CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 2014 series

0606 ADDITIONAL MATHEMATICS

0606/13 Paper 1, maximum raw mark 80

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International Examinations

1	$a=3$ $b=2$ $c=4$	**B1** **B1** **B1**	
2	$x^2=16$ or $y^2-4y+3=0$	**M1**	for correct elimination of one variable and attempt to form a quadratic equation in *x* or *y*.
	$x=\pm 4$ $y=1,3$	**A1** **A1**	
	Points (–4, 1) and (4, 3)		
	Line $AB=\sqrt{8^2+2^2}$	**M1**	for use of Pythagoras theorem
	$=\sqrt{68}$ or $2\sqrt{17}$	**A1**	allow either form
3 (i)	$\text{n}(A)=2$ $\text{n}(B)=3$ $\text{n}(C)=0$	**B1** **B1** **B1**	**B0** for n(2), {2},{0}, ∅, {} etc.
(ii)	$A\cup B=\{-1,-2,-3,3\}$	**B1**	
(iii)	$A\cap B=\{-2\}$	**B1**	
(iv)	ξ, 'the universal set', R, 'real numbers', $\{x : x\in \quad\}$	**B1**	
4 (a)	$\tan x=-\frac{5}{3}$	**M1**	Correct statement or $\tan x=-1.67$
	$x=121.0°,\ 301.0°$	**A1** **A1ft**	**A1** for either correct solution **ft** from *their* first solution
(b)	$\sin\left(3y+\frac{\pi}{4}\right)=\frac{1}{2}$	**M1**	for dealing correctly with cosec and attempt to solve subsequent equation
	$3y+\frac{\pi}{4}=\frac{\pi}{6},\ \frac{5\pi}{6},\ \frac{13\pi}{6},\ \frac{17\pi}{6}$	**A1**	for $\frac{\pi}{6}$, $\frac{5\pi}{6}$, or $\frac{13\pi}{6}$, or $\frac{17\pi}{6}$
	$3y=-\frac{\pi}{12},\ \frac{7\pi}{12},\ \frac{23\pi}{12},\ \frac{31\pi}{12}$	**DM1**	for correct order of operations
	$y=\frac{7\pi}{36},\ \frac{23\pi}{36},\ \frac{31\pi}{36}$ (0.611, 2.01 and 2.71)	**A1, A1**	**A1** for one correct solution **A1** for both the other correct solutions and no others in range.

5 (a) (i)	$\begin{pmatrix} 12 & 2 & 1 \\ 9 & 3 & 0 \\ 8 & 5 & 1 \\ 11 & 2 & 0 \end{pmatrix}\begin{pmatrix} 0.5 \\ 0.4 \\ 0.45 \end{pmatrix} = \begin{pmatrix} 7.25 \\ 5.70 \\ 6.45 \\ 6.30 \end{pmatrix}$	**M1**	for correct compatible matrices in the correct order. Allow 1 error in each matrix. Allow if done in cents
	or $\begin{pmatrix} 0.5 & 0.4 & 0.45 \end{pmatrix}\begin{pmatrix} 12 & 9 & 8 & 11 \\ 2 & 3 & 5 & 2 \\ 1 & 0 & 1 & 0 \end{pmatrix}$	**DM1**	for a correct method for multiplying their matrices to obtain an appropriate 4 by 1 or 1 by 4 matrix.
	$= \begin{pmatrix} 7.25 & 5.70 & 6.45 & 6.30 \end{pmatrix}$	**A2,1,0**	**A2** all correct or **A1** 3 correct elements.
(ii)	25.70	**B1**	Allow 25.7
(b)	$\mathbf{Y} = \mathbf{X}^{-1}$ or $\mathbf{Y} = \mathbf{X}^{-1}\mathbf{I}$	**M1**	for matrix algebra
	$\mathbf{Y} = \frac{1}{22}\begin{pmatrix} 1 & -4 \\ 5 & 2 \end{pmatrix}$ or $\begin{pmatrix} \frac{1}{22} & -\frac{4}{22} \\ \frac{5}{22} & \frac{2}{22} \end{pmatrix}$	**A1** **A1**	for $\frac{1}{22}\begin{pmatrix} & \\ & \end{pmatrix}$ for $k\begin{pmatrix} 1 & -4 \\ 5 & 2 \end{pmatrix}$
	Alternative method: $\begin{pmatrix} 2 & 4 \\ -5 & 1 \end{pmatrix}\begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ $2a + 4c = 1,\ 2b + 4d = 0$ $-5a + c = 0,\ -5b + d = 1$	**M1** **A1**	for a complete method using simultaneous equations $a = \frac{1}{22}$ and $c = \frac{5}{22}$ or $b = -\frac{4}{22}$ and $d = \frac{2}{22}$
	leading to $= \frac{1}{22}\begin{pmatrix} 1 & -4 \\ 5 & 2 \end{pmatrix}$ oe	**A1**	for correct matrix

