

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the March 2015 series

0606 ADDITIONAL MATHEMATICS

0606/22

Paper 2 (Paper 22), maximum raw mark 80

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<p>1 (i)</p> <p>(ii)</p> <p>(iii)</p>	<p>4</p> <p>360</p>	<p>B1</p> <p>B1</p> <p>B2</p>	<p>or 2π</p> <p>Correct symmetrical shape; one cycle; both maximums at 1 and minimum at -7</p>
<p>2 (a) (i)</p> <p>(ii)</p> <p>(b)</p>	<p>$({}^9C_3 =) 84$</p> <p>$({}^9P_5 =) 15120$</p> <p>$\frac{2}{6} \times 6!$ or $5! + 5!$ oe</p> <p>240</p>	<p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p>	<p>or clear indication of method</p>
<p>3</p>	<p>Eliminate x or y</p> <p>$3x^2 + 2x - 8 = 0$ or $12y^2 - 44y + 32 = 0$ oe</p> <p>Factorise 3 term quadratic oe</p> <p>$x = \frac{4}{3}$ and -2</p> <p>$y = \frac{8}{3}$ and 1</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>correct method</p> <p>Or allow A1 A1 for each (x, y) pair</p> <p>If second M0 then SC1 for one (x, y) pair found by inspection i.e. with no method or with no incorrect method shown</p>

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<p>4 (i)</p> <p>$\sin x(\text{their } (-\sin x)) + \cos x(\text{their } \cos x)$ $-\sin^2 x + \cos^2 x$ oe $1 - 2\sin^2 x$ oe</p> <p>(ii)</p> <p>$\int(1 - 2\sin^2 x)dx = \sin x \cos x (+ c)$</p> <p>$-2 \int \sin^2 x dx = \sin x \cos x - \int 1 dx$</p> <p>$\frac{x}{2} - \frac{1}{2} \sin x \cos x [+ c]$ oe isw</p>	<p>M1</p> <p>A1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p>	<p>clearly applies correct form of product rule</p> <p>If M1 A0 A0 then allow SC1 for $\sin^2 x - \cos^2 x = 2\sin^2 x - 1$</p> <p>or</p> <p>$\int \sin^2 x dx = \frac{1}{-2} \left(\int (-2\sin^2 x + 1) dx - \int 1 dx \right)$ oe</p> <p>$\int \sin^2 x dx = \frac{1}{-2} \sin x \cos x - \frac{1}{-2} \int 1 dx$</p>
<p>5 (i)</p> <p>$6\mathbf{i} + 2\mathbf{j} - (-2\mathbf{i} + 17\mathbf{j})$ $= 8\mathbf{i} - 15\mathbf{j}$</p> <p>(ii)</p> <p>$\frac{\sqrt{\text{their } 8^2 + \text{their } (-15)^2}}{\text{their } 17}$ $\frac{\text{their } (8\mathbf{i} - 15\mathbf{j})}{\text{their } 17}$</p> <p>(iii)</p> <p>$-2\mathbf{i} + 17\mathbf{j} + m(6\mathbf{i} + 2\mathbf{j})$ leading to $17 + 2m = 0$ $m = -8.5$ oe $-53\mathbf{i}$</p>	<p>B1</p> <p>M1</p> <p>A1ft</p> <p>M1</p> <p>M1</p> <p>A1</p>	<p>ft their \overline{AB}</p> <p>If M0, allow SC1 for $6m - 2 = 0$ leading to $\frac{53}{3}\mathbf{j}$</p>
<p>6 (i)</p> <p>$15\pi = 20\theta$ $\theta = \frac{3}{4}\pi$ or exact equivalent form isw</p> <p>(ii)</p> <p>Sector plus triangle approach:</p> <p>Area sector = $\frac{1}{2} \times 20^2 \times \left(\text{their } \frac{3}{4}\pi \right)$ soi</p> <p>Area triangle = $\frac{1}{2} \times 20^2 \times \sin \left(\text{their } \frac{1}{4}\pi \right)$ soi</p> <p><i>their</i> sector area + <i>their</i> triangle area</p> <p>613 or 612.6(60254...) rot to 4 sig figs</p>	<p>M1</p> <p>A1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p>	<p>Semicircle less segment approach:</p> <p>Area sector = $\frac{1}{2} \times 20^2 \times \left(\text{their } \frac{1}{4}\pi \right)$ soi</p> <p>$\frac{\pi(20)^2}{2} - (\text{their area sector} - \text{their area triangle})$ soi</p>

