

# Mark Scheme (Results) Summer 2010

GCE

## Further Pure Mathematics FP2 (6668)

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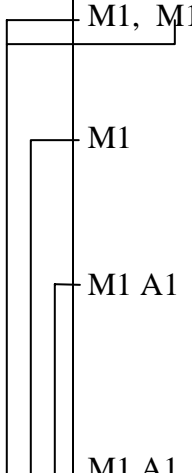
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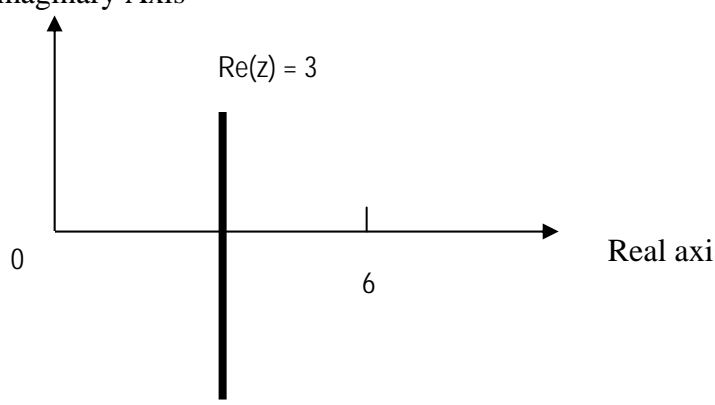
Question Number	Scheme	Marks
1(a)	$\frac{1}{3r-1} - \frac{1}{3r+2}$	M1 A1 (2)
(b)	$\sum_{r=1}^n \frac{3}{(3r-1)(3r+2)} = \frac{1}{2} - \frac{1}{5} + \frac{1}{5} - \frac{1}{8} + \frac{1}{8} - \frac{1}{11} + \dots - \frac{1}{3n-1} + \frac{1}{3n+2}$ $= \frac{1}{2} - \frac{1}{3n+2} = \frac{3n}{2(3n+2)} \quad *$	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)  <b>7</b>

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 <b>5</b>

Question Number	Scheme	Marks
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  Finds critical values $-2$ and $-5$  Establishes $x > -2$  Finds and uses critical value $-3$ to give $-5 < x < -3$	M1  A1 A1  A1ft  M1A1 (6)
(b)	$x > -2$	B1ft (1) <b>7</b>

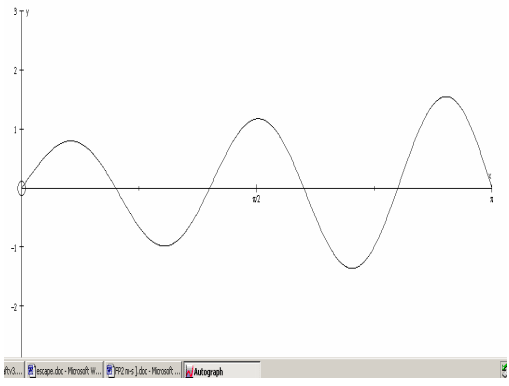
Question Number	Scheme	Marks
4(a)	Modulus = 16 $\text{Argument} = \arctan(-\sqrt{3}) = \frac{2\pi}{3}$	B1 M1A1 (3)
(b)	$z^3 = 16^3 \left( \cos\left(\frac{2\pi}{3}\right) + i \sin\left(\frac{2\pi}{3}\right) \right)^3 = 16^3 (\cos 2\pi + i \sin 2\pi) = 4096 \text{ or } 16^3$	M1 A1 (2)
(c)	$w = 16^{\frac{1}{4}} \left( \cos\left(\frac{2\pi}{3}\right) + i \sin\left(\frac{2\pi}{3}\right) \right)^{\frac{1}{4}} = 2 \left( \cos\left(\frac{\pi}{6}\right) + i \sin\left(\frac{\pi}{6}\right) \right) (= \sqrt{3} + i)$ <p>OR <math>-1 + \sqrt{3}i</math> OR <math>-\sqrt{3} - i</math> OR <math>1 - \sqrt{3}i</math></p>	<div style="display: flex; align-items: center;"> <div style="border-left: 1px solid black; border-right: 1px solid black; border-bottom: 1px solid black; width: 10px; height: 10px; margin-right: 5px;"></div> <div style="margin-right: 10px;">M1 A1ft</div> </div> <div style="display: flex; align-items: center;"> <div style="border-left: 1px solid black; border-right: 1px solid black; border-top: 1px solid black; width: 10px; height: 10px; margin-right: 5px;"></div> <div style="margin-right: 10px;">M1A2(1,0)</div> </div> <p>(5)</p> <p style="text-align: right;"><b>10</b></p>

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) <b>10</b>

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 <math>x = 3</math> meets the circle centre <math>(3, 4)</math> with radius 5.</p> <p>The complex numbers are <math>3 + 9i</math> and <math>3 - i</math>.</p>	<p>M1</p> <p>A1 A1</p> <p>(3)</p>
(c)	$ z - 6  =  z  \Rightarrow \left  \frac{30}{w} - 6 \right  = \left  \frac{30}{w} \right $ $\therefore  30 - 6w  =  30  \Rightarrow \therefore  5 - w  =  5 $ <p>This is a circle with Cartesian equation <math>(u - 5)^2 + v^2 = 25</math></p>	<p>M1</p> <p>M1 A1</p> <p>M1 A1</p> <p>(5)</p> <p><b>10</b></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 <math>2z \cdot \frac{dz}{dx} - 4z^2 \tan x = 2z</math> and thus <math>\frac{dz}{dx} - 2z \tan x = 1</math> *</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><b>12</b></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>"Sinusoidal" through O amplitude becoming larger</p> <p>Crosses x axis at  <math>\frac{\pi}{5}, \frac{2\pi}{5}, \frac{3\pi}{5}, \frac{4\pi}{5}</math></p>	B1  B1 (2)
		<b>14</b>



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