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Mark Scheme (Results)

January 2012

International GCSE Mathematics
(4PM0) Paper 01

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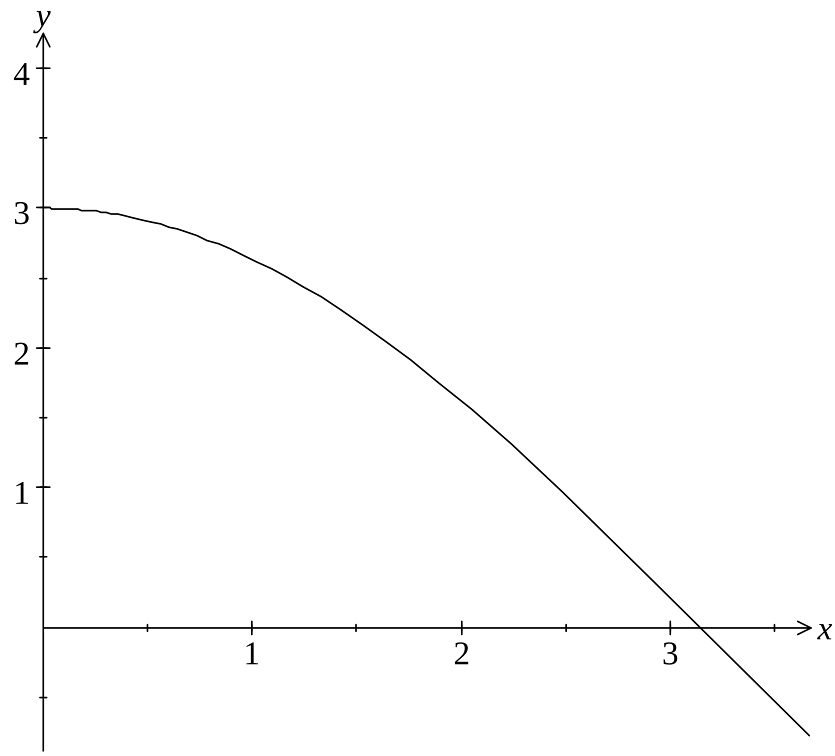
Question	Working	Notes
1	$y = -\frac{6}{4}x - \frac{15}{4}$, gradient = $-\frac{3}{2}$ oe $y = \frac{10}{15}x - \frac{9}{15}$, gradient = $\frac{2}{3}$ oe Product of gradients = $-\frac{3}{2} \times \frac{2}{3} = -1 \Rightarrow$ lines perpendicular	M1 A1 A1 A1 **4**
2	$x(x + 2) - (x + 1) = 2(x + 1)(x + 2)$ $x^2 + x - 1 = 2x^2 + 6x + 4$ $x^2 + 5x + 5 = 0$ $x = \dfrac{-5 \pm \sqrt{25 - 20}}{2} = -3.62, -1.38$	M1 A1 M1 A1 **4**
3	$(3x + 1)(2x - 7) < 0$ $-\frac{1}{3} < x < 3\frac{1}{2}$	M1 A1 M1 A1 **4**
4	$\dfrac{10!}{7!3!}1^3\left(\dfrac{1}{\sqrt{3}}\right)^7$ $= 120\dfrac{1}{27\sqrt{3}}$ $= 120\dfrac{1}{27}\dfrac{\sqrt{3}}{3}$ $= \dfrac{40}{27}\sqrt{3}$	Allow all marks if x^7 included. M1 A1 M1 rationalise A1 **4**
5	(a) $\dfrac{dy}{dx} = x^2e^x + 2xe^x$ (b) $\dfrac{dy}{dx} = 5(x^3 + 2x^2 + 3)^4(3x^2 + 4x)$	M1 two terms with one correct A1 M1 use chain rule A1 $5(x^3 + 2x^2 + 3)^4$ A1 $(3x^2 + 4x)$ **5**

6	(a)	

x	0	0.5	1	1.5	2	2.5	3	3.5
y	3	**2.91**	2.63	2.20	**1.62**	0.95	0.21	**-0.53**

B2, 1 (3 correct, 2 correct)

(b)



