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

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CAMBRIDGE
International Examinations

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)	$2000 = 1000e^{a+b} \quad \to \quad a+b = \ln 2$	B1	
(ii)	$3297 = 1000e^{2a-b} \quad \to \quad 2a+b$ $= \ln 3.297$ 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)	$n = 10 \quad P = 1000e^{5.193}$ = $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 $\mu = 3 - 3\lambda \quad \mu = \lambda$ $\mu = \lambda = 0.75$ $\dfrac{RX}{XP} = 3$ 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)	$x = 0.5 \quad \to \quad \ln y = 4\sqrt{3} + 3 = 9.928$ $y = 20\,500$	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)	$x=\frac{2}{y}+1 \quad \to \quad y=\frac{2}{x-1}$	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
	$\frac{3x+2}{x+2}=x \quad \to \quad x^2-x-2=0$	M1	form and solve 3 term quadratic
	$(x-2)(x+1)=0$ $x=2$ only	A1	
8 (i)	$v = C + K\sin 2t \qquad C \neq 0$ $v = 5 + 6\sin 2t$ $a = 12\cos 2t$	M1 A1 A1ft	
(ii)	$a=0 \quad \to \quad \cos 2t=0$ 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)	$v=2 \quad \to \quad \sin 2t=-\frac{1}{2}$ 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)	$\text{LHS} = \frac{1+\cos x + 1 - \cos x}{(1-\cos x)(1+\cos x)}$	**B1**	correct fraction
	$= \frac{2}{1-\cos^2 x}$	**B1**	correct evaluation
	$= \frac{2}{\sin^2 x} = \text{RHS}$	**B1**	use of $1 - \cos^2 x = \sin^2 x$ and completion of fully correct proof
(ii)	$2\text{cosec}^2 x = 8$	**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**	