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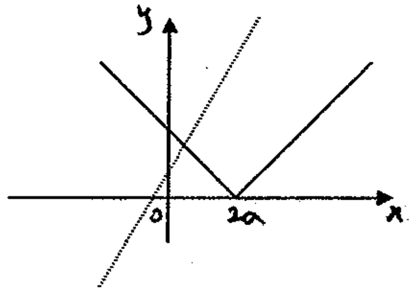
190 High Holborn London WC1V 7BH

January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

Subject: **Further Pure Mathematics** Paper: **P4/FP1**

Question Number	Scheme	Marks
1	(a)  Shape, vertex on x-axis	B1
	At least 2a seen on positive x-axis	B1 (2)
	(b) Attempting to solve $-(x-2a) = 2x + a$ anywhere	M1
	Completely correct method	dep M1
	[e.g. solving $-(x-2a) > 2x + a$; if finding two "solutions" needs to be evidence for giving "correct" result]	
	$x < \frac{1}{3}a$	A1 (3) [5]
2	(a) Second root = 3 – i	B1
	Finding product of two roots (= 10), or quadratic factor $(x^2 - 6x + 10)$	M1
	Complete method for third root or linear factor	M1
	Third root = ½	A1 (4)
	(b) Using candidate's three roots to find cubic with real coefficients $(= 2x^3 - 13x^2 + 26x - 10)$]	M1
	Equating coefficients	M1
	$a = -13, \quad b = 26$	A1 (3) [7]

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3	I.F. = $e^{\int 2\cot 2x dx}$; $= \sin 2x$	M1A1
	Multiplying **throughout** by IF.	M1 *
	y x (IF) = integral of candidate's RHS	M1
	$= \int 2\sin^2 x \cos x \, dx$ or $\int -\left(\frac{\cos 3x - \cos x}{2}\right) dx$	M1
	[This M gained when in position to complete integration, dep on M *]	
	$= \frac{2}{3}\sin^3 x (+C)$ or $-\frac{1}{6}\sin 3x + \frac{1}{2}\sin x + c$	A1
	$y = \frac{2\sin^3 x}{3\sin 2x} + \frac{C}{\sin 2x}$ or $-\frac{\sin 3x}{6\sin 2x} + \frac{\sin x}{2\sin 2x} + \frac{c}{\sin 2x}$ or equiv.	A1√ [7]
4	(a) Correct method for $f'(x)$; $x\cos x + \sin x + 2$	M1A1
	$f(1) = -0.1585$, $f'(1) = 3.382$ or better seen	A1
	Using N-R correctly: $u_1 = 1 - \frac{"-0.1585"}{"3.382"}$; = 1.05 (3 s.f)	M1A1 (5)
	[Notes: Answer 1.047, 1.05 implies second A mark}	
	(b) Two tangents drawn, one at {5, f(5)}, the other at $\{x_2, f(x_2)\}$	M1
	x_2, x_3 marked in appropriate positions	A1 (2) [7]

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Question Number	Scheme	Marks
5	(a) $\frac{1}{r(r+2)} \equiv \frac{A}{r} + \frac{B}{r+2} \equiv \frac{A(r+2)+Br}{r(r+2)}$ and attempt to find A and B	M1
	$\equiv \frac{1}{2r} - \frac{1}{2(r+2)}$	A1 (2)
	(b) $\sum \frac{4}{r(r+2)} \equiv 2\left[\frac{1}{r} - \frac{1}{r+2}\right]$	
	$\sum_1^n \left[\frac{1}{r} - \frac{1}{r+2}\right] = \{1 - \frac{1}{3}\} + \left\{\frac{1}{2} - \frac{1}{4}\right\} + \left\{\frac{1}{3} - \frac{1}{5}\right\} + \ldots\ldots$ $+ \left\{\frac{1}{n-1} - \frac{1}{n+1}\right\} + \left\{\frac{1}{n} - \frac{1}{n+2}\right\}$	M1A1
	[If A and B incorrect, allow A1√ here only, providing still differences]	
	$= \frac{3}{2} - \frac{1}{n+1} - \frac{1}{n+2}$	A1
	Forming single fraction: $\frac{3(n+1)(n+2) - 2(n+2) - 2(n+1)}{2(n+1)(n+2)}$	M1
	Deriving given answer $\frac{n(3n+5)}{(n+1)(n+2)}$, cso	A1 (5)
	(c) Using S(100) − S(49) = $\frac{100 \times 305}{101 \times 102} - \frac{49 \times 152}{50 \times 51}$	M1A1
	[= 2.96059… − 2.92078…]	
	= 0.0398 (4 d.p.)	A1 (3) [10]
	[Allow S(100) − S(50), (⇒ 0.0383) for M1]	

