



Mark Scheme (Results)

January 2012

International GCSE Mathematics  
(4PM0) Paper 01

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Publications Code UG030468

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

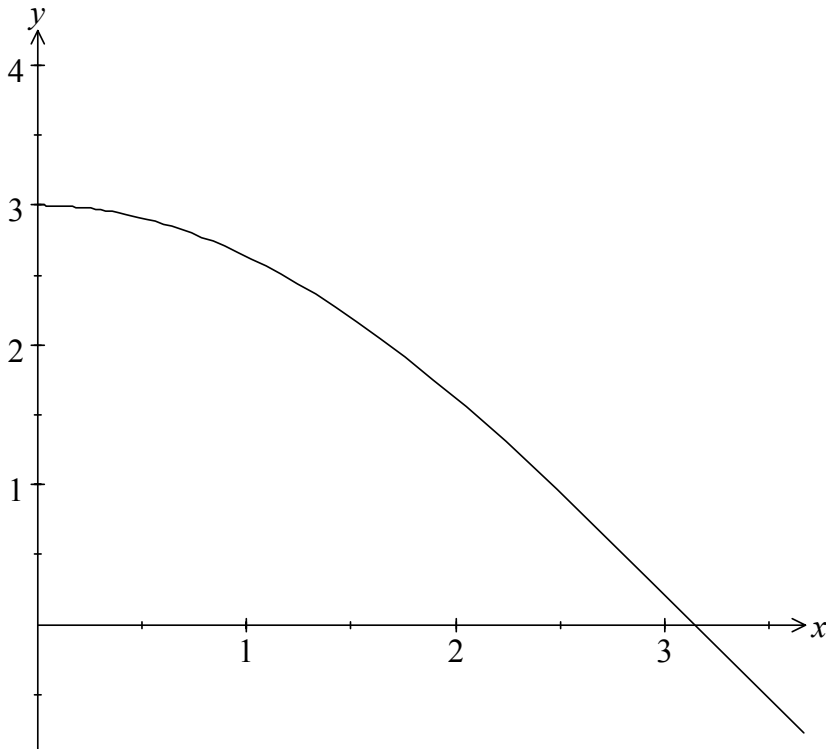
6

(a)

$x$	0	0.5	1	1.5	2	2.5	3	3.5
$y$	3	<b>2.91</b>	2.63	2.20	<b>1.62</b>	0.95	0.21	<b>-0.53</b>

B2, 1 (3 correct, 2 correct)

(b)



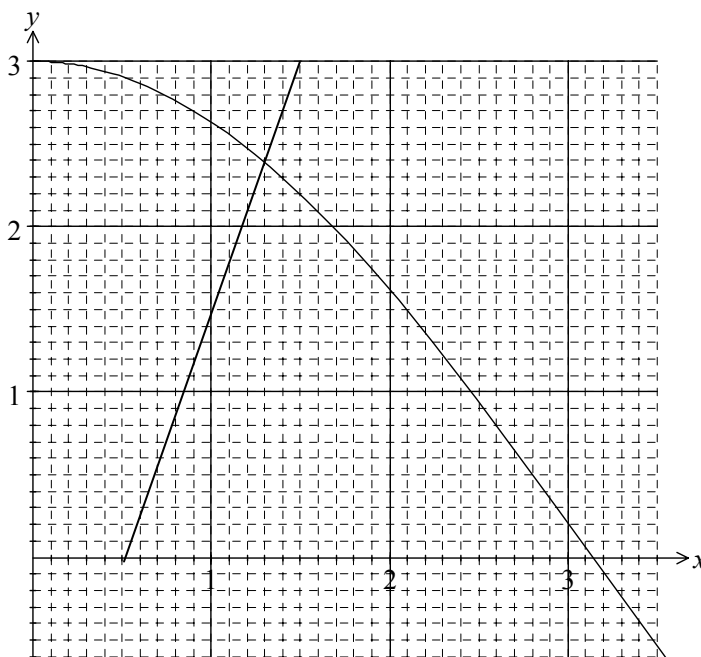
B1 plot points

B1 curve

(c)  $2x - 1 = 2 \cos(x/2)$   
 $3x - 1\frac{1}{2} = 3 \cos(x/2)$   
 $y = 3x - 1\frac{1}{2}$