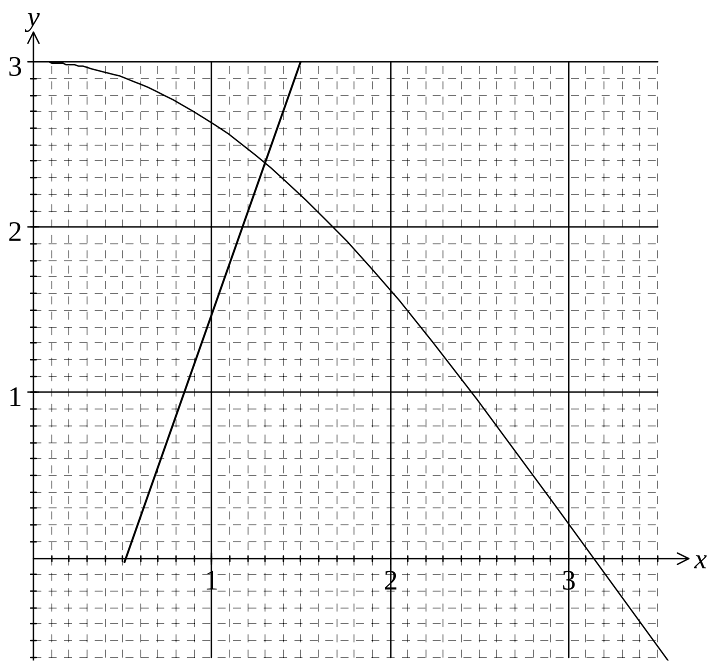
B1 plot points

B1 curve

(c) $2x - 1 = 2\cos(x/2)$ — M1 rearrange

$3x - 1\tfrac{1}{2} = 3\cos(x/2)$

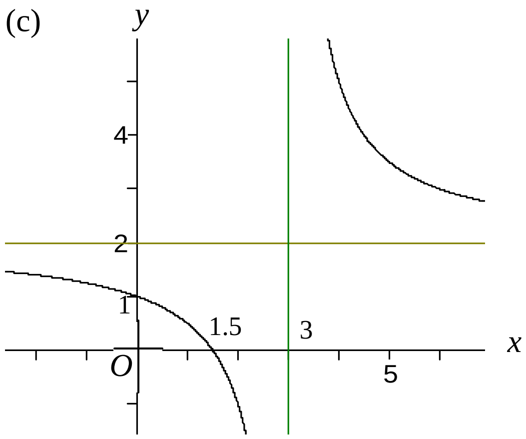
$y = 3x - 1\tfrac{1}{2}$ — A1



M1 draw their line

$x = 1.3$ — A1 1.2, 1.3 or 1.4

8

7	(a) $A\ (1\frac{1}{2}, 0)$, $B\ (0, 1)$	B1, B1	
	(b) (i) $x = 3$	B1	
	(ii) $y = 2$	B1	
	(c) 	B1	two branches in correct quadrants
		B1	asymptotes dep on some curve
		B1	intercepts
	(d) $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{2(x-3)-(2x-3)}{(x-3)^2} = \frac{-3}{(x-3)^2}$	M1	Quotient rule
		A1	Result (unsimplified)
	At B, $x = 0$ so $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{-3}{(-3)^2} = -\frac{1}{3}$	A1	
	Grad of normal = -1/(-1/3) = 3	B1ft	
	Normal $y = 3x + 1$	B1ft	
	(e) At D, $3x+1 = \frac{2x-3}{x-3}$	M1	
	$3x^2 - 8x - 3 = 2x - 3$		
	$3x^2 - 10x = 0$	A1	
	$x(3x - 10) = 0$	M1	
	$x = 0$ or $x = 10/3$		
	At D, $x = 3\frac{1}{3}$	A1	
		16	

8	(a) $k = \alpha/\beta \times \beta/\alpha = 1$	B1
	(b) $\alpha\beta = 15$ and $\alpha + \beta = -m$	M1 A1
	$-h = \alpha/\beta + \beta/\alpha$	M1
	$= \dfrac{\alpha^2 + \beta^2}{\alpha\beta}$	M1
	$= \dfrac{(\alpha+\beta)^2 - 2\alpha\beta}{\beta\alpha}$	M1
	$\Rightarrow\ h = \dfrac{30 - m^2}{15}$	A1 oe
	(c) $\alpha\beta = 15 \Rightarrow \alpha(2\alpha + 1) = 15$	M1
	$2\alpha^2 + \alpha - 15 = 0$	
	$(2\alpha - 5)(\alpha + 3) = 0$	M1
	$\alpha = 2\tfrac{1}{2}$ or $\alpha = -3$	A1
	(d) $\beta = 2 \times 2\tfrac{1}{2} + 1 = 6$ or $\beta = 2 \times -3 + 1 = -5$	M1
	$m = -(\alpha + \beta) = -(2\tfrac{1}{2} + 6)$ or $-(-3 - 5)$	M1
	$m = -8\tfrac{1}{2}$ or 8	A1
		13
9	(a) $BD^2 = 5^2 + 6^2 = 61$, $BC^2 = 8^2 + 6^2 = 100$, $CD^2 = 8^2 + 5^2 = 89$	M1 A2, 1, 0
	$100 = 61 + 89 - 2\sqrt{61}\sqrt{89}\cos BDC$	M1
	$\cos BDC = 25/\sqrt{(61 \times 89)}$	A1
	$= 0.3393$	
	$\angle BDC = 70.2^{\circ}$	A1
	(b) Area $BDC = \tfrac{1}{2}\sqrt{61}\sqrt{89}\sin 70.2^{\circ}$	M1 A1ft
	$= 34.7\text{ cm}^2$ (3sf)	A1 allow 34.6
	(c) Area $DAC = \tfrac{1}{2} \times 5 \times 8 = 20$	B1
	(d) $20 = \tfrac{1}{2} \times \sqrt{89} \times AE \Rightarrow AE = 40/\sqrt{89}$	M1 A1
	(e) Angle is $\angle BEA$	M1 identify angle
	$\tan BEA = 6/AE = 6\sqrt{89}/40$	M1 A1ft
	$= 1.415$	
	$\Rightarrow \angle BEA = 54.8^{\circ}$	A1
		16

