

# Mark Scheme (Results)

June 2011

International GCSE

Mathematics (4PM0) Paper 02

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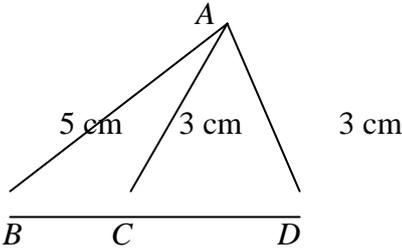
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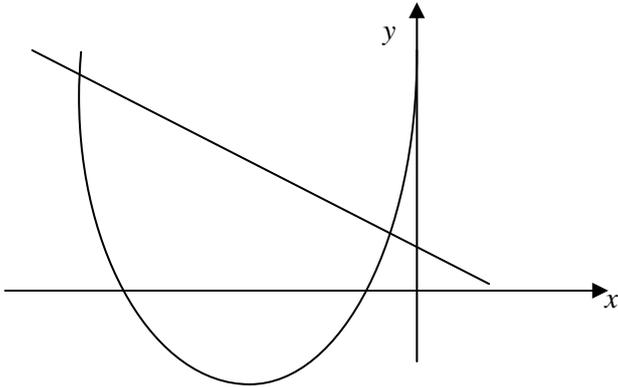
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Q.	Scheme	Marks
1.	$\sum = \frac{15}{2}(9+37), = 345$	M1A1,A1 (3)
2.	$v = 3t^2 + 4t - 3$ $12 = 3t^2 + 4t - 3$ $0 = 3t^2 + 4t - 15$ $0 = (3t - 5)(t + 3)$ $t = \frac{5}{3}$	M1A1  M1  A1  (4)
3.	<div style="display: flex; align-items: center;">  <div style="margin-left: 20px;"> <p>(a) <math>\frac{\sin C}{5} = \frac{\sin 25}{3}</math></p> <math display="block">\sin C = \frac{5 \sin 25}{3}</math> <math display="block">C = 135.2... = 135</math> <p>(b) <math>CD = 2 \times 3 \cos 44.8</math></p> <math display="block">CD = 4.257... = 4.26 \text{ cm}</math> </div> </div>	M1A1  A1  M1A1ft  A1 (6)
4.	<p>(a) <math>x = -4 \quad 0 = (-4)^3 + 2(-4)^2 - 11(-4) - m</math></p> $m = -64 + 32 + 44 = 12 \quad *$ <p>(b) <math>x^3 + 2x^2 - 11x - 12 = (x+4)(x^2 - 2x - 3)</math></p> $= (x+4)(x-3)(x+1)$ <p>(c) <math>b = -1 \quad d = 3</math></p>	M1  A1 cso  B1  M1A1  B1 (6)
5.	<p>(a) <math>\frac{5 \times 1 + 2q}{3} = 13 \quad 2q = 39 - 5 \quad q = 17</math></p> $\frac{p + 2 \times 12}{3} = 10 \quad p = 30 - 24 = 6$ <p>(b) <math>A \quad \text{---} 3 \text{---} B \quad \text{---} 2 \text{---} E</math></p> $17\mathbf{i} + 12\mathbf{j} = \frac{2(5\mathbf{i} + 6\mathbf{j}) + 3\mathbf{e}}{5}$ $85\mathbf{i} + 60\mathbf{j} = 10\mathbf{i} + 12\mathbf{j} + 3\mathbf{e}$ $3\mathbf{e} = 75\mathbf{i} + 48\mathbf{j}$ $\mathbf{e} = 25\mathbf{i} + 16\mathbf{j}$	M1A1  A1      M1      A1 A1 (6)

