MARK SCHEME for the May/June 2014 series

0606 ADDITIONAL MATHEMATICS

0606/13   Paper 1, maximum raw mark 80

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Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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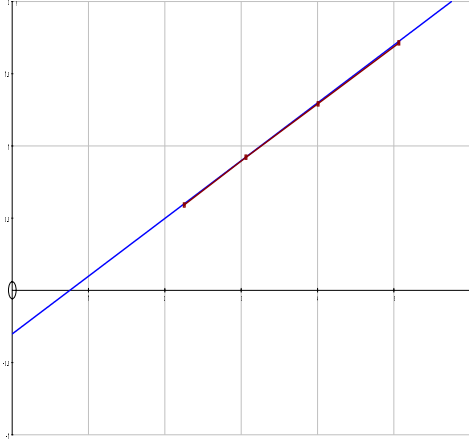
1	(i)	$y = 3(x-1)^2 + 2$ $a = 3,\ b = 1,\ c = 2$	**B1, B1, B1**	**B1** for each, may be given in the form $y = 3(x-1)^2 + 2$
	(ii)	$(1, 2)$	**√B1**	Follow through on their answers to **(i)** If using differentiation, follow through on their x only.
2		$2^{4x} \times 4^y \times 8^{x-y} = 1$ Considering powers of either 2, 4 or 8 $\quad\quad 7x - y = 0$ $3^{x+y} = \dfrac{1}{3}$ Considering powers of 3 $\quad\quad x + y = -1$ Solving both simultaneously gives $\quad x = -\dfrac{1}{8},\ y = -\dfrac{7}{8}$	**M1** **B1** **M1** **A1**	**M1** for considering powers of either 2, 4 or 8 and forming an equation using these powers **B1** for equation considering powers of 3 **M1** for attempt to solve their equations **A1** for both
3	(i)	$\begin{aligned} f(-3) &= -27 + 9p - 3p^2 + 21 \\ &= 9p - 3p^2 - 6 \end{aligned}$	**M1** **A1**	**M1** for substitution of $x = -3$ **A1** answer must be simplified
	(ii)	$9p - 3p^2 - 6 < 0$ $\quad (p-1)(p-2) > 0$ Critical values 1 and 2 $\quad p < 1,\ p > 2$	**M1** **A1** **A1**	**M1** for attempt to factorise **A1** for critical values **A1** for correct range
4	(i)	$\begin{aligned} V &= x(24 - 2x)^2 \\ &= x\left(576 - 96x + 4x^2\right) \\ &= 4x^3 - 96x^2 + 576x \end{aligned}$	**M1** **A1**	**M1** for attempt at a product of 3 lengths, 2 of which must be the same **A1** for expansion to reach given answer
	(ii)	$\dfrac{dV}{dx} = 12x^2 - 192x + 576$ When $\dfrac{dV}{dx} = 0,\quad 12x^2 - 192x + 576 = 0$ leading to $(x-4)(x-12) = 0$ with $x = 4$ the only possible solution $V = 1024$	**M1** **DM1** **A1** **A1**	**M1** for attempt to differentiate **DM1** for equating $\dfrac{dV}{dx}$ to zero and attempt to solve **A1** for $x = 4$ **A1** for $V = 1024$

5	(i)	$64 - 960x + 6000x^2$	**B1, B1, B1**	**B1** for each correct term
	(ii)	$\left(64 - 960x + 6000x^2\right)\left(a^3 + 3a^2bx\right),$	**B1**	**B1** for first two terms of $(a + bx)^3$
		$64a^3 = 512, \ a = 2$	**B1**	**B1** for equating constant term to 512 and obtaining $a = 2$
		$-960a^3 + 3a^2b(64) = 0$	**M1**	**M1** for attempt to equate coefficient of x to zero, must have two terms involved
		leading to $b = 10$	**A1**	**A1** for $b = 10$
6		When $x = 2$, $y = -4$	**B1**	**B1** for $y = -4$
		$\dfrac{dy}{dx} = x\left(\dfrac{2x}{3}\right)\left(x^2 - 12\right)^{-\frac{2}{3}} + \left(x^2 - 12\right)^{\frac{1}{3}}$	**M1, B1 A1**	**M1** for differentiation of a product **B1** for $\dfrac{2x}{3}\left(x^2 - 12\right)^{-\frac{2}{3}}$
		When $x = 2$, $\dfrac{dy}{dx} = -\dfrac{4}{3}$	**M1**	**M1** for attempt at normal equation
		Normal: $y + 4 = \dfrac{3}{4}(x - 2)$	**A1**	**A1** allow unsimplified
		$(4y = 3x - 22)$		
7	(a) (i)	15120	**B1**	
	(ii)	$(5 \times 4) \times (4 \times 3 \times 2)$	**M1**	**M1** for attempt to multiply number of ways of getting 4 letters by the number of ways of getting 2 digits.
		480	**A1**	
	(b) (i)	5456	**B1**	
	(ii)	$^{18}C_2 \times 15$	**M1**	**M1** for attempt at an appropriate product, at least one term must be correct.
		2295	**A1**	
	(iii)	5456 – Number of ways only girls get tickets 5456 – 455 = 5001	**M1 A1**	**M1** for a complete correct method *their* **(i)** – number of ways only girls get tickets