M1 rearrange

A1

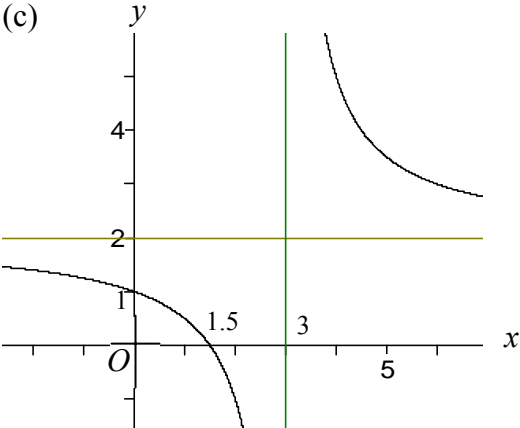


M1 draw their line

A1 1.2, 1.3 or 1.4

$x = 1.3$

**8**

7	<p>(a) <math>A(1\frac{1}{2}, 0), B(0, 1)</math></p> <p>(b) (i) <math>x = 3</math> (ii) <math>y = 2</math></p> <p>(c) </p> <p>(d) <math display="block">\frac{dy}{dx} = \frac{2(x-3) - (2x-3)}{(x-3)^2} = \frac{-3}{(x-3)^2}</math> <p>At B, <math>x = 0</math> so <math>\frac{dy}{dx} = \frac{-3}{(-3)^2} = -\frac{1}{3}</math></p> <p>Grad of normal = <math>-1/(-1/3) = 3</math></p> <p>Normal <math>y = 3x + 1</math></p> <p>(e) At D, <math>3x + 1 = \frac{2x-3}{x-3}</math></p> <math display="block">3x^2 - 8x - 3 = 2x - 3</math> <math display="block">3x^2 - 10x = 0</math> <math display="block">x(3x - 10) = 0</math> <math display="block">x = 0 \text{ or } x = 10/3</math> <p>At D, <math>x = 3\frac{1}{3}</math></p></p>	<p>B1, B1</p> <p>B1 B1</p> <p>B1 two branches in correct quadrants B1 asymptotes dep on some curve B1 intercepts</p> <p>M1 Quotient rule A1 Result (unsimplified)</p> <p>A1</p> <p>B1ft B1ft</p> <p>M1</p> <p>A1 M1</p> <p>A1 <b>16</b></p>
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8	<p>(a) <math>k = \alpha/\beta \times \beta/\alpha = 1</math></p> <p>(b) <math>\alpha\beta = 15</math> and <math>\alpha + \beta = -m</math>  <math>-h = \alpha/\beta + \beta/\alpha</math>  <math>= \frac{\alpha^2 + \beta^2}{\alpha\beta}</math>  <math>= \frac{(\alpha + \beta)^2 - 2\alpha\beta}{\beta\alpha}</math>  <math>\Rightarrow h = \frac{30 - m^2}{15}</math></p> <p>(c) <math>\alpha\beta = 15 \Rightarrow \alpha(2\alpha + 1) = 15</math>  <math>2\alpha^2 + \alpha - 15 = 0</math>  <math>(2\alpha - 5)(\alpha + 3) = 0</math>  <math>\alpha = 2\frac{1}{2}</math> or <math>\alpha = -3</math></p> <p>(d) <math>\beta = 2 \times 2\frac{1}{2} + 1 = 6</math> or <math>\beta = 2 \times -3 + 1 = -5</math>  <math>m = -(\alpha + \beta) = -(2\frac{1}{2} + 6)</math> or <math>-(-3 - 5)</math>  <math>m = -8\frac{1}{2}</math> or <math>8</math></p>	<p>B1</p> <p>M1 A1 M1</p> <p>M1</p> <p>M1</p> <p>A1 oe</p> <p>M1</p> <p>M1 A1</p> <p>M1 M1 A1 <b>13</b></p>
9	<p>(a) <math>BD^2 = 5^2 + 6^2 = 61</math>, <math>BC^2 = 8^2 + 6^2 = 100</math>, <math>CD^2 = 8^2 + 5^2 = 89</math>  <math>100 = 61 + 89 - 2\sqrt{61}\sqrt{89}\cos BDC</math>  <math>\cos BDC = 25/\sqrt{(61 \times 89)}</math>  <math>= 0.3393</math>  <math>\angle BDC = 70.2^\circ</math></p> <p>(b) Area <math>BDC = \frac{1}{2}\sqrt{61}\sqrt{89}\sin 70.2^\circ</math>  <math>= 34.7 \text{ cm}^2</math> (3sf)</p> <p>(c) Area <math>DAC = \frac{1}{2} \times 5 \times 8 = 20</math></p> <p>(d) <math>20 = \frac{1}{2} \times \sqrt{89} \times AE \Rightarrow AE = 40/\sqrt{89}</math></p> <p>(e) Angle is <math>\angle BEA</math>  <math>\tan BEA = 6/AE = 6\sqrt{89}/40</math>  <math>= 1.415</math>  <math>\Rightarrow \angle BEA = 54.8^\circ</math></p>	<p>M1 A2, 1, 0 M1 A1</p> <p>A1</p> <p>M1 A1ft A1 allow 34.6</p> <p>B1</p> <p>M1 A1</p> <p>M1 identify angle M1 A1ft</p> <p>A1 <b>16</b></p>

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

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Order Code UG030468 January 2012

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