

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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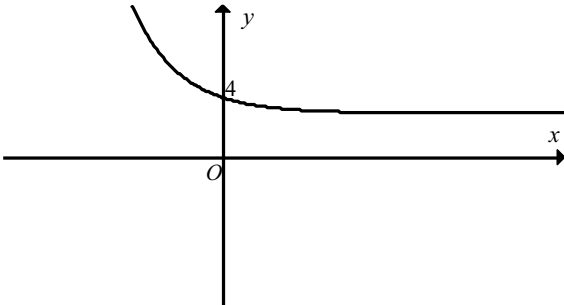
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Abbreviations

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)	$\frac{\log_3 x}{\log_3 27}$ $\frac{\log_3 x}{3} \text{ isw}$	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
	(ii)	The total value of the stock in all 3 shops	B1	Must have “total” oe

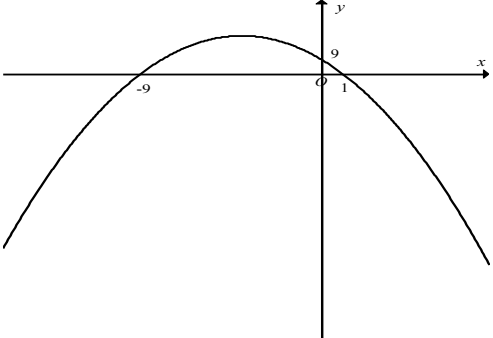
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4	(i)	$\frac{PT}{8} = \tan\left(\frac{3\pi}{8}\right)$ oe	M1	$\frac{PT}{\sin \frac{3\pi}{8}} = \frac{8}{\sin \frac{\pi}{8}}$
		$PT = 19.3$	A1	awrt 19.3
	(ii)	$\frac{1}{2} \times 8^2 \times \frac{3\pi}{4}$ oe (75.4)	M1	or $\frac{1}{2} \times 8^2 \times \frac{3\pi}{8}$
		$8 \tan\left(\frac{3\pi}{8}\right) \times 8 - \text{their sector}$ oe (=154.5-‘75.4’)	M1	$8 \times \text{their } PT - \text{their sector}$
		79.1	A1	awrt 79.1
	(iii)	$8\left(\frac{3\pi}{4}\right)$ oe (18.8)	M1	
5		$\left[6\pi + 16 \tan\left(\frac{3\pi}{8}\right)\right] = 57.5$	A1	Accept 57.4 to 57.5
	(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	

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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 $\overrightarrow{AC} = 24\mathbf{b} - 3\mathbf{a} - 5\mathbf{a} = 8(3\mathbf{b} - \mathbf{a})$ Comment: e.g. the vectors are scalar multiples of each other AND they have a common point (A , B or C as appropriate)	B1 B1 B1dep	Any correct simplified vector Any second simplified vector 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)	$\frac{1}{4} (\mathbf{e}^{4(3)+3} - \mathbf{e}^{4(2.5)+3})$ or better 706 650.99... = 707 000 to 3 sf or better	DM1 A1	ft <i>their</i> integral attempt Accept $\frac{1}{4} (\mathbf{e}^{15} - \mathbf{e}^{13})$
	(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 $+c$

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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	
	(ii)	(Greatest value $\Rightarrow$) 25 $x = -4$	B1ft B1ft	Must be clear
	(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	
	(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	condone misread of scale for M1 (11.2 only) Allow awrt -1
	(iii)	$x = 2.5 \Rightarrow \ln y = 9$ $y = e^9$ or 8000 to 1 sf	M1 A1	Allow awrt 8100
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
	(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	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
	(iii)	$n(C) = 15$ and $y + n(B \cap C) = 9 + 6 = 15$ [and so $A' \cap B' \cap C = \emptyset$].	B1	or equivalent deduction