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Mark Scheme January 2007

GCE

AO Level Pure Mathematics (7362)

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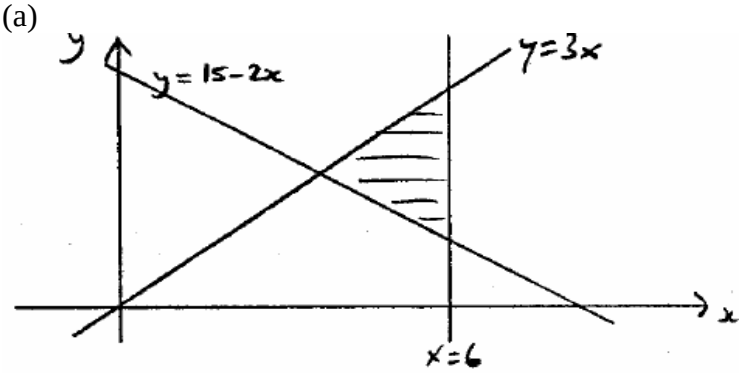
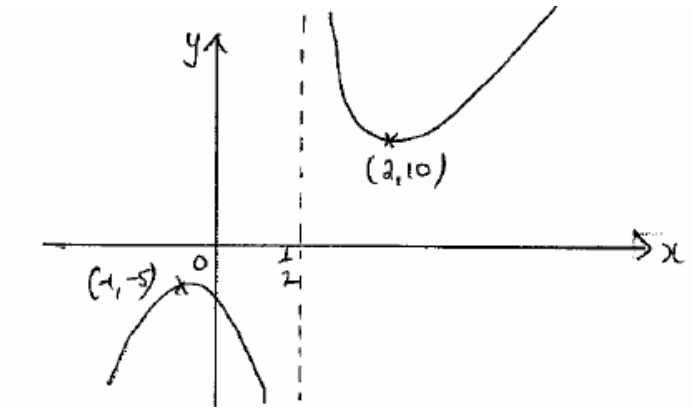
Pure Mathematics 7362

Paper 1

Q.	Scheme	Marks
1	$y=(x+2)\mathrm{e}^{3x}\qquad y'=\mathrm{e}^{3x}+3\mathrm{e}^{3x}(x+2)(=7\mathrm{e}^{3x}+3x\mathrm{e}^{3x})$	M1A1A1 (3)
2	(a)  (b) Shading	G1G1G1 B1 (4)
3	$y=3x^2-4x+2\quad x+7y=8$ $8-7x=3x^2-4x+2$ $3x^2+3x-6=0\quad x^2+x-2=0$ $(x+2)(x-1)=0\quad x=-2,\ x=1$ $y=22,\ y=1$ Points are $(-2,22)\quad(1,1)$	M1 A1 M1 A1A1 (5)
4	$\frac{\mathrm{d}A}{\mathrm{d}t}=30$ $A=\pi r^2\quad \frac{\mathrm{d}A}{\mathrm{d}r}=2\pi r,\ \ 40=\pi r^2\ \ r=\sqrt{\left(\frac{40}{\pi}\right)}$ $\frac{\mathrm{d}r}{\mathrm{d}t}=\frac{\mathrm{d}A}{\mathrm{d}t}\times\frac{\mathrm{d}r}{\mathrm{d}A}=\frac{30}{2\pi r}$ $=\frac{30}{2\pi}\times\sqrt{\left(\frac{\pi}{40}\right)}=1.338...=1.3$ cm/s	B1, B1 M1A1 M1A1 (6)
5	(a) $\sum_{r=1}^{n}(7r-3)=\frac{n}{2}(4+7n-3)=\frac{n}{2}(7n+1)$ (b) $\frac{30}{2}(7\times30+1)-\frac{14}{2}(7\times14+1),\quad =15\times211-7\times99=2472$	M1A1A1 M1A1A1 M1