Q.	Scheme	Marks
6	<p>(a) <math>8\theta = 6 \quad \theta = \frac{3}{4}</math> (accept 0.75) oe</p> <p>(b) <math>\frac{1}{2}r^2\theta = \frac{1}{2} \times 8^2 \times \frac{3}{4} = 24 \text{ cm}^2</math></p> <p>(c) Area of <math>\triangle ABC = \frac{1}{2} \times 8^2 \times \sin AOB = 21.81\dots</math>            Area of segment = <math>24 - 21.81\dots = 2.187 = 2.19 \text{ cm}^2</math></p>	<p>M1A1</p> <p>M1A1</p> <p>M1A1</p> <p>A1ft</p> <p>(7)</p>
7.	<p>(a) <math>V = 3x^2h = 30</math>  <math>S = 3x^2 + 2xh + 2 \times 3xh</math>  <math>xh = \frac{10}{x} \Rightarrow S = 3x^2 + 2 \times \frac{10}{x} + 6 \times \frac{10}{x}</math>  <math>S = 3x^2 + \frac{80}{x}</math>*</p> <p>(b) <math>\frac{dS}{dx} = 6x - \frac{80}{x^2}</math>  <math>\frac{dS}{dx} = 0 \quad 6x^3 = 80 \quad x = \sqrt[3]{\frac{40}{3}} \quad (= 2.371\dots)</math>  <math>S_{\min} = 3 \left( \sqrt[3]{\frac{40}{3}} \right)^2 + \frac{80}{\sqrt[3]{\frac{40}{3}}} = 50.60\dots = 50.6 \text{ cm}^3</math></p> <p>(c) <math>\frac{d^2S}{dx^2} = 6 + \frac{160}{x^3} &gt; 0</math> for <math>x &gt; 0</math>  <math>\therefore</math> minimum</p>	<p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>M1A1</p> <p>M1A1</p> <p>M1</p> <p>A1ft (11)</p>

Q.	Scheme	Marks
8.	<p>(a) <math>a + ar^2 = 100, \quad ar + ar^2 = 60</math></p> $\frac{1+r^2}{r+r^2} = \frac{100}{60}$ $6+6r^2 = 10r+10r^2 \quad 2r^2 + 5r - 3 = 0$ $(2r-1)(r+3) = 0$ $r = \frac{1}{2} \quad r = -3$ <p>(b) <math>r = \frac{1}{2} \quad a = \frac{100}{1+(\frac{1}{2})^2} = 80</math></p> <p>(c) <math>S_n = \frac{a(1-r^n)}{1-r} = \frac{80\left(1-\left(\frac{1}{2}\right)^n\right)}{1-\frac{1}{2}} &gt; 159.9</math></p> $\frac{159.9}{160} < 1 - \left(\frac{1}{2}\right)^n$ $\left(\frac{1}{2}\right)^n = 1 - \frac{159.9}{160}$ $n \log 0.5 < \log\left(1 - \frac{159.9}{160}\right)$ $n > \frac{\log\left(1 - \frac{159.9}{160}\right)}{\log 0.5} = 10.6$ <p>n=11</p>	<p>M1,A1</p> <p>M1</p> <p>A1A1</p> <p>M1A1</p> <p>M1A1</p> <p>M1</p> <p>A1</p> <p>(11)</p>

