

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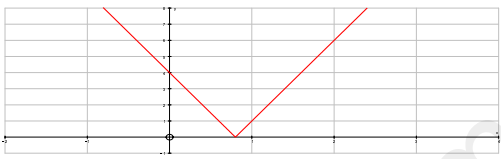
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1	(i) Members who play football or cricket , or both (ii) Members who do not play tennis (iii) There are no members who play both football and tennis (iv) There are 10 members who play both cricket and tennis.	B1 B1 B1 B1	
2	$kx - 3 = 2x^2 - 3x + k$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

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<p>5 (i)</p> <p>gradient = 4 Using either (2, 1) or (3, 5), $c = -7$ $e^y = 4x + c$ so $y = \ln(4x - 7)$</p> <p>Alternative method: $\frac{y-1}{5-1} = \frac{x-2}{3-2}$ or equivalent</p> <p>$e^y = 4x - 7$ so $y = \ln(4x - 7)$</p> <p>(ii)</p> <p>$x > \frac{7}{4}$</p> <p>(iii)</p> <p>$\ln 6 = \ln(4x - 7)$ so $x = \frac{13}{4}$</p>		<p>B1 M1</p> <p>M1,A1</p> <p>M1</p> <p>A1</p> <p>M1 A1</p> <p>B1ft</p> <p>B1ft</p>	<p>for gradient, seen or implied for attempt at straight line equation to obtain a value for c</p> <p>for correct method to deal with e^y</p> <p>for attempt at straight line equation using both points allow correct unsimplified for correct method to deal with e^y</p> <p>ft on their $4x - 7$</p> <p>ft on their $4x - 7$</p>
<p>6 (i)</p> <p>$\frac{dy}{dx} = \frac{x(2\sec^2 2x) - \tan 2x}{x^2}$</p> <p>Or $\frac{dy}{dx} = x^{-1}(2\sec^2 2x) + (-x^{-2})\tan 2x$</p> <p>(ii)</p> <p>When $x = \frac{\pi}{8}$, $y = \frac{8}{\pi}$ (2.546)</p> <p>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)</p> <p>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)</p>		<p>M1</p> <p>A2,1,0</p> <p>B1</p> <p>M1</p> <p>A1</p>	<p>for attempt to differentiate a quotient (or product) -1 each error</p> <p>for y-coordinate (allow 2.55)</p> <p>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</p>

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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	for correct use of $x = \frac{1}{2}$
	(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	for a complete method to find the inverse
		(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	A1 B1 B1 M1 DM1 A1 M1 DM1 A1
	(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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<p>9 (i)</p> <p>Area of triangular face = $\frac{1}{2}x^2 \frac{\sqrt{3}}{2} = \frac{\sqrt{3}x^2}{4}$</p> <p>Volume of prism = $\frac{\sqrt{3}x^2}{4} \times y$</p> <p>$\frac{\sqrt{3}x^2}{4} \times y = 200\sqrt{3}$</p> <p>so $x^2y = 800$</p> <p>$A = 2 \times \frac{\sqrt{3}x^2}{4} + 2xy$</p> <p>leading to $A = \frac{\sqrt{3}x^2}{2} + \frac{1600}{x}$</p> <p>(ii)</p> <p>$\frac{dA}{dx} = \sqrt{3}x - \frac{1600}{x^2}$</p> <p>When $\frac{dA}{dx} = 0$, $x^3 = \frac{1600}{\sqrt{3}}$</p> <p>$x = 9.74$ so $A = 246$</p> <p>$\frac{d^2A}{dx^2} = \sqrt{3} + \frac{3200}{x^3}$ which is positive for $x = 9.74$ so the value is a minimum</p>		<p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>M1</p> <p>A1ft</p>	<p>for area of triangular face</p> <p>for attempt at volume <i>their</i> area \times y</p> <p>for correct relationship between x and y</p> <p>for a correct attempt to obtain surface area using <i>their</i> area of triangular face</p> <p>for eliminating y correctly to obtain given answer</p> <p>for attempt to differentiate</p> <p>for equating $\frac{dA}{dx}$ to 0 and attempt to solve for correct x</p> <p>for correct A</p> <p>for attempt at second derivative and conclusion, or alternate methods</p> <p>ft for a correct conclusion from completely correct work, follow through on <i>their</i> positive x value.</p>
<p>10 (i)</p> <p>$\tan \theta = \frac{1+2\sqrt{5}}{6+3\sqrt{5}} \times \frac{6-3\sqrt{5}}{6-3\sqrt{5}}$</p> <p>$= \frac{6-3\sqrt{5}+12\sqrt{5}-30}{36-45}$</p> <p>$= \frac{8}{3} - \sqrt{5}$</p> <p>(ii)</p> <p>$\tan^2 \theta + 1 = \sec^2 \theta$</p> <p>$\frac{64}{9} - \frac{16\sqrt{5}}{3} + 5 + 1 = \operatorname{cosec}^2 \theta$</p> <p>so $\operatorname{cosec}^2 \theta = \frac{118}{9} - \frac{16\sqrt{5}}{3}$</p> <p>Alternate solutions are acceptable</p>		<p>M1</p> <p>A1, A1</p> <p>M1</p> <p>A1, A1</p>	<p>for attempt at $\cot \theta$ together with rationalisation</p> <p>Must be convinced that a calculator is not being used.</p> <p>A1 for each term</p> <p>for attempt to use the correct identity or correct use of Pythagoras' theorem together with <i>their</i> answer to (i)</p> <p>Must be convinced that a calculator is not being used.</p> <p>A1 for each term</p>

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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
(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