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Question Number	Scheme	Marks
6	(a) $\frac{dy}{dx} = x\frac{dv}{dx} + v, \quad \frac{d^2y}{dx^2} = x\frac{d^2v}{dx^2} + 2\frac{dv}{dx}$	M1A1
	[M1 for diff. product, A1 both correct]	
	$\therefore x^2\left(x\frac{d^2v}{dx^2} + 2\frac{dv}{dx}\right) - 2x\left(x\frac{dv}{dx} + v\right) + (2 + 9x^2)vx = x^5$	M1
	$x^3\frac{d^2v}{dx^2} + 2x^2\frac{dv}{dx} - 2x^2\frac{dv}{dx} - 2vx + 2vx + 9vx^3 = x^5$	A1
	$[x^3\frac{d^2v}{dx^2} + \ + 9vx^3 = x^5]$	
	Given result: $\frac{d^2v}{dx^2} + 9v = x^2$ cso	A1 (5)
	(b) CF: $v = A\sin 3x + B\cos 3x$ (may just write it down)	M1A1
	Appropriate form for P1: $v = \lambda x^2 + \mu$ (or $ax^2 + bx + c$)	M1
	Complete method to find λ and μ	M1
	$v = A\sin 3x + B\cos 3x + \frac{1}{9}x^2 - \frac{2}{81}$	M1A1√ (6)
	[f.t. only on wrong CF]	
	(c) $\therefore y = Ax\sin 3x + Bx\cos 3x + \frac{1}{9}x^3 - \frac{2}{81}x$	B1√ (1) [12]
	[f.t. for $y = x$ (candidate's CF + PI), providing two arbitary constants]	

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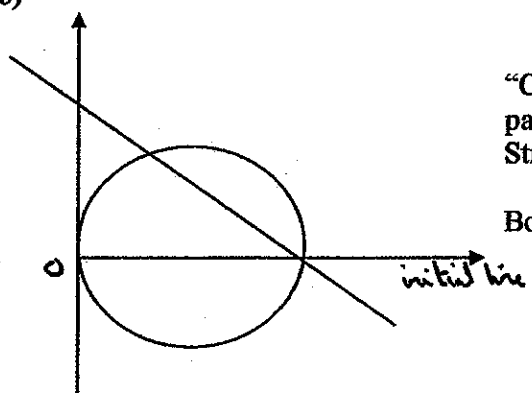
7	(a) For C: Using polar/ cartesian relationships to form Cartesian equation	M1
	so $x^2 + y^2 = 6x$	A1
	[Equation in any form: e.g. $(x-3)^2 + y^2 = 9$ from sketch.	
	or $\sqrt{x^2+y^2} = \frac{6x}{\sqrt{x^2+y^2}}$]	
	For D: $r\cos\left(\frac{\pi}{3} - \theta\right) = 3$ and attempt to expand	M1
	$\frac{x}{2} + \frac{\sqrt{3}y}{2} = 3$ (any form)	M1A1 (5)
	(b) 	
	"Circle", symmetric in initial line passing through pole	B1
	Straight line	B1
	Both passing through (6, 0)	B1 (3)
	(c) Polars: Meet where $6\cos\theta\cos(\frac{\pi}{3} - \theta) = 3$	M1
	$\sqrt{3}\sin\theta\cos\theta = \sin^2\theta$	M1
	$\sin\theta = 0$ or $\tan\theta = \sqrt{3}$ [$\theta = 0$ or $\frac{\pi}{3}$]	M1
	Points are (6, 0) and $(3, \frac{\pi}{3})$	B1,A1 (5) [13]

