**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Cambridge International General Certificate of Secondary Education**

# MARK SCHEME for the March 2015 series

## 0606 ADDITIONAL MATHEMATICS

**0606/22** Paper 2 (Paper 22), 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 March 2015 series for most Cambridge IGCSE®, components.





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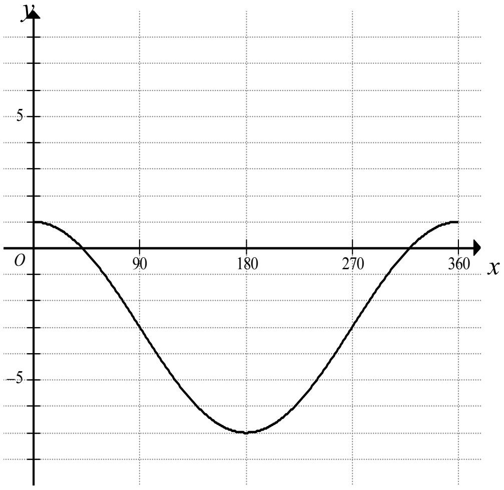
|---|---|---|---|
| **1 (i)** | 4 | **B1** | |
| **(ii)** | 360 | **B1** | or 2π |
| **(iii)** |  | **B2** | Correct symmetrical shape; one cycle; both maximums at 1 and minimum at –7 |
| **2 (a) (i)** | $\left({}^9C_3 =\right)$ 84 | **B1** | |
| **(ii)** | $\left({}^9P_5 =\right)$ 15120 | **B1** | |
| **(b)** | $\frac{2}{6} \times 6!$ or $5! + 5!$ oe<br>240 | **M1**<br>**A1** | or clear indication of method |
| **3** | Eliminate $x$ or $y$<br>$3x^2 + 2x - 8 = 0$ or $12y^2 - 44y + 32 = 0$ oe<br>Factorise 3 term quadratic oe<br>$x = \frac{4}{3}$ and –2<br>$y = \frac{8}{3}$ and 1 | **M1**<br>**A1**<br>**M1**<br>**A1**<br>**A1** | <br><br>correct method<br><br>Or allow **A1 A1** for each $(x, y)$ pair<br>If second **M0** then **SC1** for **one** $(x, y)$ pair found by inspection i.e. with no method or with no incorrect method shown |

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| **4 (i)** | $\sin x(\textit{their}(-\sin x)) + \cos x(\textit{their}\cos x)$ | **M1** | clearly applies correct form of product rule |
| | $-\sin^2 x + \cos^2 x$ oe | **A1** | If **M1 A0 A0** then allow **SC1** for |
| | $1 - 2\sin^2 x$ oe | **A1** | $\sin^2 x - \cos^2 x = 2\sin^2 x - 1$ |
| **(ii)** | $\int(1 - 2\sin^2 x)\mathrm{d}x = \sin x\cos x(+c)$ | **M1** | **or** $\int \sin^2 x\mathrm{d}x = \frac{1}{-2}\left(\int(-2\sin^2 x + 1)\mathrm{d}x - \int 1\mathrm{d}x\right)$ oe |
| | $-2\int\sin^2 x\mathrm{d}x = \sin x\cos x - \int 1\mathrm{d}x$ | **M1** | $\int\sin^2 x\mathrm{d}x = \frac{1}{-2}\sin x\cos x - \frac{1}{-2}\int 1\mathrm{d}x$ |
| | $\frac{x}{2} - \frac{1}{2}\sin x\cos x$ [+ $c$] oe isw | **A1** | |
| **5 (i)** | 6**i** + 2**j** – (–2**i** + 17**j**) = 8**i** – 15**j** | **B1** | |
| **(ii)** | $\sqrt{\textit{their}8^2 + \textit{their}(-15)^2}$ | **M1** | |
| | $\frac{\textit{their}(8\mathbf{i} - 15\mathbf{j})}{\textit{their}17}$ | **A1ft** | **ft** *their* $\overrightarrow{AB}$ |
| **(iii)** | –2**i** + 17**j** + *m*(6**i** + 2**j**) leading to | | |
| | 17 + 2*m* = 0 | **M1** | |
| | *m* = –8.5 oe | **M1** | |
| | –53**i** | **A1** | If **M0**, allow **SC1** for 6*m* – 2 = 0 leading to $\frac{53}{3}\mathbf{j}$ |
| **6 (i)** | $15\pi = 20\theta$ | **M1** | |
| | $\theta = \frac{3}{4}\pi$ or exact equivalent form isw | **A1** | |
| **(ii)** | Sector plus triangle approach: | | Semicircle less segment approach: |
| | Area sector $= \frac{1}{2}\times 20^2 \times\left(\textit{their}\frac{3}{4}\pi\right)$ soi | **B1** | Area sector $= \frac{1}{2}\times 20^2 \times\left(\textit{their}\frac{1}{4}\pi\right)$ soi |
| | Area triangle $= \frac{1}{2}\times 20^2 \times\sin\left(\textit{their}\frac{1}{4}\pi\right)$ soi | **B1** | |
| | *their* sector area + *their* triangle area | **M1** | $\frac{\pi(20)^2}{2}$ – (*their* area sector – *their* area triangle) soi |
| | 613 or 612.6(60254…) rot to 4 sig figs | **A1** | |

