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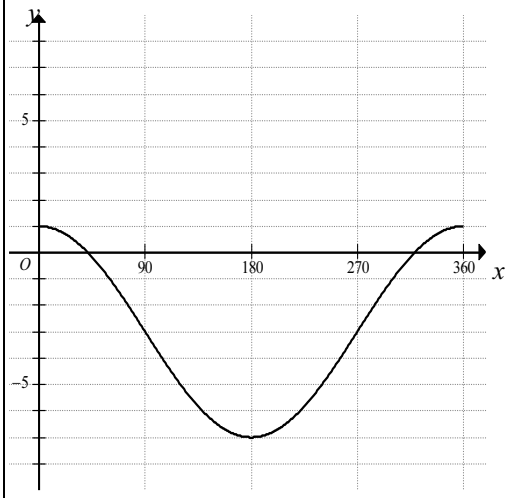
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1	**(i)**	4	**B1**	
	(ii)	360	**B1**	or 2π
	(iii)		**B2**	Correct symmetrical shape; one cycle; both maximums at 1 and minimum at –7
2	**(a)** **(i)**	$\left({}^{9}C_{3} =\right)$ 84	**B1**	
	(ii)	$\left({}^{9}P_{5} =\right)$ 15120	**B1**	
	(b)	$\frac{2}{6}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

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4 (i)	$\sin x\left(their\left(-\sin x\right)\right)+\cos x\left(their\cos x\right)$	**M1**	clearly applies correct form of product rule
	$-\sin^2 x+\cos^2 x$ oe	**A1**	If **M1 A0 A0** then allow **SC1** for $\sin^2 x-\cos^2 x=2\sin^2 x-1$
	$1-2\sin^2 x$ oe	**A1**	
(ii)	$\int\left(1-2\sin^2 x\right)dx=\sin x\cos x\left(+c\right)$	**M1**	**or** $\int\sin^2 x\,dx=\frac{1}{-2}\left(\int\left(-2\sin^2 x+1\right)dx-\int 1dx\right)$ oe
	$-2\int\sin^2 x\,dx=\sin x\cos x-\int 1dx$	**M1**	$\int\sin^2 x\,dx=\frac{1}{-2}\sin x\cos x-\frac{1}{-2}\int 1dx$
	$\frac{x}{2}-\frac{1}{2}\sin x\cos x$ [$+c$] oe isw	**A1**	
5 (i)	$6\mathbf{i}+2\mathbf{j}-(-2\mathbf{i}+17\mathbf{j})$ $=8\mathbf{i}-15\mathbf{j}$	**B1**	
(ii)	$\sqrt{their8^2+their(-15)^2}$	**M1**	
	$\frac{their(8\mathbf{i}-15\mathbf{j})}{their17}$	**A1ft**	**ft** *their* $\overline{AB}$
(iii)	$-2\mathbf{i}+17\mathbf{j}+m(6\mathbf{i}+2\mathbf{j})$ leading to $17+2m=0$	**M1**	
	$m=-8.5$ oe	**M1**	
	$-53\mathbf{i}$	**A1**	If **M0**, allow **SC1** for $6m-2=0$ leading to $\frac{53}{3}\mathbf{j}$
6 (i)	$15\pi=20\theta$	**M1**	
	$\theta=\frac{3}{4}\pi$ or exact equivalent form isw	**A1**	
(ii)	Sector plus triangle approach: Area sector $=\frac{1}{2}\times 20^2\times\left(their\frac{3}{4}\pi\right)$ soi	**B1**	Semicircle less segment approach: Area sector $=\frac{1}{2}\times 20^2\times\left(their\frac{1}{4}\pi\right)$ soi
	Area triangle $=\frac{1}{2}\times 20^2\times\sin\left(their\frac{1}{4}\pi\right)$ soi	**B1**	
	their sector area + *their* triangle area	**M1**	$\frac{\pi(20)^2}{2}$ – (*their* area sector – *their* area triangle) soi
	613 or 612.6(60254…) rot to 4 sig figs	**A1**	

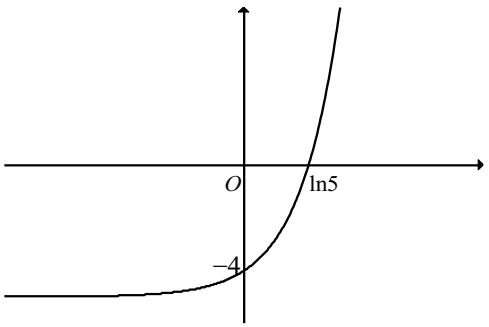
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7	**(i)**	$\mathbf{A}^2 = \begin{pmatrix} -14 & 45 \\ -27 & 85 \end{pmatrix}$ seen	**M1**	condone one error
		$\begin{pmatrix} -11 & 50 \\ -23 & 95 \end{pmatrix}$	**A1**	
	(ii)	10	**B1**	
	(iii)	$\frac{1}{their 10}$ or $\begin{pmatrix} 10 & -5 \\ -4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

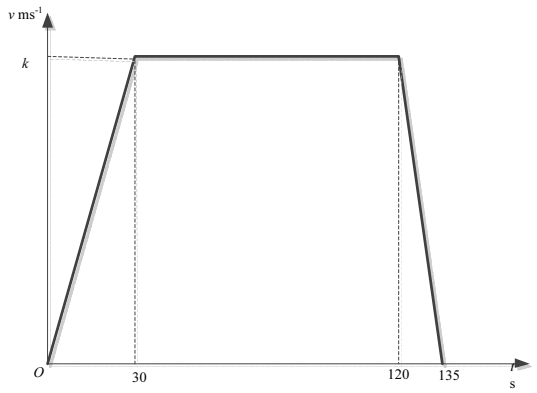
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9	**(i)**	$k(2x+1)^{-3}$	**M1**	
		$-8(2x+1)^{-3}\times 2$ oe	**A1**	
		$+\ 2$	**B1**	
		their $\frac{dy}{dx}=0$ and solves	**M1**	
		$x=\frac{1}{2},\ \ y=2$	**A1**	
	(ii)	$y=4\times\frac{1}{2}=2$	**B1**	or equivalent correct method
	(iii)	$\int\left(\frac{4}{(2x+1)^2}+2x\right)dx$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

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

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11 (a)(i)		**B2**	Horizontal line of correct length; deceleration correctly drawn; key times soi on horizontal axis
(ii)	$450 = \frac{1}{2} \times 30 \times k$	**M1**	
	$k = 30$	**A1**	
	$a = \frac{their 30}{30}$	**M1**	
	$a = 1$ [ms^{-2}]	**A1**	
(b)	$v = \int a\,dt = \int (3t^2 + 6)\,dt$	**M1**	
	$(v =)\ t^3 + 6t + 5$	**A2**	**A1** for two terms correct
	When $t = 3$, $v = 3^3 + 6(3) + 5$	**M1**	
	50 [ms^{-1}]	**A1**	

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