	(c) $\frac{n}{2}(7n+1)=1020$ $7n^2+n-2040=0$ $(7n+120)(n-17)=0$ (or formula) $n=17$	M1 A1 (9)
6	(a) $t(t^2-7t+10)=t(t-5)(t-2)=0$ $t=5,2$ (b) $v=3t^2-14t+10$ $t=2 \quad v=3\times4-14\times2+10=-6,$ speed $=6$ $t=5 \quad v=3\times25-14\times5+10=15$ (c) $\frac{dv}{dt}=6t-14$ max/min when $t=\frac{7}{3}$ $v=3\times\left(\frac{7}{3}\right)^2-14\left(\frac{7}{3}\right)=10=-6\frac{1}{3}$ $t=0\Rightarrow v=-10,$ speed $=10$ from above, $t=5\Rightarrow v=15$ $\therefore$ max speed is 15 m/s	M1 A2,1,0 M1 A1, A1ft A1 M1 A1 M1A1 A1 (12)
7	(a) $A=20w^2+4wh+10wh$ $V=10w^2h$ $A=20w^2+14\times\frac{540}{10w}=20w^2+\frac{756}{w}$ (b) $\frac{dA}{dw}=40w-\frac{756}{w^2},$ $w^3=\frac{756}{40} \quad w=2.663...=2.66$ (c) $\frac{d^2A}{dw^2}=40+\frac{1512}{w^3}$ $w=2.663...=2.66 \quad \frac{d^2A}{dw^2}>0 \quad \therefore$ min (d) $A_{\min}=20w^2+\frac{756}{w}=425.7...=426$	B1 B1 M1A1 M1A1, M1 M1A1 M1A1 M1A1 (13)
8	(a) $p\cos(\theta+\alpha)=p(\cos\theta\cos\alpha-\sin\theta\sin\alpha)$ $p\cos\theta\cos\alpha-p\sin\theta\sin\alpha=5\cos\theta-12\sin\theta$ $p\sin\alpha=12, \quad p\cos\alpha=5$ $p^2(\sin^2\alpha+\cos^2\alpha)=12^2+5^2 \quad p^2=169 \quad p=13$ $\cos\alpha=\frac{5}{13} \quad \alpha=1.176...=1.18$ (b) $13\cos(\theta+\alpha)=9 \quad \cos(\theta+\alpha)=\frac{9}{13}$ $\theta+\alpha=0.806, \quad 5.477, \quad 7.089, \quad \theta=4.30, \quad 5.91$ (c) $\int_0^{\frac{\pi}{3}} f(\theta)\,d\theta=\int_0^{\frac{\pi}{3}}(5\cos\theta-12\sin\theta)\,d\theta$ $=\left[5\sin\theta+12\cos\theta\right]_0^{\frac{\pi}{3}}$ $=\left[5\times\frac{\sqrt{3}}{2}+12\times\frac{1}{2}-(0+12)\right]=-6+\frac{5\sqrt{3}}{2}$	M1 M1 M1A1 A1 M1 M1A1A1 M1A1 M1 M1A1 (14)

9	(a) $1+5x\times\frac{1}{3}-\frac{\frac{1}{3}\times\left(-\frac{2}{3}\right)}{2!}\left(25x^2\right)+\frac{\frac{1}{3}\times\left(-\frac{2}{3}\right)\left(-\frac{5}{3}\right)}{3!}125x^3=1+\frac{5x}{3}-\frac{25}{9}x^2+\frac{625}{81}x^3$ (b) $\left(1+\frac{5}{8}\right)^{\frac{1}{3}}=\sqrt[3]{\frac{13}{8}}=\frac{1}{2}\sqrt[3]{13}$ $1+\frac{5}{24}-\frac{25}{9}\times\frac{1}{64}+\frac{625}{81}\times\frac{1}{512}=1.1800009$ $2\times1.1800009=2.360$ (c) $\frac{\left\lvert\sqrt[3]{13}-2.3600\right\rvert}{\sqrt[3]{13}}\times100\%=0.368\%...=0.37\%$ (d) $\left(1+x\right)^4=1+4x+6x^2...$ $\left(a+bx+cx^2\right)\left(1+4x+6x^2\right),=a+x\left(b+4a\right)+x^2\left(c+4b+6a\right)$ $a=1 \quad b+4a=\frac{5}{3} \quad b=-\frac{7}{3} \quad c+4b+6a=-\frac{25}{9} \quad c=\frac{5}{9}$	M1A3,2,1,0 M1A1 B1 B1 M1A1 M1,M1 M1A3,2,1,0 (16)
10	(a) $x=\frac{1}{2}$ (b) $\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{10x\left(2x-1\right)-2\left(5x^2+10\right)}{\left(2x-1\right)^2}$ $\frac{\mathrm{d}y}{\mathrm{d}x}=0 \quad 2x^2-x-x^2-2=0$ $x^2-x-2=0 \quad \left(x-2\right)\left(x+1\right)=0 \quad x=2,\ x=-1$ $x=2 \quad y=10 \quad \left(2,10\right)$ $x=-1 \quad y=-5 \quad \left(-1,-5\right)$ (c)  (d) A is $(0,-10)$ Grad. tgt $=-20$ Eqn. tgt: $y+10=-20x$ (e) Grad. normal = $\frac{1}{20}$, Eqn. normal: $y+10=\frac{1}{20}x$ (f) tgt. meets x-axis at $-\frac{1}{2}$ normal meets x-axis at 200 Area $=\frac{1}{2}\times10\times200.5=1002.5$	B1 M1A1A1 M1 A1 A1 G1 G1 G1 B1 M1A1 B1Ö ,B1 M1(200.5) M1A1 (18)