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| **7 (i)** | $\mathbf{A}^2 = \begin{pmatrix} -14 & 45 \\ -27 & 85 \end{pmatrix}$ seen | **M1** | condone one error |
| | $\begin{pmatrix} -11 & 50 \\ -23 & 95 \end{pmatrix}$ | **A1** | |
| **(ii)** | 10 | **B1** | |
| **(iii)** | $\frac{1}{\textit{their}10}$ or $\begin{pmatrix} 10 & -5 \\ -4 & 3 \end{pmatrix}$ oe, seen | **B1** | |
| | $\frac{1}{10}\begin{pmatrix} 10 & -5 \\ -4 & 3 \end{pmatrix}$ oe isw | **B1** | |
| **(iv)** | $\mathbf{X} = \mathbf{B}^{-1}\mathbf{A}$ soi | **M1** | |
| | $\begin{pmatrix} 0.5 & 0 \\ -0.5 & 1 \end{pmatrix}$ oe | **A1ft** | **ft** *their* $\mathbf{B}^{-1}$ |
| **8 (i)** | (4, 2) | **B1** | allow unsimplified |
| | $m_{AB} = \frac{3}{2} \Rightarrow m_{Perp} = -\frac{2}{3}$ | **M1** | allow arithmetic slips provided method is correct |
| | $y - 2 = -\frac{2}{3}(x - 4)$ oe | **M1** | **ft** *their* mid-point and perpendicular gradient |
| | $2x + 3y = 14$ | **A1** | allow any correct equivalent form with integer *a*, *b*, *c* |
| **(ii)** | $m_{AB}$ used<br>$y + 2 = \textit{their}\ m_{AB}(x - 10)$ | **M1**<br>**A1ft** | |
| **(iii)** | $(10-6)^2 + (5-(-2))^2$ oe | **M1** | any valid method |
| | $\sqrt{65}$ or 8.0622577… rot to 3 or more sf | **A1** | |
| **(iv)** | $AC^2 = (2-10)^2 + (-1-(-2))^2$ and $AC^2 = BC^2 = 65$<br>**or** showing *C* lies on the perpendicular bisector of *AB*<br>**or** showing line from *C* to (4, 2) is perpendicular to *AB* | **B1** | any valid method |

