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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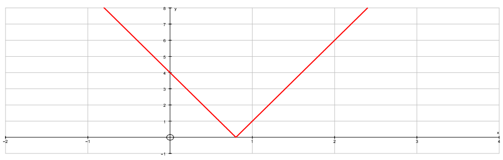
CAMBRIDGE
International Examinations

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	$kx - 3 = 2x^2 - 3x + k$ $2x^2 - x(k+3) + (k+3) = 0$	**M1**	for attempt to obtain a 3 term quadratic equation in terms of x
	Using $b^2 - 4ac$, $(k+3)^2 - (4 \times 2 \times (k+3))$ (<0)	**DM1**	for use of $b^2 - 4ac$
	$(k+3)(k-5)$ (<0)	**DM1**	for attempt to solve quadratic equation, dependent on both previous M marks
	Critical values $k = -3, 5$	**A1**	for both critical values
	so $-3 < k < 5$	**A1**	for correct range
3 **(i)**		**B1**	for shape, must touch the x-axis in the correct quadrant
		B1	for y intercept
		B1	for x intercept
(ii)	$4 - 5x = \pm 9$ or $(4-5x)^2 = 81$	**M1**	for attempt to obtain 2 solutions, must be a complete method
	leading to $x = -1$, $x = \dfrac{13}{5}$	**A1, A1**	**A1** for each
4 **(i)**	$729 + 2916x + 4860x^2$	**B1,B1** **B1**	**B1** for each correct term
(ii)	$2 \times$ *their* $4860 -$ *their* $2916 =$ 6804	**M1** **A1**	for attempt at 2 terms, must be as shown

5 **(i)**	gradient = 4 Using either (2, 1) or (3, 5), $c=-7$ $e^y = 4x + c$ 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
	Alternative method: $\frac{y-1}{5-1}=\frac{x-2}{3-2}$ or equivalent $e^y = 4x-7$ so $y=\ln(4x-7)$	**M1** **A1** **M1** **A1**	for attempt at straight line equation using both points allow correct unsimplified for correct method to deal with e^y
(ii)	$x>\frac{7}{4}$	**B1ft**	**ft** on *their* $4x-7$
(iii)	$\ln 6=\ln(4x-7)$ so $x=\frac{13}{4}$	**B1ft**	**ft** on *their* $4x-7$
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

7 (i)	$\mathrm{p}\left(\frac{1}{2}\right): \frac{a}{8}+\frac{b}{4}-\frac{3}{2}-4=0$ Simplifies to $a+2b=44$ $\mathrm{p}(-2): -8a+4b+6-4=-10$ 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)	$\mathrm{p}(x)=10x^3+17x^2-3x-4$ $=(2x-1)(5x^2+11x+4)$	**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 $0 \leqslant y \leqslant 1$	**B1**	
(ii)	Any suitable domain to give a one-one function	**B1**	e.g. $0 \leqslant x \leqslant \frac{\pi}{4}$
(b) (i)	$y=2+4\ln x$ oe $\ln x=\frac{y-2}{4}$ oe $\mathrm{g}^{-1}(x)=\mathrm{e}^{\frac{x-2}{4}}$ 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)	$\mathrm{g}(x^2+4)=10$ $2+4\ln(x^2+4)=10$ leading to $x=1.84$ only **Alternative method:** $\mathrm{h}(x)=x^2+4=\mathrm{g}^{-1}(10)$ $\mathrm{g}^{-1}(10)=\mathrm{e}^2$, so $x^2+4=\mathrm{e}^2$ 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.

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

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