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

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

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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 , $(k+3)^2-(4\times 2\times (k+3))\ \ (<0)$ $(k+3)(k-5)\ \ (<0)$ 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)		**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 $x=-1,\ x=\dfrac{13}{5}$	**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 × *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 equa... 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)**	$\text{p}\left(\frac{1}{2}\right): \frac{a}{8}+\frac{b}{4}-\frac{3}{2}-4=0$ Simplifies to $a+2b=44$ $\text{p}(-2): -8a+4b+6-4=-10$ 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)	$\text{p}(x)=10x^3+17x^2-3x-4$ $=(2x-1)(5x^2+11x+4)$	**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 $\text{g}^{-1}(x)=\text{e}^{\frac{x-2}{4}}$ 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)	$\text{g}(x^2+4)=10$ $2+4\ln(x^2+4)=10$ leading to $x=1.84$ only **Alternative method:** $\text{h}(x)=x^2+4=\text{g}^{-1}(10)$ $\text{g}^{-1}(10)=\text{e}^2$, so $x^2+4=\text{e}^2$ 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 × *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)	$2\sin x + 8(1 - \sin^2 x) = 5$	**M1**	for use of correct identity
	$8\sin^2 x - 2\sin x - 3 = 0$ $(4\sin x - 3)(2\sin x + 1) = 0$	**M1**	for attempt to solve quadratic equation
	$\sin x = \dfrac{3}{4}$, $\sin x = -\dfrac{1}{2}$ $x = 48.6°, 131.4°$ $210°, 330°$	**A1, A1**	**A1** for each pair of solutions