

Mark Scheme (Results) Summer 2010

GCE

Further Pure Mathematics FP2 (6668)



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Question Number	Scheme	Marks
1(a)	$\frac{1}{3r-1} - \frac{1}{3r+2}$	M1 A1 (2)
(b)	$\sum_{r=1}^{n} \frac{3}{(3r-1)(3r+2)} = \frac{1}{2} - \frac{1}{5} + \frac{1}{5} - \frac{1}{8} + \frac{1}{8} - \frac{1}{11} + \dots + \frac{1}{3n-1} - \frac{1}{3n+2}$	M1 A1ft
	$=\frac{1}{2} - \frac{1}{3n+2} = \frac{3n}{2(3n+2)} *$	A1 (3)
(c)	Sum = f(1000) – f(99) $\frac{3000}{6004} - \frac{297}{598} = 0.00301$ or 3.01×10^{-3}	M1 A1 (2)
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Question Number	Scheme	Marks
2	$f''(t) = -x - \cos x, \qquad f''(0) = -1$	B1
	$f'''(t) = (-1 + \sin x) \frac{dx}{dt}, \qquad f''(0) = -0.5$	M1A1
	$f(t) = f(0) + tf'(0) + \frac{t^2}{2}f''(0) + \frac{t^3}{3!}f'''(0) + \dots$	
	$= 0.5t - 0.5t^2 - \frac{1}{12}t^3 + \dots$	M1 A1 5

Question Number	Scheme	Mark	S
3(a)	$(x+4)(x+3)^2 - 2(x+3) = 0$, $(x+3)(x^2 + 7x + 10) = 0$ so $(x+2)(x+3)(x+5) = 0$ or alternative method including calculator	M1	
	Finds critical values –2 and -5	A1 A1	
	Establishes $x > -2$	A1ft	
	Finds and uses critical value -3 to give $-5 < x < -3$	M1A1	(6)
(b)	x > -2	B1ft	(1)
			7

Question Number	Scheme	Marks
4(a)	Modulus = 16	B1
	Argument = $\arctan(-\sqrt{3}) = \frac{2\pi}{3}$	M1A1 (3)
(b)	$z^{3} = 16^{3} (\cos(\frac{2\pi}{3}) + i\sin(\frac{2\pi}{3}))^{3} = 16^{3} (\cos 2\pi + i\sin 2\pi) = 4096 \text{ or } 16^{3}$	M1 A1 (2)
(c)	$w = 16^{\frac{1}{4}} (\cos(\frac{2\pi}{3}) + i\sin(\frac{2\pi}{3}))^{\frac{1}{4}} = 2(\cos\left(\frac{\pi}{6}\right) + i\sin\left(\frac{\pi}{6}\right)) \ \left(=\sqrt{3} + i\right)$	M1 A1ft
	OR $-1+\sqrt{3}i$ OR $-\sqrt{3}-i$ OR $1-\sqrt{3}i$	- M1A2(1,0) (5)
		10

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Question Number	Scheme	Marks
5(a)	$1.5 + \sin 3\theta = 2 \rightarrow \sin 3\theta = 0.5 \therefore 3\theta = \frac{\pi}{6} \left(\text{or } \frac{5\pi}{6} \right),$	M1 A1,
	and $\therefore \theta = \frac{\pi}{18}$ or $\frac{5\pi}{18}$	A1 (3)
(b)	Area = $\frac{1}{2} \left[\int_{\frac{\pi}{18}}^{\frac{5\pi}{18}} (1.5 + \sin 3\theta)^2 d\theta \right], -\frac{1}{9}\pi \times 2^2$	- M1, M1
	$= \frac{1}{2} \left[\int_{\frac{\pi}{18}}^{\frac{5\pi}{18}} (2.25 + 3\sin 3\theta + \frac{1}{2}(1 - \cos 6\theta)) d\theta \right] - \frac{1}{9}\pi \times 2^{2}$	- M1
	$= \frac{1}{2} \left[(2.25\theta - \cos 3\theta + \frac{1}{2}(\theta - \frac{1}{6}\sin 6\theta)) \right]_{\frac{\pi}{18}}^{\frac{5\pi}{18}} - \frac{1}{9}\pi \times 2^{2}$	- M1 A1
	$=\frac{13\sqrt{3}}{24} - \frac{5\pi}{36}$	- M1 A1 (7)
		10

