CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International AS & A Level Mathematics

Paper Details:	Paper 1 Pure Mathematics 1 (9709/12)	**Series:**	February/March 2026
Document Type:	Published Mark Scheme (Confidential)	**Total Marks:**	75 Marks

Mark Scheme Notes & Abbreviations:

- **M1**: Method mark, awarded for a valid method applied to the problem.
- **A1**: Accuracy mark, dependent on a previous M mark.
- **B1**: Independent mark for a correct statement or step.
- **FT**: Follow through of a previous incorrect result.
- All non-exact numerical answers must be given to 3 significant figures unless specified otherwise.

DETAILED SOLUTIONS AND MARK ALLOCATIONS

Q	ANSWERING DETAILS / SCHEME	MARKS	GUIDANCE
1	Differentiate with respect to x: $dy/dx = 3x^2 - 6x$	B1	Correct derivative.
	Set $dy/dx = 0 \Rightarrow 3x(x - 2) = 0 \Rightarrow x = 0$ or $x = 2$. Find coordinates: • When $x = 0$, $y = 9 \Rightarrow (0, 9)$ • When $x = 2$, $y = 2^3 - 3(2)^2 + 9 = 5 \Rightarrow (2, 5)$ Determine nature using the second derivative: $d^2y/dx^2 = 6x - 6$ • At $x = 0$, $d^2y/dx^2 = -6 < 0 \Rightarrow (0, 9)$ is a **Local Maximum**. • At $x = 2$, $d^2y/dx^2 = 6 > 0 \Rightarrow (2, 5)$ is a **Local Minimum**.	M1 A1 M1 A1	Set to 0 and solve. Both coordinates correct. Second derivative test. Both natures correct.
2	**(a) Perimeter of shaded region:** • Arc Length = $r\theta = 9 \times 0.8 = 7.2$ cm. • Remaining segment $AB = 12 - 9 = 3$ cm. • Calculate length BC using the cosine rule: $BC^2 = 12^2 + 9^2 - 2(12)(9)\cos(0.8)$ $BC^2 = 145 + 81 - 216 \times 0.6967 = 74.511$	B1 M1 A1 A1	Arc length correct. Cosine rule for BC. BC correct. Final answer to 3 sf.

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	$BC = \sqrt{74.511} \approx 8.632$ cm. • Total Perimeter = $7.2 + 3 + 8.632 = 18.832 \approx 18.8$ cm.		
	(b) Area of shaded region: • Area of triangle $ABC = 0.5 \times 12 \times 9 \times \sin(0.8)$ $Area_{\triangle} = 54 \times 0.71736 \approx 38.737$ cm^2. • Area of sector = $0.5 \times r^2 \theta = 0.5 \times 9^2 \times 0.8 = 32.4$ cm^2. • Shaded Area = $38.737 - 32.4 = 6.337 \approx 6.34$ cm^2.	M1 B1 A1	Triangle area formula. Sector area correct. Final answer to 3 sf.
3	**(a) Find constants:** Using vertex form: $y = a(x - 3)^2 - 5$ Substitute $(0, 31) \Rightarrow 31 = a(0 - 3)^2 - 5$ $36 = 9a \Rightarrow a = 4$. Expand to standard form: $y = 4(x^2 - 6x + 9) - 5 = 4x^2 - 24x + 31$. Thus, $a = 4$, $b = -24$, $c = 31$.	M1 A1 A1 A1	Use vertex form. Find a = 4. Find b = -24. Find c = 31.
	(b) Translation by &binom;-2;7: New vertex is $(3 - 2, -5 + 7) = (1, 2)$. Equation: $y = 4(x - 1)^2 + 2 \Rightarrow y = 4x^2 - 8x + 6$.	M1 A1	Apply shift to vertex. Correct final form.
4	**(a) Find inverse function:** Let $y = (2x + 1)/(x - 3) \Rightarrow y(x - 3) = 2x + 1$ $xy - 3y = 2x + 1 \Rightarrow xy - 2x = 3y + 1$ $x(y - 2) = 3y + 1 \Rightarrow x = (3y + 1)/(y - 2)$ $f^{-1}(x) = (3x + 1)/(x - 2)$	M1 A1 A1	Rearrange to isolate x. Correct algebra steps. Correct expression.
	(b) Composite function ff(x): $ff(x) = [2((2x+1)/(x-3)) + 1] / [((2x+1)/(x-3)) - 3]$ Multiply numerator and denominator by $(x - 3)$: Numerator: $2(2x + 1) + 1(x - 3) = 4x + 2 + x - 3 = 5x - 1$ Denominator: $(2x + 1) - 3(x - 3) = 2x + 1 - 3x + 9 = 10 - x$ $ff(x) = (5x - 1)/(10 - x)$ $\therefore$ $p = 5, q = -1, r = 10, s = -1$.	M1 A1 A1	Substitute f(x) into f. Simplify algebraic fraction. Correct integers values.
5	**(a) Identity Proof:** LHS = $1/(1 - \sin\theta) + 1/(1 + \sin\theta)$ Combine over common denominator: LHS = $[(1 + \sin\theta) + (1 - \sin\theta)] / [(1 - \sin\theta)(1 + \sin\theta)]$	M1 A1 M1 A1	Common denominator. Correct numerator

