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 $x=-1,\ x=\frac{13}{5}$	**A1, A1**	**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 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)	$p\left(\frac{1}{2}\right): \frac{a}{8}+\frac{b}{4}-\frac{3}{2}-4=0$	M1	for correct use of $x=\frac{1}{2}$
	Simplifies to $a+2b=44$		
	$p(-2): -8a+4b+6-4=-10$	M1	for correct use of $x=-2$
	Simplifies to $2a-b=3$ oe	DM1	for solution of equations
	Leads to $a=10,\ b=17$	A1	for both, be careful as AG for *a*, allow verification
(ii)	$p(x)=10x^3+17x^2-3x-4$ $=(2x-1)(5x^2+11x+4)$	B2,1,0	–1 each error
(iii)	$x=\frac{1}{2}$	B1	
	$x=\frac{-11\pm\sqrt{41}}{10}$	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	M1	for a complete method to find the inverse
	$g^{-1}(x)=e^{\frac{x-2}{4}}$	A1	must be in the correct form
	Domain $x\in$	B1	
	Range $y>0$	B1	
(ii)	$g(x^2+4)=10$	M1	for correct order
	$2+4\ln(x^2+4)=10$	DM1	for attempt to solve
	leading to $x=1.84$ only	A1	for one solution only
	Alternative method:		
	$h(x)=x^2+4=g^{-1}(10)$	M1	for correct order
	$g^{-1}(10)=e^2$, so $x^2+4=e^2$	DM1	for attempt to solve
	leading to $x=1.84$ only	A1	for one solution only
(iii)	$\frac{4}{x}=2x$	B1	for given equation, allow in this form
	$x^2=2$	M1	for attempt to solve, must be using derivatives
	$x=\sqrt{2}$	A1	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)	$\tan\theta=\frac{1+2\sqrt{5}}{6+3\sqrt{5}}\times\frac{6-3\sqrt{5}}{6-3\sqrt{5}}$	**M1**	for attempt at $\cot\theta$ together with rationalisation. Must be convinced that a calculator is **not** being used.
	$=\frac{6-3\sqrt{5}+12\sqrt{5}-30}{36-45}$		
	$=\frac{8}{3}-\sqrt{5}$	**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 $= \dfrac{\frac{1}{\sin y}}{\frac{\cos y}{\sin y} + \frac{\sin y}{\cos y}}$	**M1**	for dealing with cosec, cot and tan in terms of sin and cos
	$= \dfrac{\frac{1}{\sin y}}{\frac{\cos^2 y + \sin^2 y}{\sin y \cos y}}$	**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)	$\cos 3z = 0.5$ $3z = \frac{\pi}{3}, \frac{5\pi}{3}, \frac{7\pi}{3}$	**M1**	for use of **(i)** and correct attempt to deal with multiple angle
	$z = \frac{\pi}{9}, \frac{5\pi}{9}, \frac{7\pi}{9}$	**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
	$\sin x = \frac{3}{4}$, $\sin x = -\frac{1}{2}$ $x = 48.6°, 131.4°$ $210°, 330°$	**A1, A1**	**A1** for each pair of solutions