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Past Paper (Mark Scheme)	

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Question Scheme Marks Number 6(a) **Imaginary Axis** $\operatorname{Re}(z) = 3$ Real axis 0 6 Vertical Straight line **B**1 Through 3 on real axis **B**1 (2)(b) These are points where line x = 3 meets the circle centre (3, 4) with radius 5. M1 The complex numbers are 3 + 9i and 3 - i. A1 A1 (3) $\left|z-6\right| = \left|z\right| \Longrightarrow \left|\frac{30}{w}-6\right| = \left|\frac{30}{w}\right|$ (c) M1 $\therefore |30-6w| = |30| \implies \therefore |5-w| = |5|$ M1 A1 This is a circle with Cartesian equation $(u-5)^2 + v^2 = 25$ M1 A1 (5) 10



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Question Number	Scheme	Marks	
7(a)	$\frac{dy}{dx} = \frac{dy}{dz} \cdot \frac{dz}{dx}$ and $\frac{dy}{dz} = 2z$ so $\frac{dy}{dx} = 2z \cdot \frac{dz}{dx}$	M1 M1 A	A 1
	Substituting to get $2z \cdot \frac{dz}{dx} - 4z^2 \tan x = 2z$ and thus $\frac{dz}{dx} - 2z \tan x = 1$ *	M1 A1	(5)
(b)	I.F. = $e^{\int -2\tan x dx} = e^{2\ln \cos x} = \cos^2 x$	M1 A1	
	$\therefore \frac{\mathrm{d}}{\mathrm{d}x} (z \cos^2 x) = \cos^2 x \therefore \ z \cos^2 x = \int \cos^2 x \mathrm{d}x$	M1	
	$\therefore z \cos^2 x = \int \frac{1}{2} (\cos 2x + 1) dx = \frac{1}{4} \sin 2x + \frac{1}{2} x + c$	M1 A1	
	$\therefore z = \frac{1}{2} \tan x + \frac{1}{2} x \sec^2 x + c \sec^2 x$	A1	(6)
(c)	: $y = (\frac{1}{2} \tan x + \frac{1}{2} x \sec^2 x + c \sec^2 x)^2$	B1ft	(1)
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Mathematics FP2

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Question Number	Scheme	Mark	S
8(a)	Differentiate twice and obtaining $\frac{dy}{dx} = \lambda \sin 5x + 5\lambda x \cos 5x \text{ and } \frac{d^2 y}{dx^2} = 10\lambda \cos 5x - 25\lambda x \sin 5x$	M1 A1	
	Substitute to give $\lambda = \frac{3}{10}$	M1 A1	(4)
(b)	Complementary function is $y = A\cos 5x + B\sin 5x$ or $Pe^{5ix} + Qe^{-5ix}$	M1 A1	
	So general solution is $y = A\cos 5x + B\sin 5x + \frac{3}{10}x\sin 5x$ or in exponential form	A1ft	(3)
(c)	y=0 when $x=0$ means $A=0$	B1	
	$\frac{dy}{dx} = 5B\cos 5x + \frac{3}{10}\sin 5x + \frac{3}{2}x\cos 5x \text{ and at } x = 0 \frac{dy}{dx} = 5 \text{ and so } 5 = 5A$	M1 M1	
	So $B = 1$	A1	
	So $y = \sin 5x + \frac{3}{10}x\sin 5x$	A1	(5)
(d)	"Sinusoidal" through O amplitude becoming larger	B1	
	Crosses x axis at $\frac{\pi}{5}, \frac{2\pi}{5}, \frac{3\pi}{5}, \frac{4\pi}{5}$	B1	(2)
	hd		(2)
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