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	LHS = $2 / (1 - \sin^2\theta)$ Since $1 - \sin^2\theta = \cos^2\theta$: LHS = $2 / \cos^2\theta$ = RHS.		expansion. Use of trig identity. Completed proof.
	(b) Solve equation: $3 [1/(1-\sin\theta) + 1/(1+\sin\theta)] = 12 \Rightarrow 3 (2/\cos^2\theta) = 12$ $6 / \cos^2\theta = 12 \Rightarrow \cos^2\theta = 0.5$ $\cos\theta = \pm 1/\sqrt{2}$ For $0° \leq \theta \leq 360°$: • $\theta = 45°, 135°, 225°, 315°$	M1 A1 A1	Link to identity and rearrange. Obtain two correct angles. Obtain all 4 angles.
6	**(a) Circle Properties:** • Centre = $(0, 0)$ • Radius = $\sqrt{(45/4)} = 3\sqrt{5} / 2$	B1 B1	Correct centre. Correct exact radius.
	(b) Intersection distance: Substitute $y = 1.5 - x$ into circle equation: $x^2 + (1.5 - x)^2 = 11.25$ $x^2 + 2.25 - 3x + x^2 = 11.25$ $2x^2 - 3x - 9 = 0 \Rightarrow (2x + 3)(x - 3) = 0$ • Points: $x = 3 \Rightarrow y = -1.5 \Rightarrow A(3, -1.5)$ • Points: $x = -1.5 \Rightarrow y = 3 \Rightarrow B(-1.5, 3)$ Distance $AB = \sqrt{[(3 - (-1.5))^2 + (-1.5 - 3)^2]}$ $AB = \sqrt{[4.5^2 + (-4.5)^2]} = \sqrt{[20.25 + 20.25]} = \sqrt{40.5} = 9\sqrt{2} / 2$	M1 A1 M1 A1 M1 A1	Substitution strategy. Correct quadratic form. Solve for x coordinates. Find y coordinates. Distance formula used. Exact value fully simplified.
7	**(a) Find y in terms of x:** Expand numerator: $dy/dx = (x^2 - 6x + 9) / x^{1/2} = x^{3/2} - 6x^{1/2} + 9x^{-1/2}$ Integrate term by term: $y = (2/5)x^{5/2} - 4x^{3/2} + 18x^{1/2} + C$ Substitute $(4, 7)$: $7 = (2/5)(32) - 4(8) + 18(2) + C$ $7 = 12.8 - 32 + 36 + C \Rightarrow 7 = 16.8 + C \Rightarrow C = -9.8$ (or $-49/5$) $y = 0.4x^{5/2} - 4x^{3/2} + 18x^{1/2} - 9.8$	M1 A1 A1 M1 A1	Split terms properly. At least two terms correct. All integration correct. Substitute point to find C. Correct equation.

