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Mark Scheme (Results)

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Mathematics (4PM0) Paper 02

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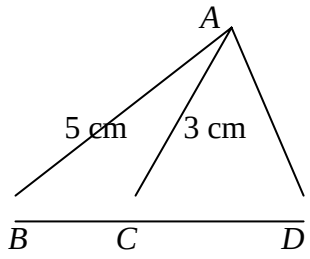
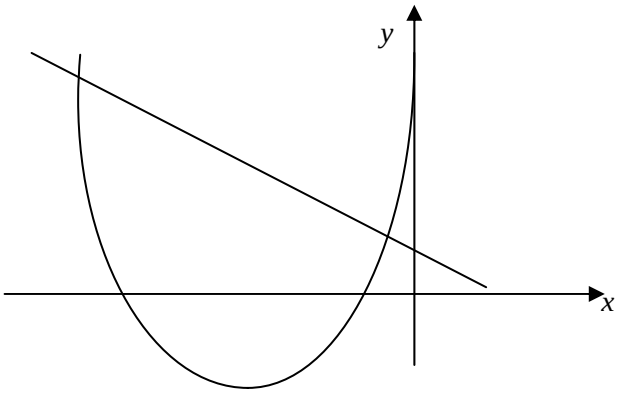
Q.	Scheme	Marks
1.	$\sum = \frac{15}{2}(9+37), = 345$	M1A1,A1 (3)
2.	$v = 3t^2 + 4t - 3$ $12 = 3t^2 + 4t - 3$ $0 = 3t^2 + 4t - 15$ $0 = (3t-5)(t+3)$ $t = \frac{5}{3}$	M1A1 M1 A1 (4)
3.	 (a) $\frac{\sin C}{5} = \frac{\sin 25}{3}$ $\sin C = \frac{5\sin 25}{3}$ $C = 135.2... = 135$ (b) $CD = 2\times 3\cos 44.8$ $CD = 4.257... = 4.26$ cm	M1A1 A1 M1A1ft A1 (6)
4.	(a) $x = -4$ $0 = (-4)^3 + 2(-4)^2 - 11(-4) - m$ $m = -64 + 32 + 44 = 12$ * (b) $x^3 + 2x^2 - 11x - 12 = (x+4)(x^2 - 2x - 3)$ $= (x+4)(x-3)(x+1)$ (c) $b = -1$ $d = 3$	M1 A1 cso B1 M1A1 B1 (6)
5.	(a) $\frac{5\times 1 + 2q}{3} = 13$ $2q = 39 - 5$ $q = 17$ $\frac{p + 2\times 12}{3} = 10$ $p = 30 - 24 = 6$ (b) A ~~3~~ B ~~2~~ E $17\mathbf{i} + 12\mathbf{j} = \frac{2(5\mathbf{i} + 6\mathbf{j}) + 3\mathbf{e}}{5}$ $85\mathbf{i} + 60\mathbf{j} = 10\mathbf{i} + 12\mathbf{j} + 3$ $3\mathbf{e} = 75\mathbf{i} + 48\mathbf{j}$ $\mathbf{e} = 25\mathbf{i} + 16\mathbf{j}$	M1A1 A1 M1 A1 A1 (6)

