

CAMBRIDGE INTERNATIONAL EXAMINATIONS**Cambridge International General Certificate of Secondary Education****MARK SCHEME for the March 2015 series****0606 ADDITIONAL MATHEMATICS****0606/12**

Paper 12, maximum raw mark 80

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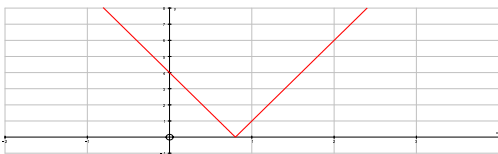
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Page 2	Mark Scheme	Syllabus	Paper
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1	(i)	Members who play football or cricket , or both	B1	
	(ii)	Members who do not play tennis	B1	
	(iii)	There are no members who play both football and tennis	B1	
	(iv)	There are 10 members who play both cricket and tennis.	B1	
2		$kx - 3 = 2x^2 - 3x + k$ $2x^2 - x(k + 3) + (k + 3) = 0$ Using $b^2 - 4ac$, $(k + 3)^2 - (4 \times 2 \times (k + 3)) (< 0)$ $(k + 3)(k - 5) (< 0)$	M1 DM1 DM1	for attempt to obtain a 3 term quadratic equation in terms of x for use of $b^2 - 4ac$ for attempt to solve quadratic equation, dependent on both previous M marks
		Critical values $k = -3, 5$ so $-3 < k < 5$	A1 A1	for both critical values for correct range
	(i)		B1 B1 B1	for shape, must touch the x -axis in the correct quadrant for y intercept for x intercept
	(ii)	$4 - 5x = \pm 9$ or $(4 - 5x)^2 = 81$ leading to $x = -1, x = \frac{13}{5}$	M1 A1, A1	for attempt to obtain 2 solutions, must be a complete method A1 for each
4	(i)	$729 + 2916x + 4860x^2$	B1, B1 B1	B1 for each correct term
	(ii)	$2 \times \text{their } 4860 - \text{their } 2916 = 6804$	M1 A1	for attempt at 2 terms, must be as shown

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5	(i)	gradient = 4 Using either (2, 1) or (3, 5), $c = -7$ $e^y = 4x + c$ so $y = \ln(4x - 7)$ Alternative method: $\frac{y-1}{5-1} = \frac{x-2}{3-2}$ or equivalent $e^y = 4x - 7$ so $y = \ln(4x - 7)$	B1 M1 M1,A1	for gradient, seen or implied for attempt at straight line equation to obtain a value for c for correct method to deal with e^y
	(ii)	$x > \frac{7}{4}$	B1ft	ft on <i>their</i> $4x - 7$
	(iii)	$\ln 6 = \ln(4x - 7)$ so $x = \frac{13}{4}$	B1ft	ft on <i>their</i> $4x - 7$
6	(i)	$\frac{dy}{dx} = \frac{x(2\sec^2 2x) - \tan 2x}{x^2}$ Or $\frac{dy}{dx} = x^{-1}(2\sec^2 2x) + (-x^{-2})\tan 2x$	M1 A2,1,0	for attempt to differentiate a quotient (or product) –1 each error
	(ii)	When $x = \frac{\pi}{8}$, $y = \frac{8}{\pi}$ (2.546) When $x = \frac{\pi}{8}$, $\frac{dy}{dx} = \frac{\frac{\pi}{2} - 1}{\frac{\pi^2}{64}}$ $= \frac{32}{\pi} - \frac{64}{\pi^2}$ (3.701) Equation of the normal: $y - \frac{8}{\pi} = -\frac{\pi^2}{32(\pi - 2)}\left(x - \frac{\pi}{8}\right)$ $y = -0.27x + 2.65$ (allow 2.66)	B1 M1 A1	for y-coordinate (allow 2.55) for an attempt at the normal, must be working with a perpendicular gradient allow in unsimplified form in terms of π or simplified decimal form

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7	(i)	$p\left(\frac{1}{2}\right): \frac{a}{8} + \frac{b}{4} - \frac{3}{2} - 4 = 0$ Simplifies to $a + 2b = 44$ $p(-2): -8a + 4b + 6 - 4 = -10$ Simplifies to $2a - b = 3$ oe Leads to $a = 10, b = 17$	M1 M1 DM1 A1	for correct use of $x = \frac{1}{2}$ for correct use of $x = -2$ for solution of equations for both, be careful as AG for a , allow verification
	(ii)	$p(x) = 10x^3 + 17x^2 - 3x - 4$ $= (2x - 1)(5x^2 + 11x + 4)$	B2,1,0	-1 each error
	(iii)	$x = \frac{1}{2}$ $x = \frac{-11 \pm \sqrt{41}}{10}$	B1 B1, B1	
8	(a) (i)	Range $0 \leq y \leq 1$	B1	
	(ii)	Any suitable domain to give a one-one function	B1	e.g. $0 \leq x \leq \frac{\pi}{4}$
	(b) (i)	$y = 2 + 4 \ln x$ oe $\ln x = \frac{y-2}{4}$ oe $g^{-1}(x) = e^{\frac{x-2}{4}}$ Domain $x \in$ Range $y > 0$	M1 A1 B1 B1	for a complete method to find the inverse must be in the correct form
		(ii) $g(x^2 + 4) = 10$ $2 + 4 \ln(x^2 + 4) = 10$ leading to $x = 1.84$ only Alternative method: $h(x) = x^2 + 4 = g^{-1}(10)$ $g^{-1}(10) = e^2$, so $x^2 + 4 = e^2$ leading to $x = 1.84$ only	M1 DM1 A1 M1 DM1 A1	for correct order for attempt to solve for one solution only for correct order for attempt to solve for one solution only
		(iii) $\frac{4}{x} = 2x$ $x^2 = 2$ $x = \sqrt{2}$	B1 M1 A1	for given equation, allow in this form for attempt to solve, must be using derivatives for one solution only, allow 1.41 or better.