6 (i)	$\cos 0.9 = \frac{6}{OC}$ or $\frac{OC}{\sin 0.9} = \frac{12}{\sin(\pi - 1.8)}$ $OC = \frac{6}{\cos 0.9} = 9.652...$	**M1**	for correct use of cosine, sine rule, cosine rule or any other valid method
	or $OC = \frac{12\sin 0.9}{\sin(\pi - 1.8)} = 9.652...$	**A1**	for manipulating correctly to $OC = 9.652(35\ldots)$ Must have 4th figure (or more) for rounding
(ii)	Perimeter = $(0.9\times 12) + 9.652 + (12 - 9.652)$	**B1** **M1**	for arc length for attempt to add the correct lengths
	= 22.8	**A1**	
(iii)	Area $= \left(\frac{1}{2}\times 12^2 \times 0.9\right) - \left(\frac{1}{2}\times 9.652^2 \sin(\pi - 1.8)\right)$	**B1** **B1**	for area of sector, allow unsimplified for area of isosceles triangle $\frac{1}{2}(9.65(2...))^2 \sin(\pi - 1.8)$ or $\frac{1}{2}(12\times 6\tan 0.9)$ or $\frac{1}{2}(12\times 9.65(2...)\times \sin 0.9)$, allow unsimplified.
	64.8 – 45.36 = 19.4 to 19.5	**B1**	for answer in range 19.4 to 19.5
	Alternative Method: $\frac{1}{2}(12 - 9.652)\times 9.652\times \sin 1.8$	**B1**	for area of triangle *ACB*, unsimplified
	$\frac{1}{2}12^2(0.9 - \sin 0.9)$	**B1**	for area of segment, unsimplified
	11.04 + 8.40 Area =19.4 to 19.5	**B1**	answer in range 19.4 to 19.5
7	$1 + 2\log_5 x = \log_5(18x - 9)$	**B1, B1**	**B1** for dealing with '1', **B1** for dealing with '2'
	$\log_5 5 + \log_5 x^2 = \log_5(18x - 9)$	**M1**	for a correct use of addition or subtraction of logarithms
	$5x^2 = 18x - 9$ $(5x - 3)(x - 3) = 0$	**DM1**	for elimination of logarithms to form a 3 term quadratic and for solution of quadratic
	$x = \frac{3}{5},\ 3$	**A1**	for both *x* values

8 (i)	$f'(x) = \left(x \times \frac{3x^2}{x^3}\right) + \left(\ln x^3\right)$	**M1** **B1**	for differentiation of a product for differentiation of $\ln x^3$
	$= 3 + 3\ln x$, $= 3(1 + \ln x)$	**A1**	for simplification to gain <u>given answer</u>
	or $f(x) = 3x\ln x$	**B1**	for use of $\ln x^3 = 3\ln x$
	$f'(x) = \left(3x \times \frac{1}{x}\right) + 3\ln x$,	**M1**	for differentiation of a product
	$= 3(1 + \ln x)$	**A1**	for simplification to gain <u>given answer</u>
(ii)	$\int 3(1 + \ln x)\,dx = x\ln x^3$ or $3x\ln x$	**M1**	for realising that differentiation is the reverse of integration and using **(i)**
	$\int 1 + \ln x\,dx = \frac{1}{3}x\ln x^3$ or $x\ln x$	**A1**	
(iii)	$x\ln x - \int 1\,dx$ or $\left[\frac{1}{3}x\ln x^3\right] - \int 1\,dx$	**DM1**	for using answer to **(ii)** and subtracting $\int 1\,dx$ dependent on M mark in **(ii)**
	$[x\ln x - x]_1^2$ or $\left[\frac{1}{3}x\ln x^3 - x\right]_1^2$	**DM1**	for correct application of limits
	$= 2\ln 2 - 2 + 1$ $= -1 + \ln 4$	**A1**	from correct working
9 (a)	$5^p = 625$, so $p = 4$	**B1**	
	${}^4C_1 5^{p-1}(-q) = -1500$ $4 \times 125(-q) = -1500$	**M1**	*their p* substituted in ${}^pC_1 5^{p-1}(-q)$ or in ${}^pC_1 5^{p-1}(-qx)$ unsimplified
	$q = 3$	**A1**	
	${}^4C_2 5^{p-2} q^2 = r$	**M1**	*their p* and *q* substituted in ${}^pC_2 5^{p-2}(-q)^2$ or ${}^pC_2 5^{p-2}(-qx)^2$ unsimplified
	$r = 1350$	**A1**	
(b)	${}^{12}C_3 (2x)^9 \left(\frac{1}{4x^3}\right)^3$	**M1**	for identifying correct term
		DM1	for attempt to evaluate correct expression
	Term is 1760	**A1**	must be evaluated