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Question Number	Scheme	Marks
7	Alternatives (only more common):	
	(a) Equation of D:	
	Finding two points on line	M1
	Using correctly in Cartesian equation for straight line	M1
	Correct Cartesian equation	A1
	(c)	
	Cartesian: Eliminate x or y to form quadratic in one variable	M1
	$\left[2x^2 - 15x + 18 = 0, \quad 4y^2 - 6\sqrt{3}\,y = 0\right]$	
	Solve to find values of x or y	M1
	Substitute to find values of other variable	M1
	$\left[x = \frac{3}{2} \text{ or } 6; \quad y = 0 \text{ or } \frac{3\sqrt{3}}{2}\right]$	
	Points must be (6, 0) and $(3, \frac{\pi}{3})$	B1A1

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8	(a) $\left\lvert\frac{z}{w}\right\rvert = \frac{\lvert z\rvert}{\lvert w\rvert}; = \frac{4}{2} = 2$	M1M1A1 (3)
	[M1 for correct modulus, M1 division of moduli]	
	(b) $\arg\left(\frac{z}{w}\right) = \arg z - \arg w$	M1
	$= \frac{3\pi}{4} - \left(-\frac{\pi}{3}\right) = \left(\frac{13\pi}{12}\right);\quad -\frac{11\pi}{12}$	M1A1 (3)
	[Second M1 for one correct arg]	
	Working with $\left(\frac{z}{w}\right)$:	
	(a) $\left(\frac{z}{w}\right) = \frac{2\sqrt{2}\,(-1+\mathrm{i})}{1-\mathrm{i}\sqrt{3}} = \frac{2\sqrt{2}(-1+\mathrm{i})(1+\mathrm{i}\sqrt{3})}{4}$	M1
	$\left[= \frac{\sqrt{2}\{-(1+\sqrt{3}) - \mathrm{i}(\sqrt{3}-1)\}}{2}\right]$	
	Correct method for finding modulus, $= 2$	M1A1 (3)
	(b) Finding $\tan^{-1}\frac{"(\sqrt{3}-1)"}{"(\sqrt{3}+1)"}$	M1
	Complete method for $\arg\left(\frac{z}{w}\right)$	M1
	$= -\frac{11\pi}{12}$	A1 (3)

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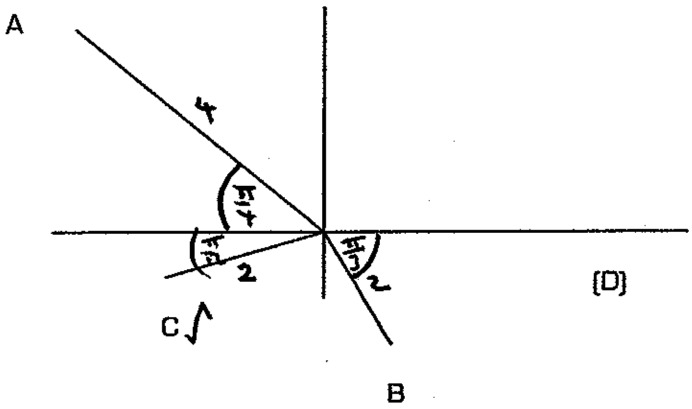
8	(c)			
				(3)
		For A	B1	
		For B	B1	
		For C	B1√	
	(d) $\angle DOB = \frac{\pi}{3}$ or 60°		B1	
	Correct method for $\angle AOC$		M1	
	$\angle AOC = \frac{\pi}{4} + \frac{\pi}{12} = \frac{\pi}{3}$ (cso)		A1	(3)
	(e) Area Δ AOC $= \frac{1}{2}$ x"4"x"2"x sin"$\frac{\pi}{3}$" $= 2\sqrt{3}$ (3.46 or better)		M1A1	(2)
				[14]