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9	(i)	$\text{Area of triangular face} = \frac{1}{2}x^2 \frac{\sqrt{3}}{2} = \frac{\sqrt{3}x^2}{4}$ $\text{Volume of prism} = \frac{\sqrt{3}x^2}{4} \times y$ $\frac{\sqrt{3}x^2}{4} \times y = 200\sqrt{3}$ $\text{so } x^2 y = 800$ $A = 2 \times \frac{\sqrt{3}x^2}{4} + 2xy$ $\text{leading to } A = \frac{\sqrt{3}x^2}{2} + \frac{1600}{x}$	B1	for area of triangular face
	(ii)	$\frac{dA}{dx} = \sqrt{3}x - \frac{1600}{x^2}$ $\text{When } \frac{dA}{dx} = 0, x^3 = \frac{1600}{\sqrt{3}}$ $x = 9.74$ $\text{so } A = 246$ $\frac{d^2A}{dx^2} = \sqrt{3} + \frac{3200}{x^3} \text{ which is positive for } x = 9.74$ $\text{so the value is a minimum}$	M1 M1 A1 A1 M1 A1ft	for attempt at volume <i>their</i> area $\times$ y for correct relationship between x and y for a correct attempt to obtain surface area using <i>their</i> area of triangular face for eliminating y correctly to obtain given answer for attempt to differentiate for equating $\frac{dA}{dx}$ to 0 and attempt to solve for correct x for correct A for attempt at second derivative and conclusion, or alternate methods ft for a correct conclusion from completely correct work, follow through on <i>their</i> positive x value.
10	(i)	$\tan \theta = \frac{1+2\sqrt{5}}{6+3\sqrt{5}} \times \frac{6-3\sqrt{5}}{6-3\sqrt{5}}$ $= \frac{6-3\sqrt{5}+12\sqrt{5}-30}{36-45}$ $= \frac{8}{3} - \sqrt{5}$	M1 A1, A1	for attempt at $\cot \theta$ together with rationalisation Must be convinced that a calculator is not being used. A1 for each term
	(ii)	$\tan^2 \theta + 1 = \sec^2 \theta$ $\frac{64}{9} - \frac{16\sqrt{5}}{3} + 5 + 1 = \operatorname{cosec}^2 \theta$ $\text{so } \operatorname{cosec}^2 \theta = \frac{118}{9} - \frac{16\sqrt{5}}{3}$ $\text{Alternate solutions are acceptable}$	M1 A1, A1	for attempt to use the correct identity or correct use of Pythagoras' theorem together with <i>their</i> answer to (i) Must be convinced that a calculator is not being used. A1 for each term

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11 (a) (i)	$\text{LHS} = \frac{\frac{1}{\sin y}}{\frac{\cos y}{\sin y} + \frac{\sin y}{\cos y}}$ $= \frac{\frac{1}{\sin y}}{\frac{\cos^2 y + \sin^2 y}{\sin y \cos y}}$ $= \frac{1}{\sin y} \times \sin y \cos y$ $= \cos y$	M1	for dealing with cosec, cot and tan in terms of sin and cos
		M1	for use of $\sin^2 y + \cos^2 y = 1$
		A1	for correct simplification to get the required result.
	(ii) $\cos 3z = 0.5$ $3z = \frac{\pi}{3}, \frac{5\pi}{3}, \frac{7\pi}{3}$ $z = \frac{\pi}{9}, \frac{5\pi}{9}, \frac{7\pi}{9}$	M1	for use of (i) and correct attempt to deal with multiple angle
		A1, A1	A1 for each ‘pair’ of solutions
(b)	$2 \sin x + 8(1 - \sin^2 x) = 5$ $8 \sin^2 x - 2 \sin x - 3 = 0$ $(4 \sin x - 3)(2 \sin x + 1) = 0$ $\sin x = \frac{3}{4}, \quad \sin x = -\frac{1}{2}$ $x = 48.6^\circ, 131.4^\circ \quad 210^\circ, 330^\circ$	M1	for use of correct identity
		M1	for attempt to solve quadratic equation
		A1, A1	A1 for each pair of solutions