

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 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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Page 2	Mark Scheme	Syllabus	Paper
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1	(i)	$f(2)=0 \rightarrow 3(2)^3+8(2)^2-33(2)+p=0$ correct working to $p = 10$ AG method for quadratic factor $f(x) = (x-2)(3x^2+14x-5)$	M1 A1 M1 A1	factorise or solve quadratic factor = 0
	(ii)	$f(x) = (x-2)(3x-1)(x+5)$ $f(x)=0 \rightarrow x=2, -5, \frac{1}{3}$	M1 A1	
2	(i)	${}^{12}C_4 = 495$	B1	
	(ii)	${}^7C_2 \times {}^5C_2 = 21 \times 10$ $= 210$	M1 A1	
	(iii)	not K and B = ${}^6C_2 \times {}^4C_1 = 15 \times 4 = 60$ K and not B = ${}^6C_1 \times {}^4C_2 = 6 \times 6 = 36$ $60 + 36$ 96 OR K and B = ${}^6C_1 \times {}^4C_1 = 6 \times 4 = 24$ not K and not B = ${}^6C_2 \times {}^4C_2 = 15 \times 6 = 90$ $210 - 90 - 24$ 96	B1 B1 M1 A1 B1 B1 M1 A1	
3	(i)	C is (1, 6) D is (1, 6) + (12, 9) $= (13, 15)$	B1 M1 A1ft	correct completion www
	(ii)	gradient of CD = $\frac{15-6}{13-1} \left(= \frac{3}{4} \right)$ gradient of AB = $\frac{10-2}{-2-4} \left(= \frac{8}{-6} = \frac{-4}{3} \right)$ $\frac{3}{4} \times \frac{-4}{3} = -1$ lines are perpendicular	B1ft B1 B1	
	(iii)	area = $\frac{1}{2} \times AB \times CD = \frac{1}{2} \times 10 \times 15$ $= 75$ or array method	M1 A1	

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4	<p>(i) $2000 = 1000e^{a+b} \rightarrow a+b = \ln 2$</p> <p>(ii) $3297 = 1000e^{2a-b} \rightarrow 2a+b = \ln 3.297$ oe</p> <p>(iii) Solve for one value $a = 0.5$ and $b = 0.193$ or 0.19</p> <p>(iv) $n = 10$ $P = 1000e^{5.193}$ $= \\$180\,000.$</p>	<p>B1</p> <p>M1 A1</p> <p>M1 A1</p> <p>M1 A1</p>	substitution of 2, 3297 and rearrange
5	<p>(i) $\overline{OX} = \mu(a+b)$</p> <p>(ii) $\overline{RP} = b - 3a$ or $\overline{RX} = \lambda(b - 3a)$ oe $\overline{OX} = 3a + \lambda(b - 3a)$</p> <p>(iii) $\overline{OX} = \overline{OX}$ and equate both coefficients $\mu = 3 - 3\lambda$ $\mu = \lambda$ $\mu = \lambda = 0.75$ $\frac{RX}{XP} = 3$ or $3:1$</p>	<p>B1</p> <p>B1 B1</p> <p>M1 A1 A1ft</p>	$\frac{\lambda}{1-\lambda}$
6	<p>(i) $m = 4$ equation of line is $\frac{\ln y - 39}{3^x - 9} = \frac{39 - 19}{9 - 4}$ $\ln y = 4(3^x) + 3$</p> <p>(ii) $x = 0.5 \rightarrow \ln y = 4\sqrt{3} + 3 = 9.928$ $y = 20\,500$</p> <p>(iii) Substitutes y and rearrange for 3^x Solve $3^x = 1.150$ $x = 0.127$</p>	<p>B1</p> <p>M1 A1ft</p> <p>M1 A1</p> <p>M1 M1 A1</p>	<p>forms equation of line</p> <p>ft only on their gradient</p> <p>correct expression for $\ln y$</p>

