EDEXCEL FOUNDATION

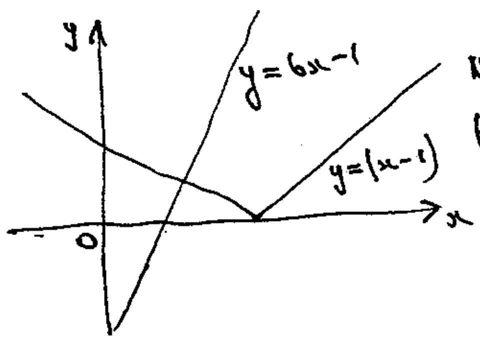
Stewart House 32 Russell Square London WC1B 5DN

January 2002

Advanced Supplementary/Advanced Level

General Certificate of Education

Subject **PURE MATHEMATICS 6674** Paper No. **P4**

Question number	Scheme	Marks
1. (a)	$w = \frac{22+4i}{6-8i} \times \frac{6+8i}{6+8i}$	M1
	$= \frac{100+200i}{100} = 1+2i$	A1 , A1
	A1 for w correct as $\frac{100+200i}{100}$ or for 1 or for $2i$	
	final A1 for $1+2i$ only.	(3)
	OR $22+4i = (a+bi)(6-8i)$ with	
	$6a+8b=22$, $6b-8a=4$	M1
	$\rightarrow a=1$, $b=2$	A1 + A1 (3)
(b)	$\arg z = \arctan \frac{4}{22}$ OR $\tan(\arg z) = \frac{4}{22}$	M1
	$\arg z = 0.18$ only	A1 (2)
2.	$x \geqslant 1$ and $x-1 > 6x-1$	
	$x < 0$ No values	
	OR  No critical value from $y=x-1$, $y=6x-1$	M1 A1
	$\left.\begin{array}{l} y = 1-x \\ y = 6x-1 \end{array}\right\} \rightarrow x = \frac{2}{7}$ as critical value	M1 A1
	Solution set $x < \frac{2}{7}$ [Correct final statement needed for A1 here]	A1 cso (5)

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3. (a)	$\sum r^2 - \sum 1$	M1
	$\frac{1}{6}n(n+1)(2n+1) - n$	A1 B1
	correct completion to $\frac{1}{6}n(n-1)(2n+5)$ ⊛	M1 A1 (5)
(b)	As this answer is a +ve integer, $n(n-1)(2n+5)$ is exactly divisible by 6 (or equivalent argument)	M1 A1 (2)
4. (a)	$f'(x) = 3x^2 + 1, (>0)$ or <u>no solutions of $f'(x) = 0$</u>	M1, <u>A1</u>
	No turning points, so $f(x)$ only crosses x-axis once. Hence α is only root of $f(x) = 0$	A1 csa (3)
(b)	Using $\alpha - \frac{f(\alpha)}{f'(\alpha)}$ with $\alpha = 1.2 \rightarrow$ <u>1.21</u> only	M1 <u>A1</u> (2)
(c)	$f(1.205) = -0.045 < 0$, $f(1.215) = 0.0086 > 0$	M1
	α lies in interval $(1.205, 1.215)$ and is 1.21 to 3 s.f.	A1 (2)
5. (a)(i)	Other root is $2 - i$	B1 (1)
(ii)	$(2+i)^2 + b(2+i) + c = 0$ [or equivalent]	M1
	Imaginary parts $b = -4$	B1
	Real parts $c + 3 + 2b = 0$, <u>$c = 5$</u>	M1 <u>A1</u> (4)
(b)	$(2+i)^3 = 2 + 11i$	B1
	$2 + 11i + m(3+4i) + n(2+i) - 5 = 0$	M1
	Reals $3m + 2n = 3$; I's $8m + 2n = -22$	M1
	$m = -5$, $n = 9$	A1, A1 (5)

