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.

Cambridge will not enter into discussions about these mark schemes.

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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	
	(ii)	$f(x)=(x-2)(3x-1)(x+5)$ $f(x)=0 \rightarrow x=2,\ -5,\ \frac{1}{3}$	M1 A1	factorise or solve quadratic factor = 0
2	(i)	$^{12}C_4=495$	B1	
	(ii)	$^7C_2\times{}^5C_2=21\times10$ $=210$	M1 A1	
	(iii)	not K and B = $^6C_2\times{}^4C_1=15\times4=60$ K and not B = $^6C_1\times{}^4C_2=6\times6=36$ $60+36$ 96 OR K and B = $^6C_1\times{}^4C_1=6\times4=24$ not K and not B = $^6C_2\times{}^4C_2=15\times6=90$ $210-90-24$ 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	
	(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	correct completion www
	(iii)	area $=\frac{1}{2}\times AB\times CD=\frac{1}{2}\times10\times15$ $=75$ or array method	M1 A1	good attempt at two relevant lengths for $\frac{1}{2}$ base × height method

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

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

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