

EDEXCEL

190 High Holborn London WC1V 7BH

January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

Subject: **Pure Mathematics**

Paper: **P3**

Question Number	Scheme	Marks	
1. (a)	$f(-2) = -16a - 4a + 6 + 7$ $f(-2) = -3 \Rightarrow -20a + 13 = -3$ <p style="text-align: center;">i.e. $20a = 16$</p> $a = \frac{4}{5}$	Attempt $f(\pm 2)$ Solve eqn. $f(\pm 2) = -3$ $\rightarrow ka = L$ o.e.	M1 M1 A1 (3)
(b)	$f\left(\frac{1}{2}\right) = \frac{a}{4} - \frac{a}{4} - \frac{3}{2} + 7 = \frac{11}{2}$	(o.e.) Attempt $f\left(\pm \frac{1}{2}\right)$ $\frac{1}{2}$ or exact equiv.	M1 A1 (2) 5
2. (a)	$\sin(3x+x) = \sin 3x \cos x + \cos 3x \sin x$ $\sin(3x-x) = \sin 3x \cos x - \cos 3x \sin x$ <p>(Subtract) $\Rightarrow \sin 4x - \sin 2x = 2 \sin x \cos 3x$</p>	Use of a correct formula $\sin \pm = \dots$ Both correct $p=4, q=2$	M1 A1 A1 c.s.o. (3)
(b)	$\int 2 \sin x \cos 3x \, dx = \int (\sin 4x - \sin 2x) \, dx$ $= -\frac{\cos 4x}{4} + \frac{\cos 2x}{2} + c$	Attempt using a } $\sin px \rightarrow \pm \frac{\cos qx}{p}$ their p, q	M1 A1 (2)
(c)	$\int_{\frac{\pi}{2}}^{\frac{5\pi}{6}} 2 \sin x \cos 3x \, dx = \left(-\frac{1}{4} \cos \frac{10\pi}{3} + \frac{1}{2} \cos \frac{5\pi}{3}\right) - \left(-\frac{1}{4} \cos 2\pi + \frac{1}{2} \cos \pi\right)$ $= \frac{9}{8}$		M1 A1 (2) 7
3. (a)	$x^2 + y^2 - 12x + 4y + 20 = 0$ $(x-6)^2 + (y+2)^2 + k = 0$	Attempt to complete square Centre $(6, -2)$	M1 A1 (2)
(b)	$(x-6)^2 + (y+2)^2 = 20$	$k = -36 - 4 + 20$ o.e. Radius = $\sqrt{20}$	M1 A1 (2)
Use of Formulae (a)	$2g = -12, 2f = 4, c = 20$ Centre $(-g, -f)$	$(\pm 6, \pm 2)$ Centre $(6, -2)$	M1 A1 (2)
(b)	Radius = $\sqrt{36 + 4 - 20}$	$36, 4, 20$ and $\sqrt{\quad}$ Radius $\sqrt{20}$	M1 A1 (2)
(c)		P.T.O.	

