CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2014 series

0606 ADDITIONAL MATHEMATICS

0606/23 Paper 2, 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.

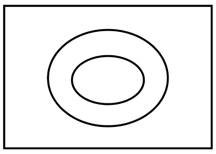
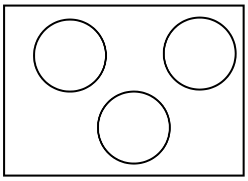
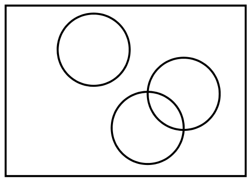
Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2014 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

CAMBRIDGE
International Examinations

1 **(i)**	$500 = \frac{1}{2}r^2(1.6)$	**M1**	
	25 only	**A1**	± 25 is **A0**
(ii)	*their* 25 + *their* 25 + *their* 25 × 1.6 or better	**M1**	*their* 25 must be positive
	90	**A1**	
2	$\log_x 3 = \frac{1}{\log_3 x}$ oe soi	**B1**	may be implied by $\log_x 3 = \frac{1}{u}$ oe
	$u^2 - 4u - 12 = 0$ oe	**M1**	condone sign errors
	solve their 3 term quadratic in u	**M1**	
	Solve $\log_3 x = 6$ or $\log_3 x = -2$ oe	**M1**	
	729 and $\frac{1}{9}$	**A1**	
3 **(i)**	$\begin{pmatrix} 3 & 1 & 4 \\ 1 & 3 & 0 \end{pmatrix}$ and $\begin{pmatrix} 5 \\ 3 \\ 1 \end{pmatrix}$	**B1**	
	or $\begin{pmatrix} 5 & 3 & 1 \end{pmatrix}$ and $\begin{pmatrix} 3 & 1 \\ 1 & 4 \\ 4 & 0 \end{pmatrix}$		
	Multiplication of compatible matrices	**M1**	Must be correct shape from candidates product
	$\begin{pmatrix} 22 \\ 17 \end{pmatrix}$ or $\begin{pmatrix} 22 & 17 \end{pmatrix}$ as appropriate	**A1**	
(ii)	$\begin{pmatrix} 1 & 1 \end{pmatrix}$ with $\begin{pmatrix} 22 \\ 17 \end{pmatrix}$ or $\begin{pmatrix} 22 & 17 \end{pmatrix}$ with $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$	**B1**	

4 (a) (i)		**B1**	
(ii)	 or 	**B1**	any Venn diagram showing three circles which do not all overlap
(b) (i)	$50 \notin C$	**B1**	
(ii)	$64 \in S \cap C$	**B1ft**	**ft** only on use of $\not\subset$ and $\subset$ instead of $\notin$ and $\in$
(iii)	$n(S') = 90$	**B1**	
5 (i)	$\left(2\sqrt{2}+4\right)^2 = 8 + 16\sqrt{2} + 16$	**B1**	
	Correct completion	**B1**	
(ii)	Use $\dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$	**M1**	$\left(= \dfrac{\left(2\sqrt{2}+4\right)}{2\left(2\sqrt{2}+3\right)} \right)$
	Multiply top and bottom by $2\sqrt{2}-3$	**M1**	
	$2-\sqrt{2}$	**A1**	Or $4\sqrt{2}-6$
6	Eliminate x or y	**M1**	
	Rearrange to quadratic in x or y	**M1**	
	$x^2 - 27x + 72 = 0$ or $y^2 + 9y - 90 = 0$	**A1**	
	Factorise or solve 3 term quadratic	**M1**	
	$x = 3$, $x = 24$ or $y = 6$, $y = -15$	**A1**	
	$y = 6$, $y = -15$ or $x = 3$, $x = 24$	**B1**	

