

CAMBRIDGE INTERNATIONAL EXAMINATIONS
Cambridge International General Certificate of Secondary Education

MARK SCHEME for the May/June 2015 series

0606 ADDITIONAL MATHEMATICS

0606/23

Paper 2 (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 2015 series for most Cambridge IGCSE[®], Cambridge International A and AS Level components and some Cambridge O Level components.

® IGCSE is the registered trademark of Cambridge International Examinations.

| | | | |
|--------|---------------------------------|----------|---------|
| Page 2 | Mark Scheme | Syllabus | Page 23 |
| | Cambridge IGCSE – May/June 2015 | 0606 | |

Abbreviations

| | |
|------|----------------------------|
| awrt | answers which round to |
| cao | correct answer only |
| dep | dependent |
| FT | follow through after error |
| isw | ignore subsequent working |
| oe | or equivalent |
| rot | rounded or truncated |
| SC | Special Case |
| soi | seen or implied |
| www | without wrong working |

| | | | | |
|---|----------|--|----------------|---|
| 1 | (a) | $\frac{\log_3 x}{\log_3 27}$ $\frac{\log_3 x}{3} \text{ isw}$ | M1 | Can use other interim bases if all correct but M1 when in base 3 only |
| | (b) | $\log_a 15 - \log_a 3 = \log_a 5 \text{ soi}$ $\log_a 5^3 \text{ or } \log_a a$ $\log_a y = \log_a 125a \Rightarrow y = 125a$ | M1 M1 A1 | NOT $\log_3 x \div 3$ |
| 2 | (a) | $[f(x) =]2x - 4 \text{ and } [f(x) =]-2x + 4$ | B1, B1 | Condone $y = \dots$ |
| | (b) | | B1 B1 B1 | correct shape; y intercept marked or seen nearby; intent to tend to $y = 3$ (i.e. not tending to or cutting x-axis) |
| 3 | (a) | $\mathbf{A} = \frac{1}{4} \left[\begin{pmatrix} 51 & -8 & 19 \\ 31 & 2 & 65 \end{pmatrix} - \begin{pmatrix} 20 & 0 & -5 \\ 15 & -10 & 25 \end{pmatrix} \right]$ $\mathbf{A} = \begin{pmatrix} 8 & -2 & 6 \\ 4 & 3 & 10 \end{pmatrix}$ | M1 A1 | Integer values |
| | (b) (i) | The (total) value of the stock in each of the 3 shops | B1 | Must have “each” oe |
| | (b) (ii) | The total value of the stock in all 3 shops | B1 | Must have “total” oe |

| | | | | |
|---|---------|---|------------------------|---|
| 4 | (i) | $\frac{PT}{8} = \tan\left(\frac{3\pi}{8}\right)$ oe $PT = 19.3$ | M1 A1 | $\frac{PT}{\sin\frac{3\pi}{8}} = \frac{8}{\sin\frac{\pi}{8}}$ awrt 19.3 |
| | (ii) | $\frac{1}{2} \times 8^2 \times \frac{3\pi}{4}$ oe (75.4) $8 \tan\left(\frac{3\pi}{8}\right) \times 8 - \text{their sector}$ oe (=154.5-'75.4') 79.1 | M1 M1 A1 | or $\frac{1}{2} \times 8^2 \times \frac{3\pi}{8}$ $8 \times \text{their } PT - \text{their sector}$ awrt 79.1 |
| | (iii) | $8\left(\frac{3\pi}{4}\right)$ oe (18.8) $\left[6\pi + 16 \tan\left(\frac{3\pi}{8}\right)\right] = 57.5$ | M1 A1 | Accept 57.4 to 57.5 |
| 5 | (a) | Permutation because the order matters oe | B1 | |
| | (b) (i) | ${}^6C_4 + {}^5C_4 + {}^7C_4$ 55 | M1 A1 | 3 correct terms added |
| | (ii) | ${}^2C_1 \times {}^6C_1 \times {}^5C_1 \times {}^7C_1$ 420 | M1 A1 | 4 correct terms multiplied |
| | (iii) | ${}^6C_3 \times {}^2C_1$ or ${}^2C_2 \times {}^5C_1 \times {}^6C_1$ summation 70 | M1 M1 A1 | for either correct product adding two correct products If 0 scored, then SC1 for 1,1,1,0 and 0,0,2,1 seen |
| 6 | (i) | $2t^2 - 14t + 12 = 0$ $(t-1)(t-6)$ oe $(t=) 1$ | M1 A1 | Can use formula, etc. If $t = 1$ with no working, then M1A1 |
| | (ii) | $\int (2t^2 - 14t + 12) dt$ $(s =) \frac{2t^3}{3} - \frac{14t^2}{2} + 12t$ | M1 A2,1,0 | -1 for each error or for +c left in or limits introduced |
| | (iii) | $(a =) \frac{dv}{dt} (4t - 14)$ $[4(3) - 14 =] -2$ cao | M1 A1 | |

| | | | |
|--------|---------------------------------|----------|-------|
| Page 4 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0606 | 23 |