Q.	Scheme	Marks
<b>9</b>	<p>(a) <math>\left(1 - \frac{3x}{4}\right)^{\frac{1}{3}} = 1 + \left(\frac{1}{3}\right)\left(-\frac{3x}{4}\right) + \frac{\left(\frac{1}{3}\right)\left(-\frac{2}{3}\right)}{2!}\left(-\frac{3x}{4}\right)^2 + \frac{\left(\frac{1}{3}\right)\left(-\frac{2}{3}\right)\left(-\frac{5}{3}\right)}{3!}\left(-\frac{3x}{4}\right)^3</math>  <math>= 1 - \frac{x}{4} - \frac{x^2}{16} - \frac{5x^3}{192}</math></p> <p>(b) <math>\left(1 + \frac{3x}{4}\right)^{-\frac{1}{3}} = 1 + \left(-\frac{1}{3}\right)\left(\frac{3x}{4}\right) + \frac{\left(-\frac{1}{3}\right)\left(-\frac{4}{3}\right)}{2!}\left(\frac{3x}{4}\right)^2 + \frac{\left(-\frac{1}{3}\right)\left(-\frac{4}{3}\right)\left(-\frac{7}{3}\right)}{3!}\left(\frac{3x}{4}\right)^3</math>  <math>= 1 - \frac{x}{4} + \frac{x^2}{8} - \frac{7x^3}{96}</math></p> <p>(c) <math> x  &lt; \frac{4}{3}</math></p> <p>(d) <math>\left(\frac{4-3x}{4+3x}\right)^{\frac{1}{3}} = \left(\frac{1-\frac{3x}{4}}{1+\frac{3x}{4}}\right)^{\frac{1}{3}} = \left(1 - \frac{x}{4} - \frac{x^2}{16} - \frac{5x^3}{192}\right)\left(1 - \frac{x}{4} + \frac{x^2}{8} - \frac{7x^3}{96}\right)</math>  <math>= 1 - \frac{x}{4} + \frac{x^2}{8} - \frac{7x^3}{96} - \frac{x}{4} + \frac{x^2}{16} - \frac{x^3}{32} - \frac{x^2}{16} + \frac{x^3}{64} - \frac{5x^3}{192}</math>  <math>= 1 - \frac{x}{2} + \frac{x^2}{8} - \frac{11x^3}{96}</math></p> <p>(e) <math>\int_0^{0.5} \left(\frac{4-3x}{4+3x}\right)^{\frac{1}{3}} dx = \int_0^{0.5} \left(1 - \frac{x}{2} + \frac{x^2}{8} - \frac{11x^3}{96}\right) dx</math>  <math>= \left[x - \frac{x^2}{4} + \frac{x^3}{24} - \frac{11x^4}{384}\right]_0^{0.5}</math>  <math>= 0.5 - \frac{0.5^2}{4} + \frac{0.5^3}{24} - \frac{11 \times 0.5^4}{384} = 0.4409... = 0.441</math></p>	<p>M1 A1A1</p> <p>M1 A1A1</p> <p>B1</p> <p>M1 M1 A1</p> <p>M1A1ft M1A1 (14)</p>
<b>10</b>	<p>(a) <math>\alpha + \beta = -6</math>   <math>\alpha\beta = 2</math></p> <p>(i) <math>\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta = 36 - 4 = 32</math></p> <p>(ii) <math>\alpha^4 + \beta^4 = (\alpha^2 + \beta^2)^2 - 2(\alpha\beta)^2 = 32^2 - 8 = 1016</math></p> <p>(b) <math>(\alpha - \beta)^2 = \alpha^2 - 2\alpha\beta + \beta^2 = 32 - 4 = 28</math>  <math>\alpha - \beta = \sqrt{28} = 2\sqrt{7}</math></p> <p>(c) <math>\alpha^4 - \beta^4 = (\alpha^2 + \beta^2)(\alpha^2 - \beta^2), = (\alpha^2 + \beta^2)(\alpha + \beta)(\alpha - \beta)</math></p> <p>(d) <math>\alpha^4 - \beta^4 = 32 \times (-6) \times 2\sqrt{7} = -384\sqrt{7}</math></p> <p>(e) <math>(\alpha^4 + \beta^4) - (\alpha^4 - \beta^4) = 2\beta^4</math>  <math>2\beta^4 = 1016 + 384\sqrt{7}</math>  <math>\beta^4 = 508 + 192\sqrt{7}</math></p>	<p>B1</p> <p>M1A1 M1A1</p> <p>M1A1</p> <p>A1</p> <p>M1,A1</p> <p>M1A1 M1</p> <p>A1   (14)</p>

Q.	Scheme	Marks
11.	<p>(a) <math>x^2 + 6x + 8 = (x+3)^2 - 9 + 8 = (x+3)^2 - 1</math></p> <p>(b) <math>f(x)</math> is least when <math>x = -3</math> least value is <math>-1</math></p> <p>(c) <math>x^2 + 6x + 8 = 2 - x</math> <math>x^2 + 7x + 6 = 0</math> <math>(x+6)(x+1) = 0</math> <math>x = -6 \quad x = -1</math></p> <p>(d) <math>x^2 + 6x + 8 = 0</math> <math>(x+2)(x+4) = 0</math> <math>x = -2 \quad x = -4</math></p> <p>(e) </p> <p>(f) Area = <math>\int_{-6}^{-1} \{2 - x - (x^2 + 6x + 8)\} dx</math>  <math display="block">= \left[ -\frac{x^3}{3} - \frac{7x^2}{2} - 6x \right]_{-6}^{-1}</math> <math display="block">= \left( \frac{1}{3} - \frac{7}{2} + 6 \right) - \left( \frac{6^3}{3} - \frac{7 \times 6^2}{2} + 6^2 \right)</math> <math display="block">= 20\frac{5}{6} \text{ or awrt } 20.8</math></p>	<p>M1A1A1</p> <p>B1 B1</p> <p>M1</p> <p>M1 A1A1</p> <p>M1A1</p> <p>B1 B1</p> <p>M1</p> <p>M1A1</p> <p>M1 A1</p> <p>(18)</p>

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