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Mark Scheme Summer 2008

GCE O Level

GCE AO Level Pure Mathematics (7362)

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Contents

Pure Mathematics 7362

Paper 1

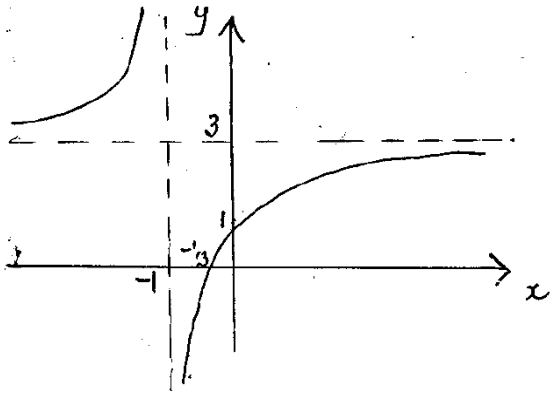
Q.	Scheme	Marks
1	$\cos\theta = \dfrac{4^2+5^2-6^2}{2\times4\times5} = \dfrac{16+25-36}{40}\left(=\dfrac{1}{8}\right)$	M1 M1A1
	$\theta = 82.8°$	A1 (4)
2	$5-x = x^2-8x+11$	M1
	$x^2-7x+6=0$	A1
	$(x-6)(x-1)=0$	M1
	$x=6 \quad y=-1$	A1
	$x=1 \quad y=4$	A1 (5)
3	$\frac{r}{h}=\tan 30 \quad h=\frac{r}{\tan 30}$	B1
	$V=\frac{1}{3}\pi r^2\times\frac{r}{\tan 30}$	M1
	$\dfrac{\mathrm{d}V}{\mathrm{d}r}=\dfrac{\pi r^2}{\tan 30}$	M1
	$\dfrac{\mathrm{d}V}{\mathrm{d}t}=-5 \quad \dfrac{\mathrm{d}r}{\mathrm{d}t}=\dfrac{\mathrm{d}V}{\mathrm{d}t}\times\dfrac{\mathrm{d}r}{\mathrm{d}V}$	B1 M1
	$=-5\times\dfrac{\tan 30}{\pi r^2}=-5\times\dfrac{\tan 30}{\pi(h\tan 30)^2}$	A1
	$h=10 \quad \dfrac{\mathrm{d}r}{\mathrm{d}t}=\dfrac{-5}{100\pi\tan 30}=-0.0275...=-0.028$ cm/s	
	Rate of decrease $=0.028$ cm/s	A1 (7)
4	(a) $\dfrac{\mathrm{d}y}{\mathrm{d}x}=10x\mathrm{e}^{2x}+2\left(5x^2-2\right)\mathrm{e}^{2x}$	M1A1A1 (3)
	(b) $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{3x^2\left(x-x^2\right)-\left(x^3+2\right)(1-2x)}{\left(x-x^2\right)^2}$	M1 A2,1,0
	$=\dfrac{2x^3-x^4+4x-2}{\left(x-x^2\right)^2}$	A1 (4)
5	(a) (i) $\overrightarrow{AB}=\overrightarrow{OB}-\overrightarrow{OA}=5\mathbf{i}+10\mathbf{j}$	B1
	(ii) $\overrightarrow{OC}=\overrightarrow{OA}+\frac{2}{5}\overrightarrow{AB}=4\mathbf{i}+5\mathbf{j}+2\mathbf{i}+4\mathbf{j}=6\mathbf{i}+9\mathbf{j}$	M1A1 (3)
	(b) unit vector $=\dfrac{\overrightarrow{AB}}{\left\lvert\overrightarrow{AB}\right\rvert}=\dfrac{5\mathbf{i}+10\mathbf{j}}{\sqrt{125}}=\dfrac{\mathbf{i}+2\mathbf{j}}{\sqrt{5}}$	M1A1 (2)
	(c) $\overrightarrow{DA}=-\lambda\mathbf{i}+4\mathbf{i}+5\mathbf{j}=(4-\lambda)\mathbf{i}+5\mathbf{j}$	M1
	Parallel to $5\mathbf{i}+10\mathbf{j} \quad \therefore\ 5=2(4-\lambda)$	M1
	$\lambda=\frac{3}{2}$	A1 (3)