10	(a)	(i) $\overrightarrow{BC} = -\tfrac{1}{2}\mathbf{c} - \mathbf{a} + \mathbf{c} = \tfrac{1}{2}\mathbf{c} - \mathbf{a}$	M1 A1
		(ii) $\overrightarrow{PQ} = \tfrac{3}{4}\mathbf{a} + \tfrac{1}{2}\mathbf{c} + \tfrac{1}{3}(\tfrac{1}{2}\mathbf{c} - \mathbf{a}) = \tfrac{5}{12}\mathbf{a} + \tfrac{2}{3}\mathbf{c}$.	M1 $\tfrac{3}{4}\mathbf{a} + \tfrac{1}{2}\mathbf{c} + \ldots$ M1 $\tfrac{1}{3}(\tfrac{1}{2}\mathbf{c} - \mathbf{a})$ A1
	(b)	(i) $\overrightarrow{AT} = -\tfrac{3}{4}\mathbf{a} + \lambda(\tfrac{5}{12}\mathbf{a} + \tfrac{2}{3}\mathbf{c})$	B1ft
		(ii) $\overrightarrow{AT} = \mu(\mathbf{c} - \mathbf{a})$	B1
	(c)	$-\tfrac{3}{4}\mathbf{a} + \lambda(\tfrac{5}{12}\mathbf{a} + \tfrac{2}{3}\mathbf{c}) = \mu(\mathbf{c} - \mathbf{a})$ $\Rightarrow -\tfrac{3}{4} + \tfrac{5}{12}\lambda = -\mu$ and $\tfrac{2}{3}\lambda = \mu$ $\Rightarrow \tfrac{5}{12}\lambda = \tfrac{3}{4} - \tfrac{2}{3}\lambda$ $\Rightarrow 5\lambda = 9 - 8\lambda$ $\Rightarrow \lambda = \tfrac{9}{13}$ $\Rightarrow PT : TQ = 9 : 4$	M1 M1 A1ft M1 A1 A1ft **13**
11	(a)	$V = \pi\int_0^h x^2 dy = \pi\int_0^h (10y - y^2)dy$ $= \pi\left[5y^2 - \tfrac{1}{3}y^3\right]_0^h$ $= \pi\left[5h^2 - \tfrac{1}{3}h^3\right]$ $= 1/3\ \pi h^2(15 - h)$	M1 use of $\int \pi x^2\, dy$ M1 A1 integration M1 use of correct limits A1 cso
	(b)	$V = \pi(5h^2 - \tfrac{1}{3}h^3) \Rightarrow \dfrac{dV}{dh} = \pi(10h - h^2)$	B1 oe
	(c)	$\dfrac{dV}{dt} = \pi(10h - h^2)\dfrac{dh}{dt}$ When h=1.5, $6 = \pi(15 - 2.25)\ \tfrac{dh}{dt}$ $\Rightarrow \tfrac{dh}{dt} = 6/(12.75\pi) = 0.150$ cm/s (3sf)	M1 chain rule M1 A1 substitution A1 cao
	(d)	$W = \pi x^2 = \pi(10y - y^2)$ When depth is h, $W = \pi(10h - h^2)$ $\dfrac{dV}{dt} = \pi(10h - h^2)\dfrac{dh}{dt} = W\dfrac{dh}{dt}$ Since $\tfrac{dV}{dt} = 6$, $\tfrac{dh}{dt} = 6/W$ so $k = 6$	B1 M1 A1 **13**