Paper 2

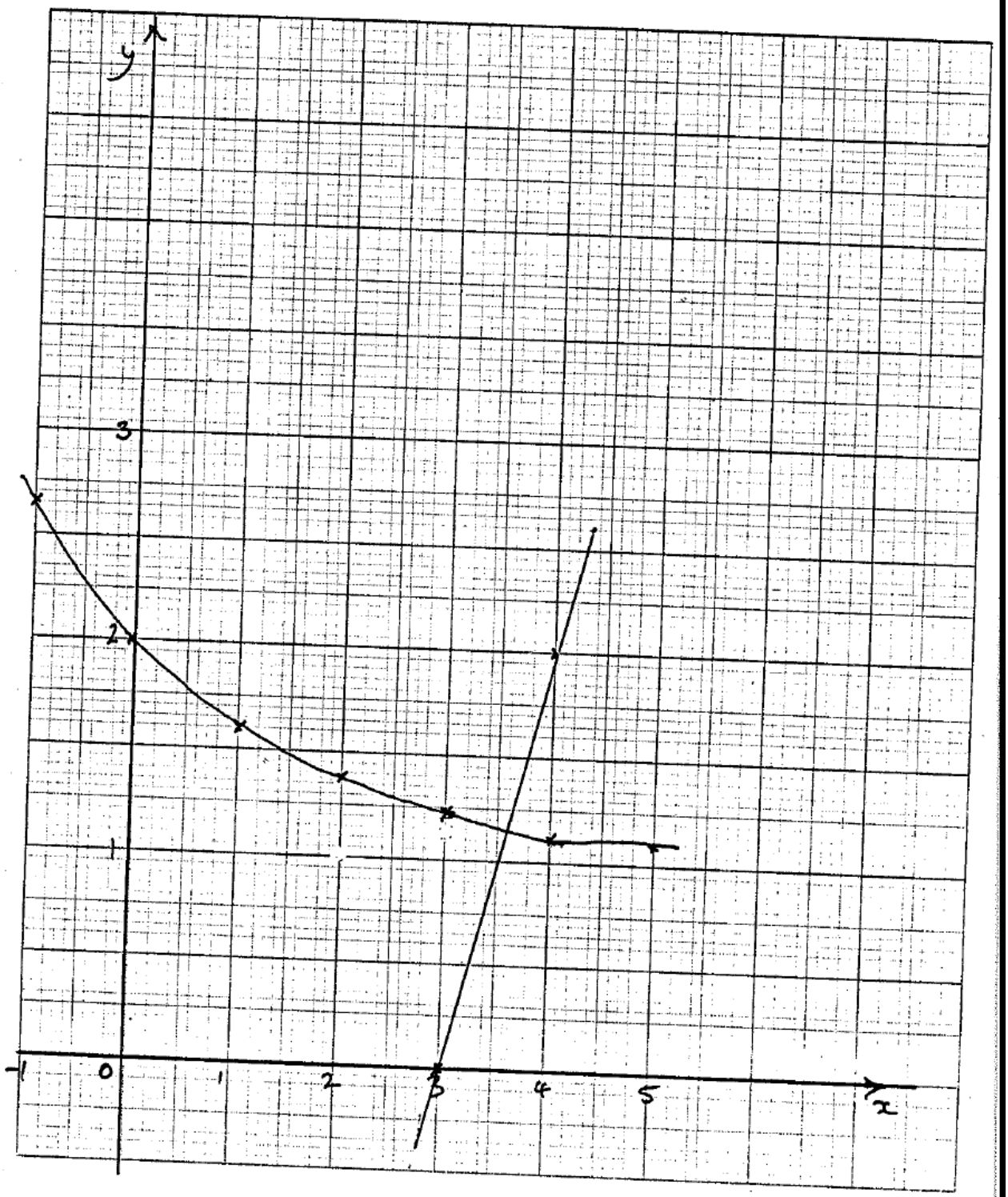
1	$\cos\theta = \dfrac{4.6^2 + 5.3^2 - 6.5^2}{2\times 4.6\times 5.3}$, $\theta = 81.7° = 82°$	M1A1,A1 (3)
2	$S_{10} = 5(2a+9d) = 295$, $S_8 = 4(2a+7d) = 196$ $2a+9d = 59$ $2a+7d = 49$ $2d = 10$ $d = 5$ $a = \frac{49-7\times 5}{2} = 7$	M1,A1 M1A1 A1 (5)
3	$\log_3(5x+12) + \log_3 x = 2$ $\log_3\left[x(5x+12)\right] = 2$ $5x^2+12x = 3^2$, $5x^2+12x-9 = 0$ $(5x-3)(x+3) = 0$ $x = \frac{3}{5}$ ($x = -3$, not poss).	M1 M1,M1A1 A1 (5)
4	(a) $\overrightarrow{OT} = (5\mathbf{i}+12\mathbf{j})$ (by ratio formula or vectors) (b) $\sqrt{5^2+12^2} = 13$ unit vector $= \frac{1}{13}(5\mathbf{i}+12\mathbf{j})$	M1A1A1 M1A1 (5)