10 (a)	$\frac{5^x}{5^{2(3y-2)}}=1$ or $\frac{3^x}{3^{3(y-1)}}=3^4$ oe	**M1**	for obtaining one correct equation in powers of 5, 3, 25, 27 or 81
	$x=6y-4$	**A1**	for $x=6y-4$ oe linear equation
	$x=3y+1$	**A1**	for $x=3y+1$ oe linear equation
		M1	for attempt to solve linear simultaneous equations which have been obtained correctly
	Leads to $x=6,\ y=\frac{5}{3}$	**A1**	for both.
(b)	Using the cosine rule: $\left(1+2\sqrt{3}\right)^2=\left(2+\sqrt{3}\right)^2+2^2-4\left(2+\sqrt{3}\right)\cos A$	**M1**	for correct substitution in cosine rule, may use in form of $\cos A=...$
	$\cos A=\frac{\left(13+4\sqrt{3}\right)-\left(7+4\sqrt{3}\right)-4}{-4\left(2+\sqrt{3}\right)}$ oe	**DM1**	for attempt to make cos*A* subject and simplify
	$\cos A=\frac{-1}{2\left(2+\sqrt{3}\right)}\times\frac{2-\sqrt{3}}{2-\sqrt{3}}$	**DM1**	for rationalisation.
	$\cos A=-1+\frac{\sqrt{3}}{2}$	**A1**	

11 (i)	$\frac{dy}{dx} = (x+5)2(x-1)+(x-1)^2$	**M1**	for differentiation of a product, allow unsimplified
		A1	correct
	$\frac{dy}{dx} = (x-1)(3x+9)$		
	When $\frac{dy}{dx} = 0$	**DM1**	for equating to zero and solution of quadratic
	$x = 1$	**A1**	
	$x = -3$	**A1**	
	Alternative method:		
	$y = x^3 + 3x^2 - 9x + 5$	**M1**	for expansion of brackets and differentiation of each term of a 4 term cubic
	$\frac{dy}{dx} = 3x^2 + 6x - 9$	**A1**	
	When $\frac{dy}{dx} = 0$	**DM1**	for equating to zero and solution of 3 term quadratic
	$x = 1$	**A1**	from correct quadratic equation
	$x = -3$	**A1**	from correct quadratic equation
(ii)	$\int x^3 + 3x^2 - 9x + 5 dx$	**M1**	for correct attempt to obtain and integrate a 4 term cubic
	$= \frac{x^4}{4} + x^3 - \frac{9x^2}{2} + 5x \ (+c)$	**A2,1,0**	**A2** for 4 correct terms or **A1** for 3 correct terms
(iii)	$\left[\frac{x^4}{4} + x^3 - \frac{9x^2}{2} + 5x\right]_{-5}^{1}$	**M1**	for correct substitution of limits 1 and –5 for *their* **(ii)**
	$= \left(\frac{1}{4} + 1 - \frac{9}{2} + 5\right) - \left(\frac{625}{4} - 125 - \frac{225}{2} - 25\right)$		
	$= 108$	**A1**	
(iv)	When $x = -3, y = 32$	**M1**	for realising that the *y*-coordinate of the maximum point is needed.
	$k > 32$	**A1**	