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7	(i)	$x = \frac{2}{y} + 1 \rightarrow y = \frac{2}{x-1}$ $f^{-1}(x) = \frac{2}{x-1}$	M1 A1	any valid method
	(ii)	$gf(x) = \left(\frac{2}{x} + 1\right)^2 + 2$	B2/1/0	-1 each error
	(iii)	$fg(x) = \frac{2}{x^2 + 2} + 1$	B2/1/0	-1 each error
	(iv)	$ff(x) = \frac{2}{\frac{2}{x} + 1} + 1 = \frac{2x}{x+2} + 1$ $= \frac{3x+2}{x+2}$ $\frac{3x+2}{x+2} = x \rightarrow x^2 - x - 2 = 0$ $(x-2)(x+1) = 0$ $x = 2 \text{ only}$	M1 A1 M1 A1	correct starting expression correct algebra to given answer form and solve 3 term quadratic
8	(i)	$v = C + K\sin 2t \quad C \neq 0$ $v = 5 + 6\sin 2t$ $a = 12\cos 2t$	M1 A1 A1ft	
	(ii)	$a = 0 \rightarrow \cos 2t = 0 \text{ and solve}$ $t = \frac{\pi}{4} \text{ or } 0.785 \text{ or } 0.79$ $v = 5 + 6\sin \frac{\pi}{2} = 11$	M1 A1 A1ft	set $a = 0$ and solve for t ft only on K
	(iii)	$v = 2 \rightarrow \sin 2t = -\frac{1}{2} \text{ and solve}$ $t = \frac{7\pi}{12} \text{ or } 1.83 - 1.84$ $a = 12\cos \frac{7\pi}{6} = -6\sqrt{3} \text{ or } -10.4$	M1 A1 A1	set $v = 2$ and solve for t

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<p>9 (i)</p> $\frac{dy}{dx} = 4 - \frac{1}{(x-2)^2}$ $\frac{dy}{dx} = 0 \rightarrow (x-2)^2 = \frac{1}{4}$ $(4x^2 - 16x + 15 = 0)$ <p>$x = 2.5$ or 1.5 $y = 12$ or 4</p> $\frac{d^2y}{dx^2} = 2(x-2)^{-3}$ <p>$x = 2.5 \rightarrow \frac{d^2y}{dx^2} > 0 \rightarrow$ minimum $x = 1.5 \rightarrow \frac{d^2y}{dx^2} < 0 \rightarrow$ maximum</p> <p>(ii)</p> <p>$x = 3 \rightarrow \frac{dy}{dx} = 3$</p> <p>Use $m_1 m_2 = -1$ for gradient normal from gradient tangent</p> <p>Eqn of normal : $\frac{y-13}{x-3} = -\frac{1}{3}$</p> <p>Intersection of norm and curve</p> $14 - \frac{x}{3} = 4x + \frac{1}{x-2}$ $13x^2 - 68x + 87 = 0$ $x = \frac{29}{13} \text{ or } 2.23$	<p>B1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>M1</p> <p>A1ft</p> <p>M1</p> <p>DM1</p> <p>A1</p>	<p>solve 3 term quadratic from $\frac{dy}{dx} = 0$</p> <p>x values or 1 pair</p> <p>y values or 1 pair</p> <p>use $\frac{d^2y}{dx^2}$ with solution from $\frac{dy}{dx} = 0$</p> <p>both identified www</p> <p>must use numerical values</p> <p>equation and attempt to simplify</p> <p>attempt to solve 3 term quadratic</p>
<p>10 (i)</p> $\text{LHS} = \frac{1 + \cos x + 1 - \cos x}{(1 - \cos x)(1 + \cos x)}$ $= \frac{2}{1 - \cos^2 x}$ $= \frac{2}{\sin^2 x} = \text{RHS}$ <p>(ii)</p> $2\text{cosec}^2 x = 8$ $\sin^2 x = \frac{1}{4}$ $\sin x = \pm \frac{1}{2}$ $x = 30^\circ, 150^\circ, 210^\circ, 330^\circ$	<p>B1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>A1</p>	<p>correct fraction</p> <p>correct evaluation</p> <p>use of $1 - \cos^2 x = \sin^2 x$ and completion of fully correct proof</p> <p>identity used</p>