| | | | | |
|---|---------|---|----------------------|--|
| 7 | (a) | $\overrightarrow{AB} = 15\mathbf{b} - 5\mathbf{a} = 5(3\mathbf{b} - \mathbf{a})$ or $\overrightarrow{BC} = 24\mathbf{b} - 3\mathbf{a} - 15\mathbf{b} = 3(3\mathbf{b} - \mathbf{a})$ or $\overrightarrow{AC} = 24\mathbf{b} - 3\mathbf{a} - 5\mathbf{a} = 8(3\mathbf{b} - \mathbf{a})$ | B1 B1 | Any correct simplified vector Any second simplified vector |
| | | Comment: e.g. the vectors are scalar multiples of each other AND they have a common point (A , B or C as appropriate) | B1dep | Dep on both B marks being awarded. |
| | (b) (i) | $2\mathbf{i} + 11\mathbf{j}$ soi $\Rightarrow \sqrt{2^2 + 11^2}$ $\sqrt{125}$ or $5\sqrt{5}$ or 11.2 (3 s.f.) or better | B1 B1fT | ft <i>their</i> $2\mathbf{i} + 11\mathbf{j}$ (not \overrightarrow{OP} or \overrightarrow{OQ}) |
| | (ii) | $\frac{1}{5\sqrt{5}} (2\mathbf{i} + 11\mathbf{j})$ isw | B1fT | ft <i>their</i> answers from (i) |
| | (iii) | $\frac{\mathbf{i} - 4\mathbf{j} + 3\mathbf{i} + 7\mathbf{j}}{2}$ or $\mathbf{i} - 4\mathbf{j} + \frac{2\mathbf{i} + 11\mathbf{j}}{2}$ or $3\mathbf{i} + 7\mathbf{j} - \frac{2\mathbf{i} + 11\mathbf{j}}{2}$ $2\mathbf{i} + 1.5\mathbf{j}$ | M1 A1 | |
| 8 | (a) (i) | $k\mathbf{e}^{4x+3}$ (+c) oe $k = \frac{1}{4}$ oe | M1 A1 | any constant, non-zero k |
| | (ii) | $\frac{1}{4} (e^{4(3)+3} - e^{4(2.5)+3})$ or better 706 650.99... = 707 000 to 3 sf or better | DM1 A1 | ft <i>their</i> integral attempt Accept $\frac{1}{4}(e^{15} - e^{13})$ |
| | (b) (i) | $k \sin\left(\frac{x}{3}\right)$ (+c) $k = 3$ | M1 A1 | any constant, non-zero k |
| | (ii) | $3 \sin\left(\frac{\pi}{6} \times \frac{1}{3}\right) - 3 \sin(0)$ 0.520 944... = 0.521 to 3 sf or better | DM1 A1 | Dep on <i>their</i> integral attempt in sin; condone omission of lower limit Accept $3 \sin\left(\frac{\pi}{18}\right)$ |
| | (c) | $\int (x^{-2} + 2 + x^2) dx = \frac{x^{-1}}{-1} + 2x + \frac{x^3}{3}$ $+ c$ | B1 M1 A1 B1 | Expands – accept unsimplified integration of <i>their</i> 3 term expansion Fully correct $+c$ |

| | | | |
|--------|---------------------------------|----------|-------|
| Page 5 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0606 | 23 |

| | | | | |
|-------|---------|---|--|---|
| 9 | (a) | $(4x-1)(x+5) [\leq 0]$ critical values $\frac{1}{4}$ and -5 soi $-5 \leq x \leq \frac{1}{4}$ | M1 A1 A1 | Solves quadratic Accept: $\left[-5, \frac{1}{4}\right]; -5 \leq x \text{ AND } x \leq 0.25$ |
| | (b) (i) | $(x+4)^2 - 25$ or $a = 4$ and $b = -25$ | B1, B1 | Must be clear |
| | (ii) | (Greatest value \Rightarrow) 25 $x = -4$ | B1ft B1ft | |
| (iii) | | B1 B1 | Correct shape with maximum in second quadrant and crossing positive and negative axes correctly All 3 intercepts correctly shown on graph | |
| 10 | (i) | $\ln y = \ln(Ab^x) \Rightarrow \ln y = \ln A + \ln b^x$ $\Rightarrow \ln y = \ln A + x \ln b$ | M1 A1 | condone misread of scale for M1 (11.2 only) Allow awrt -1 Allow awrt 8100 |
| | (ii) | $\ln A = 11.4 \Rightarrow A = e^{\text{their } 11.4}$ $A = 90\,000 \text{ cao}$ $\ln b = -1$ $b = 0.4 \text{ cao}$ | M1 A1 M1 A1 | |
| | (iii) | $x = 2.5 \Rightarrow \ln y = 9$ $y = e^9$ or 8000 to 1 sf | M1 A1 | |
| 11 | (i) | $7 - x, x, 6 - x$ oe <i>their</i> attempt at $7 - x + x + 6 - x + 16 = 25$ oe $x = 4$ | B1 M1 A1 | Condone $x = 4$ for all 3 marks or $n(A \cup C) = 48 - 16 = 32$ or $32 = 30 + 15 - (\text{their } 4 + y)$ or $48 = (23 - y) + 3 + 16 + y + 4 + 2 + (9 - y)$ Condone $y = 9$ for all 3 marks |
| | (ii) | $23 - y, y, 9 - y$ oe $48 = 30 + 25 + 15 - 7 - 6 - (\text{their } 4 + y) + \text{their } 4$ oe soi $y = 9$ | B1 M1 A1 | |
| | (iii) | $n(C) = 15$ and $y + n(B \cap C) = 9 + 6 = 15$ [and so $A' \cap B' \cap C = \emptyset$]. | B1 | |