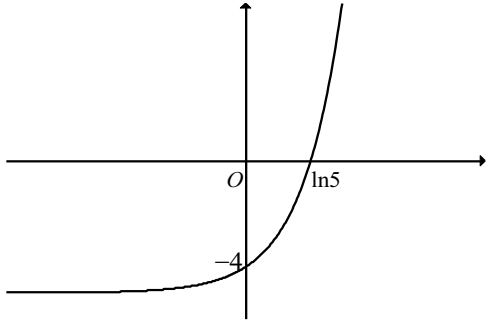
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7	(i)	$\mathbf{A}^2 = \begin{pmatrix} -14 & 45 \\ -27 & 85 \end{pmatrix}$ seen $\begin{pmatrix} -11 & 50 \\ -23 & 95 \end{pmatrix}$	M1	condone one error	
	(ii)	10	A1		
	(iii)	$\frac{1}{\text{their } 10}$ or $\begin{pmatrix} 10 & -5 \\ -4 & 3 \end{pmatrix}$ oe, seen $\frac{1}{10} \begin{pmatrix} 10 & -5 \\ -4 & 3 \end{pmatrix}$ oe isw	B1		
	(iv)	$\mathbf{X} = \mathbf{B}^{-1}\mathbf{A}$ soi $\begin{pmatrix} 0.5 & 0 \\ -0.5 & 1 \end{pmatrix}$ oe	M1 A1ft		ft their \mathbf{B}^{-1}
8	(i)	$(4, 2)$ $m_{AB} = \frac{3}{2} \Rightarrow m_{\text{Perp}} = -\frac{2}{3}$ $y - 2 = -\frac{2}{3}(x - 4)$ oe $2x + 3y = 14$	B1	allow unsimplified	
	(ii)	m_{AB} used $y + 2 = \text{their } m_{AB}(x - 10)$	M1 A1ft		allow arithmetic slips provided method is correct
	(iii)	$(10 - 6)^2 + (5 - (-2))^2$ oe $\sqrt{65}$ or 8.0622577... rot to 3 or more sf	M1		ft their mid-point and perpendicular gradient
	(iv)	$AC^2 = (2 - 10)^2 + (-1 - (-2))^2$ and $AC^2 = BC^2 = 65$ or showing C lies on the perpendicular bisector of AB or showing line from C to $(4, 2)$ is perpendicular to AB	A1		allow any correct equivalent form with integer a, b, c
			B1	any valid method	

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9	(i)	$k(2x+1)^{-3}$ $-8(2x+1)^{-3} \times 2$ oe $+ 2$ <i>their</i> $\frac{dy}{dx} = 0$ and solves $x = \frac{1}{2}, y = 2$	M1 A1 B1 M1 A1	
	(ii)	$y = 4 \times \frac{1}{2} = 2$	B1	or equivalent correct method
	(iii)	$\int \left(\frac{4}{(2x+1)^2} + 2x \right) dx$ $4 \times \frac{(2x+1)^{-1}}{-2} + \frac{2x^2}{2}$ or better $\left[\textit{their} \left(4 \times \frac{(2x+1)^{-1}}{-2} + \frac{2x^2}{2} \right) \right]_0^{\textit{their}0.5}$ Substitution of correct limits seen, leading to $1\frac{1}{4}$ Shaded area = <i>their</i> $1\frac{1}{4} - \textit{their} \frac{1}{2}$ $\frac{3}{4}$	M1 A1 M1 A1 M1 A1	Alternative method: M1 for $\int \left(\frac{4}{(2x+1)^2} + 2x - 4x \right) dx$ A1 for $4 \times \frac{(2x+1)^{-1}}{-2} + \frac{2x^2}{2} - 2x^2$ or better M1 for $\left[\textit{their} \left(4 \times \frac{(2x+1)^{-1}}{-2} - \frac{2x^2}{2} \right) \right]_0^{\textit{their}0.5}$ A1 for subst of <i>their</i> limits into <i>their</i> genuine attempt at an integral A1 for subst of correct limits into correct expression A1 for for $\frac{3}{4}$

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<p>10 (a)(i)</p>		<p>B3</p>	<p>B1 correct shape B1 through (0, -4) B1 through (ln5, 0)</p>
<p>(ii)</p>	<p>$k \leq -5$</p>	<p>B1</p>	
<p>(b)</p>	<p>$\frac{1}{2} \log_a 2 + 3 \log_a 2 - \log_a 2$ or $\log_a (2^{\frac{1}{2}} \times 2^3 \times 2^{-1})$ oe $2 \frac{1}{2} \log_a 2$ oe</p>	<p>M1 A1</p>	<p>condone one error</p>
<p>(c)</p>	<p>$\log_9 4x = \frac{\log_3 4x}{\log_3 9}$ or $\log_3 x = \frac{\log_9 x}{\log_9 3}$ $\log_3 x - \frac{\log_3 4x}{2} = 1$ or $\frac{\log_9 x}{\frac{1}{2}} - \log_9 4x = 1$ $\log_3 \frac{x}{(4x)^{\frac{1}{2}}} = \log_3 3$ or $\log_9 \frac{x^2}{4x} = \log_9 9$ oe $x = 36$</p>	<p>B1 M1 M1 A1</p>	<p>soi</p>

<p>11 (a)(i)</p>			
<p>(ii)</p>	$450 = \frac{1}{2} \times 30 \times k$ $k = 30$ $a = \frac{\text{their } 30}{30}$ $a = 1 \text{ [ms}^{-2}\text{]}$	<p>M1 A1 M1 A1</p>	
<p>(b)</p>	$v = \int a dt = \int (3t^2 + 6) dt$ $(v =) t^3 + 6t + 5$ <p>When $t = 3$, $v = 3^3 + 6(3) + 5$ $50 \text{ [ms}^{-1}\text{]}$</p>	<p>M1 A2 M1 A1</p>	<p>A1 for two terms correct</p>