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

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

Q.	Scheme	Marks
9	(a) $\left(1-\frac{3x}{4}\right)^{\frac{1}{3}}=1+\left(\frac{1}{3}\right)\left(-\frac{3x}{4}\right)+\frac{\left(\frac{1}{3}\right)\left(-\frac{2}{3}\right)}{2!}\left(-\frac{3x}{4}\right)^2+\frac{\left(\frac{1}{3}\right)\left(-\frac{2}{3}\right)\left(-\frac{5}{3}\right)}{3!}\left(-\frac{3x}{4}\right)^3$	M1
	$=1-\frac{x}{4}-\frac{x^2}{16}-\frac{5x^3}{192}$	A1A1
	(b) $\left(1+\frac{3x}{4}\right)^{-\frac{1}{3}}=1+\left(-\frac{1}{3}\right)\left(\frac{3x}{4}\right)+\frac{\left(-\frac{1}{3}\right)\left(-\frac{4}{3}\right)}{2!}\left(\frac{3x}{4}\right)^2+\frac{\left(-\frac{1}{3}\right)\left(-\frac{4}{3}\right)\left(-\frac{7}{3}\right)}{3!}\left(\frac{3x}{4}\right)^3$	M1
	$=1-\frac{x}{4}+\frac{x^2}{8}-\frac{7x^3}{96}$	A1A!
	(c) $\lvert x\rvert<\frac{4}{3}$	B1
	(d) $\left(\frac{4-3x}{4+3x}\right)^{\frac{1}{3}}=\left(\frac{1-\frac{3x}{4}}{1+\frac{3x}{4}}\right)^{\frac{1}{3}}=\left(1-\frac{x}{4}-\frac{x^2}{16}-\frac{5x^3}{192}\right)\left(1-\frac{x}{4}+\frac{x^2}{8}-\frac{7x^3}{96}\right)$	M1
	$=1-\frac{x}{4}+\frac{x^2}{8}-\frac{7x^3}{96}-\frac{x}{4}+\frac{x^2}{16}-\frac{x^3}{32}-\frac{x^2}{16}+\frac{x^3}{64}-\frac{5x^3}{192}$	M1
	$=1-\frac{x}{2}+\frac{x^2}{8}-\frac{11x^3}{96}$	A1
	(e) $\int_0^{0.5}\left(\frac{4-3x}{4+3x}\right)^{\frac{1}{3}}\mathrm{d}x=\int_0^{0.5}\left(1-\frac{x}{2}+\frac{x^2}{8}-\frac{11x^3}{96}\right)\mathrm{d}x$	
	$=\left[x-\frac{x^2}{4}+\frac{x^3}{24}-\frac{11x^4}{384}\right]_0^{0.5}$	
	$=0.5-\frac{0.5^2}{4}+\frac{0.5^3}{24}-\frac{11\times0.5^4}{384}=0.4409...=0.441$	M1A1ft
		M1A1 (14)
10	(a) $\alpha+\beta=-6\quad\alpha\beta=2$	B1
	(i) $\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta=36-4=32$	M1A1
	(ii) $\alpha^4+\beta^4=\left(\alpha^2+\beta^2\right)^2-2(\alpha\beta)^2=32^2-8=1016$	M1A1
	(b) $(\alpha-\beta)^2=\alpha^2-2\alpha\beta+\beta^2=32-4=28$	M1A1
	$\alpha-\beta=\sqrt{28}=2\sqrt{7}$	A1
	(c) $\alpha^4-\beta^4=\left(\alpha^2+\beta^2\right)\left(\alpha^2-\beta^2\right),=\left(\alpha^2+\beta^2\right)(\alpha+\beta)(\alpha-\beta)$	M1,A1
	(d) $\alpha^4-\beta^4=32\times(-6)\times2\sqrt{7}=-384\sqrt{7}$	
	(e) $\left(\alpha^4+\beta^4\right)-\left(\alpha^4-\beta^4\right)=2\beta^4$	M1A1
	$2\beta^4=1016+384\sqrt{7}$	M1
	$\beta^4=508+192\sqrt{7}$	A1 (14)

Q.	Scheme	Marks
11.	(a) $x^2+6x+8=(x+3)^2-9+8=(x+3)^2-1$	M1A1A1
	(b) f(x) is least when $x=-3$ least value is -1	B1 B1
	(c) $x^2+6x+8=2-x$ $x^2+7x+6=0$ $(x+6)(x+1)=0$ $x=-6 \quad x=-1$	M1 M1 A1A1
	(d) $x^2+6x+8=0$ $(x+2)(x+4)=0$ $x=-2 \quad x=-4$	M1A1
	(e) 	B1 B1
	(f) Area $=\int_{-6}^{-1}\{2-x-(x^2+6x+8)\}\,dx$ $=\left[-\frac{x^3}{3}-\frac{7x^2}{2}-6x\right]_{-6}^{-1}$ $=\left(\frac{1}{3}-\frac{7}{2}+6\right)-\left(\frac{6^3}{3}-\frac{7\times6^2}{2}+6^2\right)$ $=20\frac{5}{6}$ or awrt 20.8	M1 M1A1 M1 A1 (18)

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