6	(a) $p^5 = 243, \quad p = 3$	M1,A1 (2)
	(b) $3q + 4 = 4^3$	
	$3q + 4 = 64 \quad 3q = 60 \quad q = 20$	M1A1 (2)
	(c) $\mathrm{f}(x) = 2x\log_x 3 - 10\log_x 3 - x + 5$	M1
	$= 2\log_x 3(x-5) - (x-5)$	
	$= (x-5)(2\log_x 3 - 1) \quad a = 2, \quad b = 1$	M1A1 (3)
	(d) $\log_x 3 = \frac{1}{2}$	
	$x^{\frac{1}{2}} = 3 \quad x = 9$	M1A1
	or $x = 5$	B1 (3)
7	(a) $A = 2\left(10x^2 + 5xh + 2xh\right)$	B1 (1)
	(b) $(V =)10x^2h = 500$	B1
	$A = 20x^2 + 14x \times \frac{50}{x^2}$	M1
	$A = 20x^2 + \frac{700}{x}$	A1 (3)
	(c) $\frac{\mathrm{d}A}{\mathrm{d}x} = 40x - \frac{700}{x^2}$	M1
	$\frac{\mathrm{d}A}{\mathrm{d}x} = 0 \quad x^3 = \frac{700}{40} \quad (x = 2.596...)$	M1A1
	$A_{\min} = 20 \times 2.596^2 + \frac{700}{2.596} = 404.4... \quad = 404 \text{ cm}^3$	M1A1 (5)
	(d) $\frac{\mathrm{d}^2A}{\mathrm{d}x^2} = 40 + \frac{700 \times 2}{x^3}$	M1
	$x > 0 \Rightarrow \frac{\mathrm{d}^2A}{\mathrm{d}x^2} > 0 \quad \therefore \min A \text{ at } x = 2.596...$	A1ft (2)
8	(a) $(15x+6)(x+4) = (6x-3)^2$	M1
	$15x^2 + 66x + 24 = 36x^2 - 36x + 9$	
	$21x^2 - 102x - 15 = 0 \quad 7x^2 - 34x - 5 = 0$	M1
	$(7x+1)(x-5) = 0 \quad x = -\frac{1}{7} \quad x = 5$	A1A1 (4)
	(b) $x = 5 \quad r = \frac{6x-3}{15x+6} = \frac{27}{81} = \frac{1}{3}$	M1A1ft
	$x = -\frac{1}{7} \quad r = \frac{-\frac{6}{7}-3}{-\frac{15}{7}+6} = \frac{-27/7}{27/7} = -1$	A1ft (3)
	(c) $r = \frac{1}{3} \quad a = 81 \quad S_\infty = \frac{a}{1-r} = \frac{81}{2/3} = \frac{243}{2} = 121\frac{1}{2}$	B1M1A1 (3)
	(d) $S_n = \frac{81\left(1-\left(\frac{1}{3}\right)^n\right)}{\frac{2}{3}} = \frac{243}{2}\left(1-\left(\frac{1}{3}\right)^n\right)$	M1
	$\%\text{ error } = \frac{(-)\frac{243}{2} \times \left(\frac{1}{3}\right)^n}{\frac{243}{2}} \times 100\% = (-)100\left(\frac{1}{3}\right)^n \%$	M1A1ft (on r) (3)

9	(a) $\cos 2A \equiv \cos^2 A - \sin^2 A = \cos^2 A - \left(1 - \cos^2 A\right) = 2\cos^2 A - 1$	M1A1 (2)
	(b) $\sin 2A = 2\sin A \cos A$	B1 (1)
	(c) $\cos 3A = \cos\left(2A + A\right) = \cos 2A \cos A - \sin 2A \sin A$	M1
	$= \left(2\cos^2 A - 1\right)\cos A - 2\sin^2 A \cos A$	M1
	$= 2\cos^3 A - \cos A - 2\left(1 - \cos^2 A\right)\cos A$	M1
	$= 4\cos^3 A - 3\cos A$	A1 (4)
	(d) $\cos 3x = 0.6$	M1
	$3x = 53.13°, \quad 306.86°, \quad 413.13°$	M1
	$x = 17.7°, \quad 102.3°, \quad 137.7°$	A3,2,1,0 (5)
	(e) $\frac{1}{4}\int_0^{\frac{\pi}{3}} \left(\cos 3\theta + 3\cos\theta\right) \mathrm{d}\theta, \quad = \frac{1}{4}\left[\frac{1}{3}\sin 3\theta + 3\sin\theta\right]_0^{\frac{\pi}{3}}$	M1,M1A1
	$= \frac{1}{4}\left[\frac{1}{3}\sin\pi + 3\sin\frac{\pi}{3} - 0\right] = \frac{3}{4}\frac{\sqrt{3}}{2} = \frac{3\sqrt{3}}{8} \quad a = 3, \ b = 8, \ c = 3$	M1A1 (5)
10	(a) $\left(-2, 0\right)$ on curve: $-8 + 4p - 2q + 6 = 0$	M1
	$4p - 2q = 2 \quad 2p - q = 1$	
	$\left(2, -4\right)$ on curve: $8 + 4p + 2q + 6 = -4$	A1
	$2p + q = -9$	
	Add: $4p = -8$	M1
	$p = -2 \quad q = -5$	A1A1 (5)
	(b) $\mathrm{f}\left(x\right) = \left(x + 2\right)\left(x^2 - 4x + 3\right) = \left(x + 2\right)\left(x - 3\right)\left(x - 1\right)$	M1
	D is $\left(1, 0\right) \quad E$ is $\left(3, 0\right)$	A1A1 (3)
	(c) $y = x^3 - 2x^2 - 5x + 6 \quad \frac{\mathrm{d}y}{\mathrm{d}x} = 3x^2 - 4x - 5$	M1
	$x = 2 \quad \frac{\mathrm{d}y}{\mathrm{d}x} = 12 - 8 - 5 = -1$	A1ft
	grad normal $= 1 \quad$ eqn. normal: $y + 4 = x - 2 \quad (y = x - 6)$	B1ft B1 (4)
	(d) $\int_1^2 \left(x^3 - 2x^2 - 5x + 6\right) \mathrm{d}x = \left[\frac{x^4}{4} - \frac{2x^3}{3} - \frac{5x^2}{2} + 6x\right]_1^2$	M1
	$= \left(4 - \frac{16}{3} - 10 + 12\right) - \left(\frac{1}{4} - \frac{2}{3} - \frac{5}{2} + 6\right) = -2\frac{5}{12}$	M1A1
	Normal cuts x-axis at $x = 6$	M1A1
	Area $\Delta = \frac{1}{2} \times 4 \times 4 = 8$	B1ft (6)
	Total area $= 8 + 2\frac{5}{12} = 10\frac{5}{12}$ units^2	