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| **9** **(i)** | $k(2x+1)^{-3}$ | **M1** | |
| | $-8(2x+1)^{-3}\times 2$ oe | **A1** | |
| | $+\ 2$ | **B1** | |
| | *their* $\frac{dy}{dx}=0$ and solves | **M1** | |
| | $x=\frac{1}{2},\ \ y=2$ | **A1** | |
| **(ii)** | $y=4\times\frac{1}{2}=2$ | **B1** | or equivalent correct method |
| **(iii)** | $\int\left(\frac{4}{(2x+1)^2}+2x\right)dx$ | **M1** | **Alternative method:** **M1** for $\int\left(\frac{4}{(2x+1)^2}+2x-4x\right)dx$ |
| | $4\times\frac{(2x+1)^{-1}}{-2}+\frac{2x^2}{2}$ or better | **A1** | **A1** for $4\times\frac{(2x+1)^{-1}}{-2}+\frac{2x^2}{2}-2x^2$ or better |
| | $\left[\textit{their}\left(4\times\frac{(2x+1)^{-1}}{-2}+\frac{2x^2}{2}\right)\right]_0^{\textit{their}\,0.5}$ | **M1** | **M1** for $\left[\textit{their}\left(4\times\frac{(2x+1)^{-1}}{-2}-\frac{2x^2}{2}\right)\right]_0^{\textit{their}\,0.5}$ |
| | Substitution of correct limits seen, leading to $1\frac{1}{4}$ | **A1** | **M1** for subst of *their* limits into *their* genuine attempt at an integral **A1** for subst of correct limits into correct expression |
| | Shaded area = *their* $1\frac{1}{4}-$ *their* $\frac{1}{2}$ | **M1** | |
| | $\frac{3}{4}$ | **A1** | **A1** for for $\frac{3}{4}$ |

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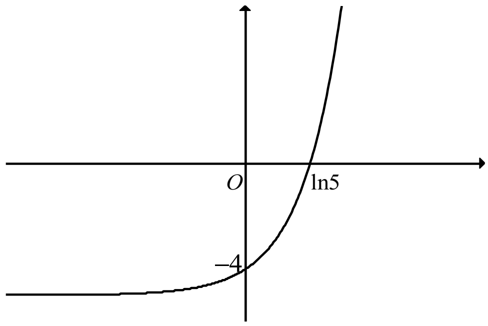
| **10 (a)(i)** |  | **B3** | **B1** correct shape<br>**B1** through (0, –4)<br>**B1** through (ln5, 0) |
| **(ii)** | $k \leqslant -5$ | **B1** | |
| **(b)** | $\frac{1}{2}\log_a 2 + 3\log_a 2 - \log_a 2$ or<br>$\log_a\left(2^{\frac{1}{2}} \times 2^3 \times 2^{-1}\right)$ oe | **M1** | condone one error |
| | $2\frac{1}{2}\log_a 2$ oe | **A1** | |
| **(c)** | $\log_9 4x = \frac{\log_3 4x}{\log_3 9}$ **or** $\log_3 x = \frac{\log_9 x}{\log_9 3}$ | **B1** | soi |
| | $\log_3 x - \frac{\log_3 4x}{2} = 1$ **or** $\frac{\log_9 x}{\frac{1}{2}} - \log_9 4x = 1$ | **M1** | |
| | $\log_3 \frac{x}{(4x)^{\frac{1}{2}}} = \log_3 3$ **or** $\log_9 \frac{x^2}{4x} = \log_9 9$ oe | **M1** | |
| | $x = 36$ | **A1** | |

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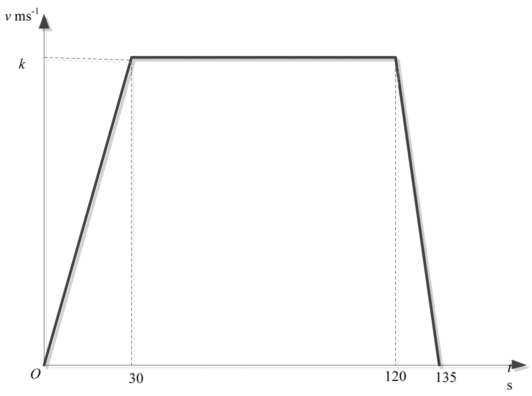
| **11 (a)(i)** |  | **B2** | Horizontal line of correct length; deceleration correctly drawn; key times soi on horizontal axis |
| **(ii)** | $450=\frac{1}{2}\times 30\times k$ | **M1** | |
| | $k = 30$ | **A1** | |
| | $a=\frac{their30}{30}$ | **M1** | |
| | $a = 1$ [$ms^{-2}$] | **A1** | |
| **(b)** | $v=\int a\,dt=\int(3t^2+6)\,dt$ | **M1** | |
| | $(v=)\ t^3+6t+5$ | **A2** | **A1** for two terms correct |
| | When $t = 3$, $v = 3^3+6(3)+5$ | **M1** | |
| | 50 [$ms^{-1}$] | **A1** | |