5	(a) $\cos 2\theta = \cos^2\theta - \sin^2\theta = \cos^2\theta - (1-\cos^2\theta) = 2\cos^2\theta - 1$ (b) $\text{Vol} = \int_0^{\frac{\pi}{8}} \pi\times 9\cos^2 2x\ \mathrm{d}x, = \frac{9}{2}\pi\int_0^{\frac{\pi}{8}}(\cos 4x+1)\mathrm{d}x$ $= \frac{9}{2}\pi\left[\frac{1}{4}\sin 4x + x\right]_0^{\frac{\pi}{8}}, = \frac{9}{2}\pi\left[\frac{1}{4}\sin\frac{\pi}{2} + \frac{\pi}{8} - 0\right] = \frac{9}{16}\pi^2 + \frac{9}{8}\pi$	M1A1 M1,M1 M1A1, M1A1 (8)
6	(a) $(x+2)(7x-4) = (3x)^2$ $7x^2+10x-8 = 9x^2$ $x^2-5x+4 = 0$, $(x-1)(x-4) = 0$ $x = 4$, $x = 1$ $x = 1$ terms are 3,3,3 $\Rightarrow x = 4$ and $a = 6$ (b) $r = \frac{12}{6} = 2$ (c) $S_{17} = \frac{6(2^{17}-1)}{2-1} = 786426$	M1 A1,M1A1 A1 B1 M1A1 (8)