		Or 1B 2G 1890
		    2B 1G 2295
		    3B 816
		    Total 5001
			M1
			
			A1
				M1 must be considering at least 2 of the cases shown

8	(i)	1	**B1**	
	(ii)	$a = 8e^{-2t}$	**M1**	**M1** for attempt to differentiate
		$8e^{-2t} = 6, \ -2t = \ln\dfrac{3}{4}$	**DM1**	**DM1** for correct attempt to solve equation in the form $e^{-2t} = $ constant
		$t = 0.144$	**A1**	**A1** must be at least 3 sf
	(iii)	$s = 5t + 2e^{-2t} \ \ (+c)$	**M1**	**M1** for attempt to integrate
		When $t = 0, \ s = 0, \ so \ c = -2$	**DM1, A1**	**DM1** for attempt to find c, **A1** c correct
		When $t = 1.5, \ s = 5.60$	**M1, A1**	**M1** for substitution of $t = 1.5$
		Alternative: $s = \left[5t + 2e^{-2t} \right]_0^{1.5}$	**M1** **DM1** **A1** **M1**	**M1** for attempt to integrate **DM1** for attempt to use limits **A1** all correct **M1** for evaluation of square bracket notation
		Leading to $s = 5.60$	**A1**	
	(iv)	Velocity is always +ve, so no change in direction	**B1**	Allow any valid argument.
9	(i)	$\cos x \, (3 \sin x - 2) = 0$		
		$\cos x = 0, \ x = 90°$	**B1**	**B1** for 90°
		$\sin x = \dfrac{2}{3},$	**M1**	**M1** for attempt to solve $\sin x = \dfrac{2}{3}$
		$x = 41.8°, \ 138.2°$	**A1,√A1**	Follow through on their first answer
	(ii)	$10\sin^2 y + \cos y = 8$ $10(1 - \cos^2 y) + \cos y = 8$	**M1**	**M1** for use of correct identity
		$10\cos^2 y - \cos y - 2 = 0$	**M1**	**M1** for attempt to reduce to a 3 term quadratic and attempt to solve quadratic
		$(2\cos y - 1)(5\cos y + 2) = 0$ $\cos y = \dfrac{1}{2}, \ \cos y = -\dfrac{2}{5}$	**M1**	**M1** for attempt to solve using factors in terms of cos
		$y = 60°, \ 300°$ and $y = 113.6°, \ 246.4°$	**A1, A1**	**A1** for any 'pair'

10 (i)

x^2	2.25	3.06	4	5.06
lg y	0.59	0.92	1.29	1.71

B1

(ii)

M1
A1, 0

M1 for plotting log$y$ against x^2
−1 each error, poor point plotting, poor line drawing

(iii) Gradient:
lg $b = 0.4$, $b = 2.5$ (allow 2.45 to 2.55)

M1
A1

M1 for correct use of gradient

Intercept :
lg $A = -0.3$, $A = 0.5$ (allow 0.4 to 0.6)

M1
A1

M1 for correct use intercept

(iv) 2.1 (allow 2 to 2.2)

M1, A1

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11	(i)	at A $\quad \sqrt{3}\sin 3x + \cos 3x = 0$	M1	M1 for equating to zero and attempt to solve using tan
		$\tan 3x = -\dfrac{1}{\sqrt{3}}, \ 3x = \dfrac{5\pi}{6} \ \ 150°$	DM1	DM1 for dealing with $3x$
		$x = \dfrac{5\pi}{18}\,(0.873) \ (\text{allow } 50°)$	A1	
	(ii)	$\dfrac{dy}{dx} = 3\sqrt{3}\cos 3x - 3\sin 3x$	B1, B1	B1 for $\dfrac{dy}{dx}$
		When $\dfrac{dy}{dx} = 0$, $\tan 3x = \sqrt{3}$, $3x = \dfrac{\pi}{3}$ or $3x = 60°$,	M1	M1 for attempt to solve $\dfrac{dy}{dx}=0$
		$x = \dfrac{\pi}{9}\,(0.349)\,(\text{allow } 20°)$	A1	
	(iii)	Area $= \left[-\dfrac{\sqrt{3}}{3}\cos 3x + \dfrac{1}{3}x + \dfrac{1}{3}\sin 3x \right]_{\frac{\pi}{9}}^{\frac{5\pi}{18}}$	M1 A1, A1	M1 for attempt to integrate A1 for each term
		$= \left(-\dfrac{\sqrt{3}}{3}\cos\dfrac{5\pi}{6} + \dfrac{1}{3}\sin\dfrac{5\pi}{6} \right) - \left(-\dfrac{\sqrt{3}}{3}\cos\dfrac{\pi}{3} + \dfrac{1}{3}\sin\dfrac{\pi}{3} \right)$	DM1	DM1 for correct application of their limits
		$= \dfrac{2}{3}$ or 0.667 or better	A1	