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**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.

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| | | | |
|---|---|---|---|
| **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 $\begin{pmatrix} 5 \\ 3 \\ 1 \end{pmatrix}$ or $\begin{pmatrix} 5 & 3 & 1 \end{pmatrix}$ and $\begin{pmatrix} 3 & 1 \\ 1 & 4 \\ 4 & 0 \end{pmatrix}$ | **B1** | |
| | 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** | |

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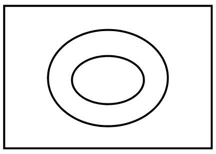
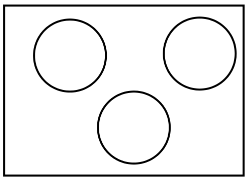
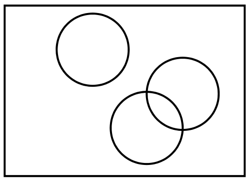
| **4 (a) (i)** |  | **B1** | |
| **(ii)** |  or  | **B1** | any Venn diagram showing three circles which do not all overlap |
| **(b) (i)** | $50 \notin C$ | **B1** | |
| **(ii)** | $64 \in S \cap C$ | **B1ft** | **ft** only on use of $\not\subset$ and $\subset$ instead of $\notin$ and $\in$ |
| **(iii)** | $n(S') = 90$ | **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** | |

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| 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<br>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** | |

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| **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 |
| | $\dfrac{2\sqrt{(x^2+21)} - 2x \times \dfrac{x}{\sqrt{(x^2+21)}}}{(x^2+21)}$ | **A1** | |
| | Multiply each term by $\sqrt{(x^2+21)}$ | **M1** | |
| | $\dfrac{2(x^2+21) - 2x^2}{(x^2+21)^{\frac{3}{2}}}$ 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** | |

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

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