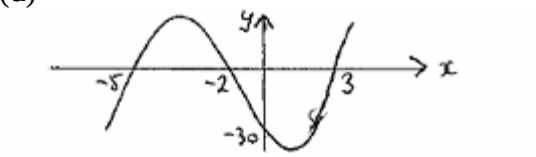
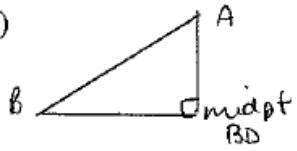
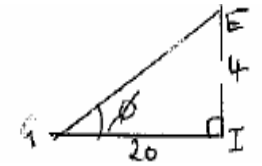
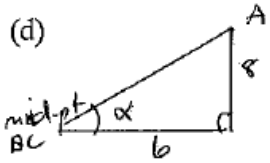
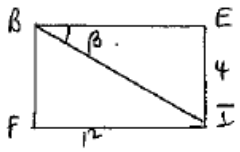
7	(a) mid-point is $\left(1\frac{1}{2}, 4\frac{1}{2}\right)$ grad AB $= \frac{5-4}{5+2} = \frac{1}{7}$, grad perp. $= -7$ eqn. perp bisector: $y - 4\frac{1}{2} = -7\left(x - 1\frac{1}{2}\right)$, $y + 7x = 15$ (b) perp bisector of AC : $x = 2$ (c) centre of circle where perp bisectors cross (i) centre is $(2,1)$ (ii) radius $= \sqrt{\left(4^2 + 3^2\right)} = 5$	B1 M1,A1 M1,A1 B1 M1 A1 M1A1 (10)
8	(a) x: -1, **2.65**; 0, 2; 1, 1.61; 2, **1.37**; 3, 1.22; 4, 1.14; 5, **1.08** (b) Graph (c) $e^{-\frac{1}{2}x} + 1 = 1.8$, $x = 0.45$ (d) $x = -2\ln(2x-7)$ $-\frac{1}{2}x = \ln(2x-7)$ $e^{-\frac{1}{2}x} + 1 = 2x - 7 + 1$ Draw $y = 2x - 6$. $x = 3.6$	B2,1,0 G2 M1A1 M1A1 M1A1 (10)
9	(a) $\alpha\beta = \frac{3}{2}$, $x^2 - \left(\frac{9}{4} + \frac{4}{9}\right)x + 1 = 0$ $36x^2 - 97x + 36 = 0$ (b) $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta = \left(-\frac{p}{2}\right)^2 - 2 \times \frac{3}{2} = \frac{p^2}{4} - 3$ $x^2 - \left(\frac{p^2}{4} - 3\right)x + \frac{9}{4} = 0$ (c) $\alpha^2 = 3$ $\alpha^2\beta^2 = \frac{9}{4}$ $\beta^2 = \frac{3}{4}$ (d) $\frac{p^2}{4} - 3 = 3 + \frac{3}{4}$ $\frac{p^2}{4} = \frac{27}{4}$ $p^2 = 27$ $p = \pm\sqrt{27}$ (± 5.2)	M1M1 A1 M1A1 B1($\underline{AB}$)^2 M1A1 M1A1 M1M1A1 (13)

CSE and GCE Examining Bodies

2mm GRAPH PAPER

Examining body	Jan 2007 Paper 2	Centre number	
Candidate name	No 8.	Candidate number	
Paper reference		Question number	Sheet number



10	(a) $-125+25p+55+q=0$ $25p+q=70$ $27+9p-33=0$ $9p+q=6$ (b) $16p=64 \quad p=4 \quad q=-30$ (c) $x^3+4x^2-11x-30=(x+5)(x-3)(x+2)$ (d)  (e) $y=x^3+4x^2-11x-30 \quad \frac{dy}{dx}=3x^2+8x-11$ At min. $(3x+11)(x-1)=0$ min. at $(1,-36)$ Tgt: $y=-36$ meets curve where $x^3+4x^2-11x-30=-36$ $x^3+4x^2-11x+6=0 \quad (x-1)(x-1)(x+6)=0 \quad x=-6$ ie at (	M1A1 A1 M1A1A1 B1 G1 G1 G1 M1 M1A1 M1 M1A1 (16)
11	(a) (i) $GE^2=12^2+16^2+4^2=416 \quad GE=20.4$ (ii)  $BD=20$ $AB^2=64+100 \quad AB=12.8$ (b) $\tan\phi=\frac{4}{20}$ ϕ=11.3°  (c) $\tan\theta=\frac{8}{20}\times 2=\frac{4}{5} \quad \theta=38.7°$ (d)  $\tan\alpha=\frac{8}{6} \quad (\alpha=53.13°)$ $\tan\beta=\frac{4}{12} \quad (\beta=18.43°)$ reqd. angle $=71.56°=71.6°$  	M1A1A1 B1 M1A1 M1A1 Ö A1 M1A1 Ö A1 M1A1 M1A1 A1 (17)

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