Pure Mathematics 7362

Paper 2

1	$b^2-4ac>0 \quad 4p^2-4(10-3p)>0$ $4p^2+12p-40>0 \qquad p^2+3p-10>0$ $(p+5)(p-2)>0 \quad$ crit. values $p=-5 \;\; p=2$ $p<-5 \;\; p>2$	M1 M1A1 A1ft (4)
2	$\sum_{r=5}^{195} r-\sum_{r=1}^{39} 5r$ $=\frac{191}{2}(5+195)-5\times\frac{39}{2}(1+39), \qquad =19100-3900=15200$	M1A1 M1A1,A1 (5)
3	Grad. line $=\frac{12}{-6}=-2$ Grad. perp. $=\frac{1}{2}$ Mid pt. is $(8, 3)$ Eqn. perp. $\quad y-3=\frac{1}{2}(x-8) \quad 2y=x-2$	M1 A1 B1 M1A1 (5)
4	$y=0 \quad x^2=9 \quad x=\pm 3$ $V=\int_{-3}^{3}\pi y^2\,\mathrm{d}x=\int_{-3}^{3}\pi\left(9-x^2\right)^2\,\mathrm{d}x=\pi\int_{-3}^{3}\left(81-18x^2+x^4\right)\mathrm{d}x$ $=\pi\left[81x-6x^3+\frac{x^5}{5}\right]_{-3}^{3}$ $=\pi\left[\left(81\times 3-6\times 27+\frac{3^5}{5}\right)-\left(-81\times 3+6\times 3^3-\frac{3^5}{5}\right)\right]=814$	B1 M1 M1A1 M1A1 (6)
5	(a) $v=t^2-2t+9 \quad \frac{\mathrm{d}v}{\mathrm{d}t}=2t-2$ $t=3 \quad$ accel. $=4\mathrm{m/s}^2$ (b) $s=\int\left(t^2-2t+9\right)\mathrm{d}t=\left[\frac{t^3}{3}-t^2+9t\right]_0^6$ $=72-36+54=90\mathrm{m}$	M1 A1 (2) M1A1 M1A1 (4)
6	(a) (i) $y=3 \quad$ (ii) $x=-1$ (b) (i) $y=0 \quad 3=\frac{2}{x+1} \quad x=-\frac{1}{3} \quad \left(-\frac{1}{3},0\right)$ (ii) $x=0 \;\; y=1 \quad (0, 1)$ (c)  	B1B1 (2) B1 B1 (2) G1 G1ft G1ft (3)