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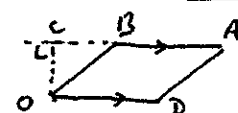
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3. (c)	$x^2 - 12x + 20 = 0$ $\Rightarrow x = 2, 10$ <p>Centre of C_2 is <u>(6, 0)</u></p> <p>Radius of C_2 is $6 - 2$ or $10 - 6 = 4$</p> <p>Equation of C_2 is <u>$(x - 6)^2 + y^2 = 4^2$</u> o.e.</p>	MI A1 B1 B1 MI \downarrow Centre and radius A1 (6) (10)
4. (a)	$(1 - x)^{-\frac{1}{2}} = 1 + \frac{1}{2}x + \frac{(-\frac{1}{2})(-\frac{3}{2})}{2!}(-x)^2 + \frac{(-\frac{1}{2})(-\frac{3}{2})(-\frac{5}{2})}{3!}(-x)^3$ $= 1 + \frac{1}{2}x + \frac{3}{8}x^2 + \frac{5}{16}x^3 \dots$ $(1 + x)^{\frac{1}{2}} = 1 + \frac{1}{2}x + \frac{(\frac{1}{2})(-\frac{1}{2})}{2!}x^2 + \frac{(\frac{1}{2})(-\frac{1}{2})(-\frac{3}{2})}{3!}x^3$ $= 1 + \frac{1}{2}x - \frac{1}{8}x^2 + \frac{1}{16}x^3 \dots$ $\therefore f(x) = \underline{\underline{\frac{1}{2}x^2 + \frac{1}{4}x^3}}$	MI A1 MI A1 MI A1 (6)
(b)	$f'(x) = x + \frac{3}{4}x^2 \dots, f''(x) = 1 + \frac{3}{2}x \dots$ $f(0) = 0 \text{ and } f'(0) = 0$ $f''(0) > 0, \therefore \text{Minimum at origin } \odot$	MI B1 MI, A1 c.o. (4) (10)
5. (a)	$\vec{AB} = \underline{b - a} = \begin{pmatrix} 3 \\ -3 \\ -6 \end{pmatrix}; \therefore \text{Equation of } L \quad \underline{\underline{\vec{r} = \begin{pmatrix} 0 \\ 5 \\ 5 \end{pmatrix} + t \begin{pmatrix} 3 \\ -3 \\ -6 \end{pmatrix}}}$ (o.e.)	MI; A1 (2)
(b)	$\begin{pmatrix} 3t \\ 5 - 3t \\ 5 - 6t \end{pmatrix} \cdot \begin{pmatrix} 3 \\ -3 \\ -6 \end{pmatrix} = 0$ $\Rightarrow 9t - 15 + 9t - 30 + 36t = 0$ $\therefore t = \frac{5}{6}$ $\therefore \underline{\underline{\vec{OC} = \begin{pmatrix} 2.5 \\ 2.5 \\ 0 \end{pmatrix}}}$	MI MI MI A1 A1 (5)
(c)	 $\vec{OB} = \vec{BA} = \underline{a - b} \text{ or } -\vec{AB}, = \underline{\underline{\begin{pmatrix} -3 \\ 3 \\ 6 \end{pmatrix}}}$	MI, A1 (2)
(d)	$ \vec{OC} = 2.5\sqrt{2}; \vec{OB} = 3\sqrt{1^2 + 4^2} = 3\sqrt{5}$ $\text{Area} = \vec{OC} \times \vec{OB} \text{ (o.e.) } = 7.5\sqrt{10} \text{ or } \underline{\underline{15\sqrt{3}}} \text{ or AWR } 26.0$	MI A1 MI, A1 (4) (13)

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6. (a)	$\frac{dy}{dx} = \frac{\dot{y}}{\dot{x}} = \frac{3}{2t}$ <p>Gradient of normal is $-\frac{2t}{3}$</p> <p>At P $t = 2$</p> <p>\therefore Gradient of normal @ P is $-\frac{4}{3}$</p> <p>Equation of normal @ P is $y - 9 = -\frac{4}{3}(x - 5)$</p> <p>Q is where $y = 0$ $\therefore x = \frac{27}{4} + 5 = \frac{47}{4}$ (o.e)</p> <p>(b) Curved Area = $\int y dx = \int y \frac{dx}{dt} dt$</p> $= \int 3(1+t) \cdot 2t dt$ $= [3t^2 + 2t^3]$ <p>Curve cuts x-axis when $t = -1$</p> <p>Curved Area = $[3t^2 + 2t^3]_{-1}^2 = (12 + 16) - (3 - 2) (= 27)$</p> <p>Area of $\triangle P Q$ triangle = $\frac{1}{2}(a - 5) \times 9 (= 30.375)$</p> <p>Total area of R = Curved Area + Δ</p> $= 57.375 \text{ or AWAT } \underline{57.4}$	<p>M1</p> <p>M1</p> <p>B1</p> <p>A1</p> <p>M1</p> <p>A1 (6)</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>A1 (9)</p> <p>(15)</p>