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6. (a)	$\frac{dv}{dt} - \frac{1}{t}v = 1 \rightarrow$ I.F. $= e^{-\int \frac{1}{t}dt} = e^{-\ln t} = \frac{1}{t}$	M1 A1 A1
	$\frac{d}{dt}\left(\frac{v}{t}\right) = \frac{1}{t} \rightarrow \frac{v}{t} = \ln t + c$	M1 A1
	$v = t(\ln t + c)$ ⊛	A1 (6)
(b)	$v = 3$ at $t = 2$ so $c = \frac{3}{2} - \ln 2$ or $\cdot 807$	M1 A1
	At $t = 4$, $\frac{v}{4} = \ln 4 + \frac{3}{2} - \ln 2$	M1
	$v = 8.77$	A1 (4)
7. (a)	$y = \frac{1}{2}x^2e^x$, $y' = \frac{1}{2}x^2e^x + xe^x$	B1
	$y'' = \frac{1}{2}x^2e^x + 2xe^x + e^x$	B1
	$y'' - 2y' + y = \frac{1}{2}x^2e^x + 2xe^x + e^x - x^2e^x - 2xe^x + \frac{1}{2}x^2e^x$	M1
	$= e^x$	A1 (4)
	OR $ye^{-x} = \frac{1}{2}x^2$, $y'e^{-x} - ye^{-x} = x$ M1, B1	
	$y''e^{-x} - 2y'e^{-x} + ye^{-x} = 1 \Rightarrow y'' - 2y' + y = e^x$ B1 A1	
(b)	Auxiliary equation $m^2 - 2m + 1 = 0$, $\Rightarrow m = 1$ repeated	M1, A1
	Complementary function $e^x(A + Bx)$	A1
	General solution $y = e^x(A + Bx) + \frac{1}{2}x^2e^x$	A1 f.t.
	$x = 0$, $y = 1 \Rightarrow A = 1$ (cso)	B1
	$y' = e^x(A + Bx) + Be^x + xe^x + \frac{1}{2}x^2e^x$	M1
	$y' = 2$ at $x = 0 \Rightarrow 2 = A + B \Rightarrow B = 1$	M1 A1
	Specific solution $y = e^x\left(1 + x + \frac{1}{2}x^2\right)$	A1 cso (9)

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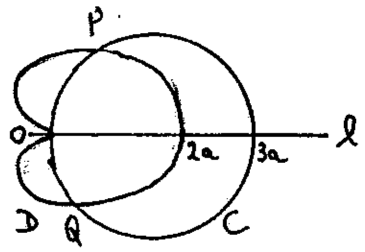
8. (a)	 Circle Diameter O → 3a on initial line Cardioid cusp at O Symmetry on initial line and 2a	B1 B1 B1 B1 (4)
(b)	$3a\cos\theta = a(1+\cos\theta) \rightarrow \cos\theta = \frac{1}{2}$ $\theta = \pm\frac{\pi}{3}$ $r = \frac{3a}{2}$ at P and Q	M1 A1 A1 (3)
(c)	Area $A_1 = \frac{1}{2}\int a^2(1+\cos\theta)^2\,d\theta$ $= \frac{1}{2}a^2\int\left[1 + 2\cos\theta + \frac{1}{2}(1+\cos 2\theta)\right]d\theta$ $= \frac{1}{2}a^2\left[\frac{3\theta}{2} + 2\sin\theta + \frac{1}{4}\sin 2\theta\right]$ Evaluating A1 using limits 0 and $\frac{\pi}{3}$ to get $A_1 = \frac{\pi a^2}{4} + \frac{9\sqrt{3}a^2}{16}$	M1 M1A1 (A1, A1, A0) M1 A1 cao (7)
(d)	Area required $= \frac{9}{4}\pi a^2 - 2A_1 - 2A_2$ $= \frac{9\pi a^2}{4} - \frac{\pi a^2}{2} - \frac{9\sqrt{3}a^2}{8} - \frac{3\pi a^2}{4} + \frac{9a^2\sqrt{3}}{8}$ $= \pi a^2$	M1, B1 M1 A1 (4)

H.M.K.
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