7 **(a)**	$\dfrac{\dfrac{\sin\theta}{\cos\theta}+\dfrac{\cos\theta}{\sin\theta}}{\dfrac{1}{\cos\theta}+\dfrac{1}{\sin\theta}}$	**B1**	
	Clears the fractions in the numerator and denominator using common denominator	**M1**	
	$\dfrac{\sin^2\theta+\cos^2\theta}{\sin\theta+\cos\theta}$ and completion	**A1**	
(b)	evidence of 13	**B1**	
	$\sin x=\dfrac{5}{13}$	**B1**	
	$\cos x=-\dfrac{12}{13}$	**B1ft**	**ft** on *their* 13
8 **(i)**	Attempt to find b^2-4ac	**M1**	may be in formula or attempt to complete square
	Completely correct argument	**A1**	
(ii)	$m = 6(4) - 8(2) + 3$	**M1**	
	$y - 10 = 11(x - 2)$ or $y = 11x - 12$	**A1**	
(iii)	Integrate to $2x^3 - 4x^2 + 3x(+c)$	**B2,1,0**	
	$10 = 2(2)^3 - 4(2)^2 + 3(2) + c$	**M1**	dep on c being a genuine constant of integration
	$y = 2x^3 - 4x^2 + 3x + 4$ soi	**A1**	

9 (i)	(0, 7)	**B1**	
	$m_{AB} = 2$	**B1**	
	perpendicular gradient $= -\frac{1}{2}$	**M1**	
	$y = -\frac{1}{2}x + 7$	**A1**	
(ii)	$m_{AB} = -1$	**B1**	
	$y = -x + 13$	**B1**	
	Solve their $y = -x + 13$ and $y = -\frac{1}{2}x + 7$	**M1**	
	$D(12,1)$	**A1**	
	Complete method for area	**M1**	
	84	**A1**	
10 (i)	$\frac{\mathrm{d}}{\mathrm{d}x}\left(\sqrt{x^2+21}\right) = \frac{x}{\sqrt{x^2+21}}$	**B1**	Alt method using product rule $\frac{\mathrm{d}}{\mathrm{d}x}\frac{1}{\left(\sqrt{x^2+21}\right)} = \frac{-x}{\left(\sqrt{x^2+21}\right)^3}$ is B1
	Use of quotient rule	**M1**	then **M1 A1** as in quotient
	$\dfrac{2\sqrt{\left(x^2+21\right)} - 2x \times \dfrac{x}{\sqrt{\left(x^2+21\right)}}}{\left(x^2+21\right)}$	**A1**	
	Multiply each term by $\sqrt{\left(x^2+21\right)}$	**M1**	
	$\dfrac{2\left(x^2+21\right) - 2x^2}{\left(x^2+21\right)^{\frac{3}{2}}}$ leading to $k = 42$	**A1**	
(ii)	$\frac{6}{k} \times \frac{2x}{\sqrt{x^2+21}}$	**M1**	k must be a constant
	Use limits in $C \times \frac{2x}{\sqrt{x^2+21}}$	**M1**	
	$\frac{8}{55}$ or 0.145	**A1**	

11 **(i)**	$\overrightarrow{OM} = \mathbf{a}$	**B1**	
	$\overrightarrow{MB} = 5\mathbf{b} - \mathbf{a}$	**B1**	
(ii)	$\overrightarrow{ON} = 3b$	**B1**	
	$\overrightarrow{AP} = \lambda(3\mathbf{b} - 2\mathbf{a})$	**B1**	
(iii)	$\overrightarrow{MP} = \overrightarrow{MA} + \overrightarrow{AP}$ $\mathbf{a} + \lambda(3\mathbf{b} - 2\mathbf{a})$	**M1** **A1**	
(iv)	Put $\overrightarrow{MP} = \mu\overrightarrow{MB}$	**M1**	
	Equate components	**M1**	
	Solve simultaneous equations	**M1**	
	$\lambda = \frac{5}{7}$	**A1**	
12 **(i)**	$3 < \mathrm{f} < 7$	**B1,B1**	If **B0** then **SC1** for $3 < \mathrm{f} < 7$
(ii)	$\mathrm{f}(12) = 5$	**B1**	$\mathrm{f}^2(x)$ $\sqrt{\left(\sqrt{(x-3)} + 2 - 3\right)} + 2$ earns **B1**
	$(\mathrm{f}(5) =)$ $2 + \sqrt{2}$	**B1**	
(iii)	Clear indication of method $\mathrm{f}^{-1}(x) = (x-2)^2 + 3$	**M1** **A1**	condone $y = (x-2)^2 + 3$
(iv)	$\mathrm{gf}(x) = \dfrac{120}{\sqrt{(x-3)} + 2}$	**B1**	
	Attempt to solve *their* $\mathrm{gf}(x) = 20$	**M1**	
	$x = 19$	**A1**	