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7. (a)	$I = \int x \operatorname{cosec}^2(x + \frac{\pi}{6}) dx = \int x d(-\cot(x + \frac{\pi}{6}))$ $= -x \cot(x + \frac{\pi}{6}) + \int \cot(x + \frac{\pi}{6}) dx$ $= -x \cot(x + \frac{\pi}{6}) + \ln \sin(x + \frac{\pi}{6}) + c$	M1 A1 A1 c.s.o. (3)
(b)	$\int \frac{1}{y(1+y)} dy = \int 2x \operatorname{cosec}^2(x + \frac{\pi}{6}) dx$ $\text{LHS} = \int (\frac{1}{y} - \frac{1}{1+y}) dy$ $\therefore \ln y - \ln 1+y \text{ or } \ln \frac{y}{1+y} = 2(a)$ $\therefore \frac{1}{2} \ln \frac{y}{1+y} = -x \cot(x + \frac{\pi}{6}) + \ln \sin(x + \frac{\pi}{6}) + c$	M1 M1 A1 M1 M1 A1 c.s.o. (6)
(c)	$y=1, x=0 \Rightarrow \frac{1}{2} \ln \frac{1}{2} = \ln(\sin \frac{\pi}{6}) + c$ $\therefore c = -\frac{1}{2} \ln \frac{1}{2}$ $x = \frac{\pi}{12} \Rightarrow \frac{1}{2} \ln \frac{y}{1+y} = -\frac{\pi}{12} \cdot 1 + \ln \frac{1}{\sqrt{2}} - \frac{1}{2} \ln \frac{1}{2}$ <p>(i.e. $\ln \frac{y}{1+y} = -\frac{\pi}{6}$)</p> $\frac{y+1}{y} = e^{\frac{\pi}{6}} \quad (\text{o.e.})$ $1 = y(e^{\frac{\pi}{6}} - 1)$ $\therefore y = \frac{1}{e^{\frac{\pi}{6}} - 1} \quad (\text{o.e.})$	M1 A1 M1 A1 M1 A1 A1 (6)

(15)

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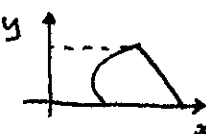
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4 (a)	<p style="text-align: center;"><u>ALTERNATIVE SOLUTIONS</u></p> $f(x) = \frac{1 - \sqrt{1-x^2}}{\sqrt{1-x}}$ $(1-x)^{-\frac{1}{2}} = 1 + \frac{1}{2}x + \dots$ $1 - (1-x^2)^{\frac{1}{2}} = 1 - (1 - \frac{1}{2}x^2 \dots) = \frac{x^2}{2} \dots$ $f(x) = \frac{x^2}{2} \left\{ 1 + \frac{x}{2} + \dots \right\}$ $= \frac{x^2}{2} + \frac{x^3}{4}$ <p style="text-align: right;">Use of binomial to attempt both Multiply</p>	<p>MI</p> <p>AI</p> <p>MI</p> <p>AI</p> <p>MI</p> <p>AI</p> <p>(6)</p>
6. (a)	<p>Cartesian Equation: $(y-3)^2 = 9(x-1)$ or $y = 3 + 3\sqrt{x-1}$</p> $\frac{dy}{dx} = \frac{3}{2\sqrt{x-1}}$ <p>[Rest as in scheme]</p> <p>(b) $x = 2$ ($y = 0$), $x = 1$ ($y = 3$)</p> <p>(Two functions) \pm</p> <p>Curved Area = $\int (3+3\sqrt{x-1}) dx - \int (3-3\sqrt{x-1}) dx$</p> <p>[Rest as in scheme]</p> <p><u>ALT</u></p>  <p>Trapezium - $\int x dy$</p> $\int x dy = \frac{1}{9} \int [(y-3)^2 + 1] dy$ <p>[Rest as in scheme \rightarrow MI for $\int + \Delta$ is for Trap - \int]</p>	<p>BI</p> <p>MI</p> <p>BI</p> <p>MI</p> <p>AI</p> <p>MI</p> <p>BI</p> <p>MI</p> <p>AI</p>