**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

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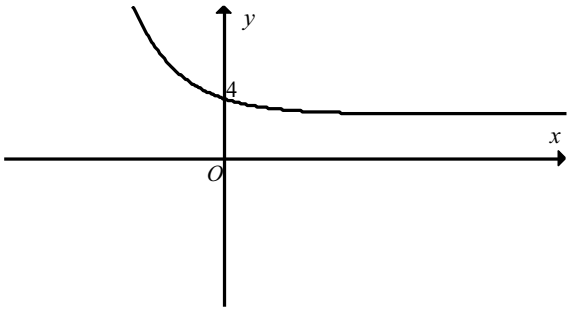
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**Abbreviations**

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

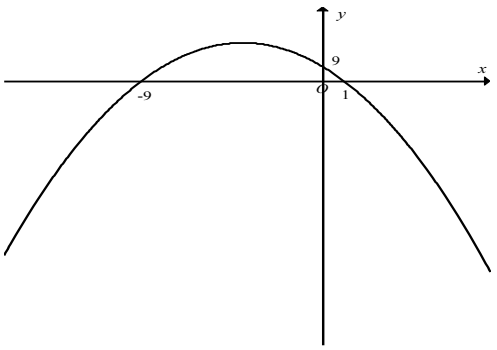
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| **4** | **(i)** | $\frac{PT}{8}=\tan\left(\frac{3\pi}{8}\right)$ oe | M1 | $\frac{PT}{\sin\frac{3\pi}{8}}=\frac{8}{\sin\frac{\pi}{8}}$ |
| | | $PT=19.3$ | A1 | awrt 19.3 |
| | **(ii)** | $\frac{1}{2}\times 8^2\times\frac{3\pi}{4}$ oe (75.4) | M1 | or $\frac{1}{2}\times 8^2\times\frac{3\pi}{8}$ |
| | | $8\tan\left(\frac{3\pi}{8}\right)\times 8$ – *their* sector oe (=154.5-'75.4') | M1 | $8\times$ *their PT* – *their* sector |
| | | 79.1 | A1 | awrt 79.1 |
| | **(iii)** | $8\left(\frac{3\pi}{4}\right)$ oe (18.8) | M1 | |
| | | $\left[6\pi+16\tan\left(\frac{3\pi}{8}\right)\right]=57.5$ | A1 | Accept 57.4 to 57.5 |
| **5** | **(a)** | Permutation because the order matters oe | B1 | |
| | **(b) (i)** | ${}^6C_4+{}^5C_4+{}^7C_4$ | M1 | 3 correct terms added |
| | | 55 | A1 | |
| | **(ii)** | ${}^2C_1\times{}^6C_1\times{}^5C_1\times{}^7C_1$ | M1 | 4 correct terms multiplied |
| | | 420 | A1 | |
| | **(iii)** | ${}^6C_3\times{}^2C_1$ or ${}^2C_2\times{}^5C_1\times{}^6C_1$ | M1 | for either correct product |
| | | summation | M1 | adding two correct products |
| | | 70 | A1 | |
| | | | | If 0 scored, then SC1for 1,1,1,0 and 0,0,2,1 seen |
| **6** | **(i)** | $2t^2-14t+12=0$ | M1 | Can use formula, etc. |
| | | $(t-1)(t-6)$ oe | | |
| | | $(t=)$ 1 | A1 | If $t$ = 1 with no working, then M1A1 |
| | **(ii)** | $\int(2t^2-14t+12)\,\mathrm{d}t$ | M1 | |
| | | $(s=)\ \frac{2t^3}{3}-\frac{14t^2}{2}+12t$ | A2,1,0 | −1 for each error or for +$c$ left in or limits introduced |
| | **(iii)** | $(a=)\frac{\mathrm{d}v}{\mathrm{d}t}\ (4t-14)$ | M1 | |
| | | [4(3) – 14 =] –2 cao | A1 | |

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| 7 | (a) | $\overrightarrow{AB} = 15\mathbf{b} - 5\mathbf{a} = 5(3\mathbf{b} - \mathbf{a})$ or<br>$\overrightarrow{BC} = 24\mathbf{b} - 3\mathbf{a} - 15\mathbf{b} = 3(3\mathbf{b} - \mathbf{a})$ or<br>$\overrightarrow{AC} = 24\mathbf{b} - 3\mathbf{a} - 5\mathbf{a} = 8(3\mathbf{b} - \mathbf{a})$ | B1<br>B1 | Any correct simplified vector<br>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<br>$\Rightarrow \sqrt{2^2 + 11^2}$ | B1 | |
| | | $\sqrt{125}$ or $5\sqrt{5}$ or 11.2 (3 s.f.) or better) | B1fT | ft *their* $2\mathbf{i} + 11\mathbf{j}$ (not $\overrightarrow{OP}$ or $\overrightarrow{OQ}$) |
| | (ii) | $\frac{1}{5\sqrt{5}}(2\mathbf{i} + 11\mathbf{j})$ isw | B1fT | ft *their* 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<br>$3\mathbf{i} + 7\mathbf{j} - \frac{2\mathbf{i} + 11\mathbf{j}}{2}$ | M1 | |
| | | $2\mathbf{i} + 1.5\mathbf{j}$ | A1 | |
| 8 | (a) (i) | $ke^{4x+3}$ $(+c)$ oe | M1 | any constant, non-zero $k$ |
| | | $k = \frac{1}{4}$ oe | A1 | |
| | (ii) | $\frac{1}{4}\left(e^{4(3)+3} - e^{4(2.5)+3}\right)$ or better | DM1 | ft *their* integral attempt |
| | | 706 650.99… = 707 000 to 3 sf or better | A1 | Accept $\frac{1}{4}\left(e^{15} - e^{13}\right)$ |
| | (b) (i) | $k \sin\left(\frac{x}{3}\right)$ $(+c)$ | M1 | any constant, non-zero $k$ |
| | | $k = 3$ | A1 | |
| | (ii) | $3\sin\left(\frac{\pi}{6} \times \frac{1}{3}\right) - 3\sin(0)$ | DM1 | Dep on *their* integral attempt in sin; condone omission of lower limit |
| | | 0.520 944… = 0.521 to 3 sf or better | A1 | Accept $3\sin\left(\frac{\pi}{18}\right)$ |
| | (c) | $\int\left(x^{-2} + 2 + x^2\right)dx = \frac{x^{-1}}{-1} + 2x + \frac{x^3}{3}$ | B1<br>M1<br>A1 | Expands – accept unsimplified<br>integration of *their* 3 term expansion<br>Fully correct |
| | | $+c$ | B1 | $+c$ |

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

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