2)**

(c) Solve $f(\theta) = 6$ for 0 degrees $\leq \theta \leq$ 360 degrees, giving your answers to 1 decimal place. **(5)**

(Total for Question 8 is 10 marks)

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9 Given that θ is small and measured in radians. You may use the approximation $\sin x = x - x^3/6$ for small x.

(a) Show that, for small θ, $(2\text{theta} - \sin(2\text{theta})) / \theta^3$ is approximately equal to 4/3. **(4)**

(b) Using your calculator, find the estimate from part (a) and the true value of $(2\text{theta} - \sin(2\text{theta}))/\theta^3$ when $\theta = 0.1$ radians, and hence find the percentage error in the estimate, giving your answer to 2 significant figures. **(4)**

(Total for Question 9 is 8 marks)

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10 Solve $3\cos(x) + 1 = 0$ for -180 degrees $\leq x \leq$ 180 degrees, giving your answers to 1 decimal place.

(Total for Question 10 is 3 marks)

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11 Solve $2\sin^2(x) + \sin(x) - 1 = 0$ for 0 degrees $\leq x \leq$ 360 degrees, giving all solutions.

(Total for Question 11 is 4 marks)

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Mark scheme · 1.5 Pure: Trigonometry: Test Pack

Question 1

30 degrees cao **B1**

Answer: 30 degrees

Question 2

1 cao **B1**

Answer: 1

Question 3

(a) 75 degrees cao **B1**

(a) Answer: 75 degrees

(b) uses s = r*θ with θ in radians, e.g. 8 * 5pi/12 **M1**

(b) 10pi/3 cm oe cao (exact form) **A1**

(b) Answer: 10pi/3 cm (approx 10.5 cm)

(c) uses A = 0.5 * r^2 * θ, e.g. 0.5 * 8^2 * 5pi/12 **M1**

(c) awrt 41.9 cm^2 cao **A1**

(c) Answer: 41.9 cm^2 (3 s.f.)

(d) correct method for chord AB, e.g. AB = 2*8*sin(37.5 deg) or cosine rule $AB^2 = 8^2+8^2-2*8*8*cos75$ **M1**

(d) AB = awrt 9.74 cm **A1**

(d) (dep on both M marks) perimeter = arc length + chord AB **dM1**

(d) awrt 20.2 cm cao **A1**

(d) Answer: 20.2 cm (3 s.f.)

Question 4

(a) correct statement of the cosine rule, $AC^2 = AB^2 + BC^2 - 2*AB*BC*cos(ABC)$ **M1**

(a) correct substitution: $AC^2 = 3.6^2 + 5.1^2 - 2*3.6*5.1*cos(112)$ **M1**

(a) AC = awrt 7.26 km cao **A1**

(a) Answer: AC = 7.26 km (3 s.f.)

(b) correct statement of the sine rule, sin(BCA)/AB = sin(ABC)/AC **M1**

(b) correct rearrangement: sin(BCA) = 3.6*sin(112)/7.2612 (ft AC from (a)) **M1**

(b) angle BCA = awrt 27.4 degrees cao (acute value taken since angle ABC is obtuse) **A1**

(b) Answer: angle BCA = 27.4 degrees (1 d.p.)

(c) angle BAC = 180 - 112 - 27.4 (ft) = 40.6 degrees **M1**

(c) bearing of C from A = bearing of B from A + angle BAC = 072 + 40.6 (since C is on a greater bearing) **M1**

(c) 113 degrees (awrt, cao), i.e. bearing 113 degrees **A1**

(c) Answer: Bearing of C from A = 113 degrees (to nearest degree)

Question 5

10 cm cao **B1**

Answer: 10 cm

Question 6

1 cao **B1**

Answer: 1

Question 7

(a) replaces $\cos^2 x$ by $1 - \sin^2 x$ **M1**

(a) collects terms **M1**

(a) $2s^2 + 3s + 1 = 0$ where s = sin x **A1**

(a) Answer: $2s^2 + 3s + 1 = 0$

(b) solves the quadratic **M1**

(b) sin x = -1 or sin x = -1/2 **A1**

(b) uses inverse sine and symmetry for each value **M1**

(b) -150, -90, -30 degrees **A1**

(b) Answer: -150, -90, -30 degrees

Question 8

(a) R = 13, from $\sqrt{5^2 + 12^2}$ **B1**

(a) correct trig ratio for α, e.g. tan(α) = 12/5 **M1**

(a) α = 67.38 degrees (awrt 2 d.p.), cao **A1**

(a) Answer: f(θ) = 13 cos(θ + 67.38 degrees)

(b) maximum value = 13 (ft R from (a)) **B1**

(b) θ = 292.6 degrees (awrt, ft from α), from θ + α = 360 **B1**

(b) Answer: Maximum value = 13, occurring at θ = 292.6 degrees

(c) forms 13cos(θ + 67.38) = 6, i.e. cos(θ + 67.38) = 6/13 (ft from (a)) **M1**

(c) finds principal value arccos(6/13), awrt 62.5 degrees **M1**

(c) correct method for second value within the shifted range (using 360 - 62.5 and/or 360 + 62.5) **M1**

(c) θ = 230.1 degrees (awrt), ft **A1**

(c) θ = 355.1 degrees (awrt), cao **A1**

(c) Answer: θ = 230.1 degrees, 355.1 degrees

Question 9

(a) uses the small angle approximation sin(2theta) = 2theta - $(2theta)^3/6$ + ... **M1**

(a) correctly simplifies $(2theta)^3/6$ to $4theta^3/3$ **A1**

(a) substitutes to give 2theta - sin(2theta) = $4theta^3/3$ **M1**

(a) cso divides by θ^3 to obtain 4/3 **A1**

(a) Answer: Shown that $(2theta - sin2theta)/\theta^3 = 4/3$ (approx)

(b) estimate = 4/3 = 1.333 (awrt) **M1**

(b) true value = (0.2 - sin(0.2))/0.001, using calculator in radians **M1**

(b) true value = awrt 1.33 (1.3307), and correct percentage error method: abs(estimate - true)/true * 100 **M1**

(b) percentage error = awrt 0.20% cao **A1**

(b) Answer: Estimate = 1.33 (4/3); true value = 1.3307; percentage error = 0.20%

Question 10

rearranges to cos(x) = -1/3 **M1**

finds the principal value, awrt 109.5 degrees **M1**

x = 109.5 and x = -109.5 degrees (awrt 1 d.p.), both values, no extras in range **A1**

Answer: x = 109.5 degrees, -109.5 degrees

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Question 11

lets s = sin(x) and factorises $2s^2+s-1$ as (2s-1)(s+1)	**M1**
sin(x) = 1/2 or sin(x) = -1, both stated	**A1**
correct method for all solutions from sin(x)=1/2 (30, 150) and sin(x)=-1 (270)	**M1**
x = 30, 150, 270 degrees, cao, no extras	**A1**

Answer: x = 30, 150, 270 degrees

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