7	(a) $\alpha+\beta=-k \quad \alpha\beta=-5$ $\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta=k^2+10$ $\alpha^2\beta^2=25$ (b) $5(k^2+10)-7\times25=0$ $5k^2=175-50$ $k^2=25 \quad k=\pm5$ (c) $k=5 \quad \frac{1}{\alpha^2}+\frac{1}{\beta^2}=\frac{\alpha^2+\beta^2}{\alpha^2\beta^2}=\frac{25+10}{25}=\frac{7}{5}$ $\frac{1}{\alpha^2\beta^2}=\frac{1}{25}$ Eqn. $x^2-\frac{7}{5}x+\frac{1}{25}=0$ $25x^2-35x+1=0$	B1 M1A1 B1 (4) M1 A1 (2) M1A1 B1 M1 A1 (5)
8	(a) $\sin\theta=\frac{1}{4}$ ($\sin\theta=-\frac{5}{2}$ not poss.) $\theta=0.253, \quad 2.89$ (b) $(2\theta-\frac{\pi}{3})=1.176, \quad 4.317$ $2\theta=2.223, \quad 5.364$ $\theta=1.11, \quad 2.68$ (c) $9(1-\cos^2\theta)-9\cos\theta=11$ $9\cos^2\theta+9\cos\theta+2=0$ $(3\cos\theta+1)(3\cos\theta+2)=0 \quad \cos\theta=-\frac{1}{3}, \quad \cos\theta=-\frac{2}{3}$ $\theta=1.91, \quad \theta=2.30$	M1 A1A1 (3) M1 M1 A1A1 (4) M1 M1A1 A1,A1 (5)
9	(a) $a+2d=\log pq^4 \quad a+4d=\log pq^8$ $2d=\log pq^8-\log pq^4$ $=\log\frac{pq^8}{pq^4}=\log q^4=4\log q \qquad d=2\log q \quad b=2$ (b) $a=\log pq^4-4\log q=\log\frac{pq^4}{q^4}=\log p$ (c) $S_n=\frac{n}{2}\{2\log p+2(n-1)\log q\}$ $=n\{\log pq^{n-1}\} \quad s=n \quad r=n-1$ (d) $S_{16}=16\log pq^{15} \qquad S_4=4\log pq^3$ $16\log pq^{15}=40\log pq^3$ $2\log p+30\log q=5\log p+15\log q$ $3\log p=15\log q, \qquad \log p=5\log q$	M1 M1 A1 (3) M1A1 (2) M1A1 M1A1 (4) M1A1ft M1A1 (4)

10	(a) $\left(1+\frac{x}{2}\right)^{\frac{1}{5}} = 1+\left(\frac{1}{5}\right)\left(\frac{x}{2}\right)+\frac{\left(\frac{1}{5}\right)\left(-\frac{4}{5}\right)}{2!}\left(\frac{x}{2}\right)^2$ $= 1+\frac{x}{10}-\frac{x^2}{50}$	M1 A2,1,0 (3)
	(b) $\left(1-\frac{x}{2}\right)^{-\frac{1}{5}} = 1+\left(-\frac{1}{5}\right)\left(-\frac{x}{2}\right)+\frac{\left(-\frac{1}{5}\right)\left(-\frac{6}{5}\right)}{2!}\left(-\frac{x}{2}\right)^2$ $= 1+\frac{x}{10}+\frac{3x^2}{100}$	M1 A2,1,0 (3)
	(c) $\lvert x\rvert < 2$	B1 (1)
	(d) $\left(\frac{2+x}{2-x}\right)^{\frac{1}{5}} = \left(\frac{1+\frac{x}{2}}{1-\frac{x}{2}}\right)^{\frac{1}{5}} = \left(1+\frac{x}{10}-\frac{x^2}{50}\right)\left(1+\frac{x}{10}+\frac{3x^2}{100}\right)$ $= 1+\frac{x}{5}+\frac{x^2}{50}$	M1 M1A1 (3)
	(e) $\int_0^{0.5}\left(\frac{2+x}{2-x}\right)^{\frac{1}{5}}\mathrm{d}x = \int_0^{0.5}\left(1+\frac{x}{5}+\frac{x^2}{50}\right)\mathrm{d}x$ $= \left[x+\frac{x^2}{10}+\frac{x^3}{150}\right]_0^{0.5}$ $= 0.5+\frac{0.5^2}{10}+\frac{0.5^3}{150} = 0.5258$	M1A1ft M1A1 (4)
11	(a) $AC = \sqrt{\left(12^2+12^2\right)} = 12\sqrt{2}$ $VP = 6\sqrt{2}\tan 45 = 6\sqrt{2}$	M1A1 M1A1 (4)
	(b) $VA^2 = \left(6\sqrt{2}\right)^2+\left(6\sqrt{2}\right)^2 = 144$ $VA = 12$ cm	M1A1ft A1 (3)
	(c) $DX^2 = 12^2-6^2$ $DX = \sqrt{108} = 6\sqrt{3}$	M1A1 A1 (3)
	(d) $\tan\theta = \frac{6\sqrt{2}}{6}$ $\theta = 54.7°$	M1A1A1 (3)
	(e) Identify the angle $\cos\phi = \frac{\left(6\sqrt{3}\right)^2+\left(6\sqrt{3}\right)^2-\left(12\sqrt{2}\right)^2}{2\times 6\sqrt{3}\times 6\sqrt{3}}$ $= -\frac{1}{3}$ $\phi = 109.5°$	B1 M1A1ft A1 (4)

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