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	(b) Transformation: The graph is translated vertically. Curve D passes through $(4, k)$ while C passes through $(4, 7)$. **Translation by vector:** *&binom;0;k - 7*	M1 A1	Recognize vertical translation. State vector or description.
8	**(a) Binomial Expansion:** $(3 - 2x)^4 = 3^4 + 4(3^3)(-2x) + 6(3^2)(-2x)^2 + 4(3)(-2x)^3 + (-2x)^4$ $= 81 - 216x + 216x^2 - 96x^3 + 16x^4$	M1 A1 A1	Apply binomial theorem. First three terms correct. Fully correct simplified form.
	(b) Substitute $x = \sqrt{2}$: $= 81 - 216\sqrt{2} + 216(\sqrt{2})^2 - 96(\sqrt{2})^3 + 16(\sqrt{2})^4$ $= 81 - 216\sqrt{2} + 216(2) - 96(2\sqrt{2}) + 16(4)$ $= 81 - 216\sqrt{2} + 432 - 192\sqrt{2} + 64$ Combine terms: $577 - 408\sqrt{2}$ $\therefore$ $p = 577, q = -408$.	M1 A1 A1	Substitute x = √2. Simplify coefficients. Correct exact integers values.
9	Rewrite the equation: $x^{2/3} + 2x^{1/3} - 24 = 0$ Let $u = x^{1/3} \Rightarrow u^2 + 2u - 24 = 0$ Factorize: $(u + 6)(u - 4) = 0 \Rightarrow u = 4$ or $u = -6$ Solve for x: • $x^{1/3} = 4 \Rightarrow x = 4^3 = 64$ • $x^{1/3} = -6 \Rightarrow x = (-6)^3 = -216$	M1 A1 M1 A1	Recognize as quadratic in x^(1/3). Obtain u = 4, -6. Cube to find x values. Both answers correct.
10	**(a) Find 20th term of AP:** $u_7 = a + 6d = 77$ $S_{11} = (11/2)(2a + 10d) = 11(a + 5d) = 880 \Rightarrow a + 5d = 80$ Subtract the two simultaneous equations: $(a + 6d) - (a + 5d) = 77 - 80 \Rightarrow d = -3$ Find a: $a + 5(-3) = 80 \Rightarrow a = 95$. Calculate 20th term: $u_{20} = a + 19d = 95 + 19(-3) = 38$.	B1 M1 A1 A1	Correct equation for u7. Use of sum formula to get a + 5d = 80. Find a and d values. Correct 20th term.
	(b) Smallest N such that $S_N < 50$: $S_N = (N/2)[2(95) + (N - 1)(-3)] < 50$	M1 A1	Set up correct inequality. Obtain standard

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	$N [190 - 3N + 3] < 100 \Rightarrow N(193 - 3N) < 100$ $3N^2 - 193N + 100 > 0$ Solving quadratic boundary equation: $N \approx 63.8$ or 0.52 Test discrete integer values: • When $N = 63$, $S_{63} = 31.5 \times (193 - 189) = 126$ • When $N = 64$, $S_{64} = 32 \times (193 - 192) = 32 < 50$ Therefore, the smallest number of terms is $N = 64$.	M1 A1	quadratic form. Test values or solve boundary. State N = 64.
11	**(a) Equation of straight line:** $dy/dx = -3x^2 + 18x - 15 = 0 \Rightarrow x^2 - 6x + 5 = 0 \Rightarrow (x - 1)(x - 5) = 0$. Stationary points at $x = 1$ and $x = 5$. • At $x = 1$, $y = -1 + 9 - 15 - 3 = -10 \Rightarrow (1, -10)$ • At $x = 5$, $y = -125 + 225 - 75 - 3 = 22 \Rightarrow (5, 22)$ Gradient $m = (22 - (-10)) / (5 - 1) = 32 / 4 = 8$. Equation of line: $y - 22 = 8(x - 5) \Rightarrow y = 8x - 18$. (Shown)	M1 A1 M1 A1 A1	Differentiate and set to 0. Find stationary x values. Find corresponding y values. Find gradient m = 8. Fully shown correct equation.
	(b) Verification: At $x = 3$: • Line: $y = 8(3) - 18 = 6$ • Curve: $y = -(3)^3 + 9(3)^2 - 15(3) - 3 = -27 + 81 - 45 - 3 = 6$ Since both give $y = 6$, they meet at $x = 3$.	B1	Valid verification.
	(c) Shaded Area: The shaded area is bounded between $x = 3$ and $x = 5$ where the curve is above the straight line. $Area = \int_3^5 [(-x^3 + 9x^2 - 15x - 3) - (8x - 18)]\, dx$ $= \int_3^5 (-x^3 + 9x^2 - 23x + 15)\, dx$ Integrate: $[-x^4/4 + 3x^3 - 23x^2/2 + 15x]_3^5$ • Upper Limit (5): $-625/4 + 375 - 575/2 + 75 = 6.25$ • Lower Limit (3): $-81/4 + 81 - 207/2 + 45 = 2.25$ $Area = 6.25 - 2.25 = 4$	M1 A1 A1 M1 A1	Set up correct integral limits. Correct combined function. Correct term-by-term integration. Substitute limits accurately. Correct final area value = 4.