

Mark Scheme (Results)

Summer 2010

GCE

Further Pure Mathematics FP2 (6668)

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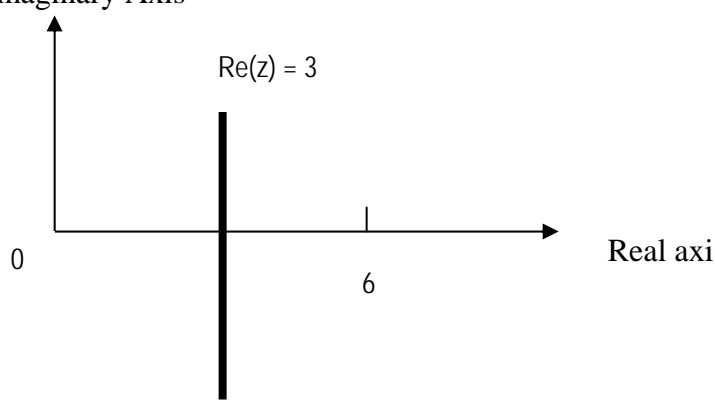
Question Number	Scheme	Marks
1(a)	$\frac{1}{3r-1} - \frac{1}{3r+2}$	M1 A1 (2)
(b)	$\sum_{r=1}^n \frac{3}{(3r-1)(3r+2)} = \frac{1}{2} - \frac{1}{5} + \frac{1}{5} - \frac{1}{8} + \frac{1}{8} - \frac{1}{11} + \dots - \frac{1}{3n-1} + \frac{1}{3n+2}$ $= \frac{1}{2} - \frac{1}{3n+2} = \frac{3n}{2(3n+2)} \quad *$	M1 A1ft A1 (3)
(c)	$\text{Sum} = f(1000) - f(99)$ $\frac{3000}{6004} - \frac{297}{598} = 0.00301 \quad \text{or } 3.01 \times 10^{-3}$	M1 A1 (2) 7

Question Number	Scheme	Marks
2	$f''(t) = -x - \cos x, \quad f''(0) = -1$ $f'''(t) = (-1 + \sin x) \frac{dx}{dt}, \quad f'''(0) = -0.5$ $f(t) = f(0) + tf'(0) + \frac{t^2}{2} f''(0) + \frac{t^3}{3!} f'''(0) + \dots$ $= 0.5t - 0.5t^2 - \frac{1}{12}t^3 + \dots$	B1 M1A1 M1 A1 5

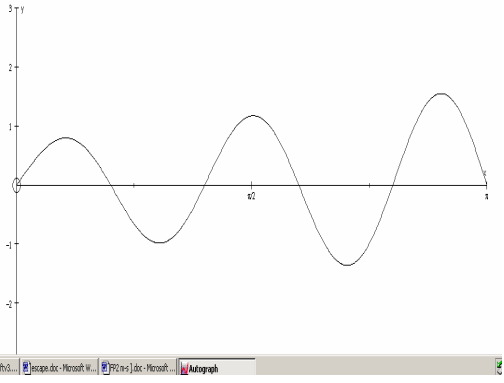
Question Number	Scheme	Marks
3(a)	<p>$(x+4)(x+3)^2 - 2(x+3) = 0$, $(x+3)(x^2 + 7x + 10) = 0$ so $(x+2)(x+3)(x+5) = 0$ or alternative method including calculator</p> <p>Finds critical values -2 and -5</p> <p>Establishes $x > -2$</p> <p>Finds and uses critical value -3 to give $-5 < x < -3$</p>	<p>M1</p>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

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

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

Question Number	Scheme	Marks
6(a)	<p>Imaginary Axis</p>  <p>Real axis</p> <p>Vertical Straight line Through 3 on real axis</p>	<p>B1 B1</p> <p>(2)</p>
(b)	<p>These are points where line $x = 3$ meets the circle centre $(3, 4)$ with radius 5.</p> <p>The complex numbers are $3 + 9i$ and $3 - i$.</p>	<p>M1 A1 A1</p> <p>(3)</p>
(c)	<p>$z - 6 = z \Rightarrow \left \frac{30}{w} - 6 \right = \left \frac{30}{w} \right$</p> <p>$\therefore 30 - 6w = 30 \Rightarrow \therefore 5 - w = 5$</p> <p>This is a circle with Cartesian equation $(u - 5)^2 + v^2 = 25$</p>	<p>M1 M1 A1 M1 A1</p> <p>(5)</p> <p>10</p>

Question Number	Scheme	Marks
7(a)	$\frac{dy}{dx} = \frac{dy}{dz} \cdot \frac{dz}{dx} \text{ and } \frac{dy}{dz} = 2z \text{ so } \frac{dy}{dx} = 2z \cdot \frac{dz}{dx}$ <p>Substituting to get $2z \cdot \frac{dz}{dx} - 4z^2 \tan x = 2z$ and thus $\frac{dz}{dx} - 2z \tan x = 1$ *</p>	<p>M1 M1 A1</p> <p>M1 A1 (5)</p>
(b)	$\text{I.F.} = e^{\int -2 \tan x dx} = e^{2 \ln \cos x} = \cos^2 x$ $\therefore \frac{d}{dx} (z \cos^2 x) = \cos^2 x \therefore z \cos^2 x = \int \cos^2 x dx$ $\therefore z \cos^2 x = \int \frac{1}{2} (\cos 2x + 1) dx = \frac{1}{4} \sin 2x + \frac{1}{2} x + c$ $\therefore z = \frac{1}{2} \tan x + \frac{1}{2} x \sec^2 x + c \sec^2 x$	<p>M1 A1</p> <p>M1</p> <p>M1 A1</p> <p>A1 (6)</p>
(c)	$\therefore y = \left(\frac{1}{2} \tan x + \frac{1}{2} x \sec^2 x + c \sec^2 x \right)^2$	<p>B1ft (1)</p> <p>12</p>

Question Number	Scheme	Marks
8(a)	Differentiate twice and obtaining $\frac{dy}{dx} = \lambda \sin 5x + 5\lambda x \cos 5x$ and $\frac{d^2y}{dx^2} = 10\lambda \cos 5x - 25\lambda x \sin 5x$	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
	$\frac{dy}{dx} = 5B \cos 5x + \frac{3}{10} \sin 5x + \frac{3}{2} x \cos 5x$ and at $x = 0$ $\frac{dy}{dx} = 5$ and so $5 = 5A$	M1 M1
	So $B = 1$	A1
	So $y = \sin 5x + \frac{3}{10} x \sin 5x$	A1 (5)
(d)	 <p data-bbox="938 1332 1257 1400">"Sinusoidal" through O amplitude becoming larger</p> <p data-bbox="938 1433 1141 1545">Crosses x axis at $\frac{\pi}{5}, \frac{2\pi}{5}, \frac{3\pi}{5}, \frac{4\pi}{5}$</p>	B1 B1 (2) 14

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