

Mark Scheme (Results) Summer 2010

GCE

Further Pure Mathematics FP2 (6668)

Edexcel is one of the leading examining and awarding bodies in the UK and throughout the world. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers.

Through a network of UK and overseas offices, Edexcel's centres receive the support they need to help them deliver their education and training programmes to learners.

For further information, please call our GCE line on 0844 576 0025, our GCSE team on 0844 576 0027, or visit our website at www.edexcel.com.

If you have any subject specific questions about the content of this Mark Scheme that require the help of a subject specialist, you may find our **Ask The Expert** email service helpful.

Ask The Expert can be accessed online at the following link:

<http://www.edexcel.com/Aboutus/contact-us/>

Summer 2010

Publications Code UA023928

All the material in this publication is copyright

© Edexcel Ltd 2010

June 2010
Further Pure Mathematics FP2 6668
Mark Scheme

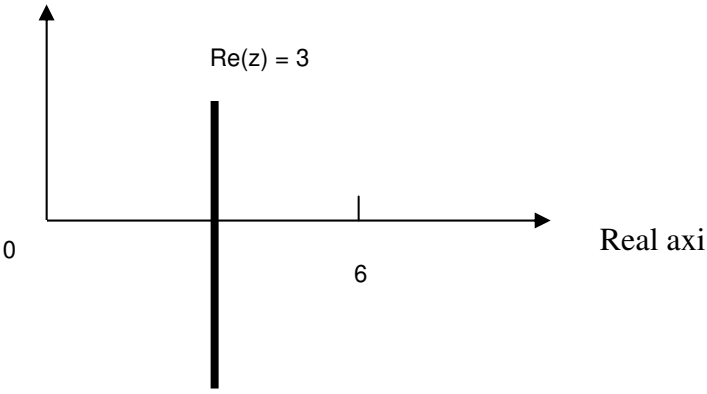
Question Number	Scheme	Marks
1(a)	$\frac{1}{3r-1} - \frac{1}{3r+2}$	M1 A1 (2)
(b)	$\sum_{r=1}^n \frac{3}{(3r-1)(3r+2)} = \frac{1}{2} - \frac{1}{5} + \frac{1}{5} - \frac{1}{8} + \frac{1}{8} - \frac{1}{11} + \dots - \frac{1}{3n-1} + \frac{1}{3n+2}$ $= \frac{1}{2} - \frac{1}{3n+2} = \frac{3n}{2(3n+2)} \quad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

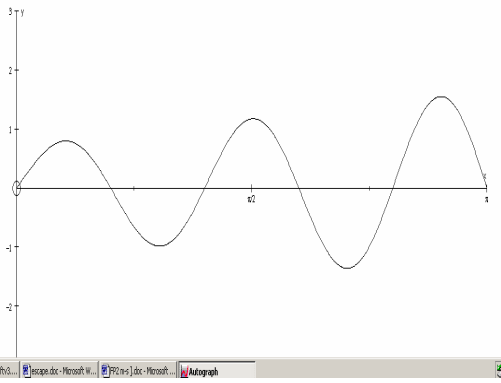
Question Number	Scheme	Marks
3(a)	$(x+4)(x+3)^2 - 2(x+3) = 0$, $(x+3)(x^2 + 7x + 10) = 0$ so $(x+2)(x+3)(x+5) = 0$ or alternative method including calculator Finds critical values -2 and -5 Establishes $x > -2$ Finds and uses critical value -3 to give $-5 < x < -3$	M1 A1 A1 A1ft M1A1 (6)
(b)	$x > -2$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

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 $-1 + \sqrt{3}i$ 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</p> <p>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</p> <p>M1 A1</p> <p>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 1330 1257 1397">"Sinusoidal" through O amplitude becoming larger</p> <p data-bbox="938 1435 1139 1541">Crosses x axis at $\frac{\pi}{5}, \frac{2\pi}{5}, \frac{3\pi}{5}, \frac{4\pi}{5}$</p>	B1 B1 (2) 14

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts, NG18 4FN

Telephone 01623 467467
Fax 01623 450481

Email publications@inneydirect.com

Order Code UA023928 Summer 2010

For more information on Edexcel qualifications, please visit www.edexcel.com/quals

Edexcel Limited. Registered in England and Wales no.4496750
Registered Office: One90 High Holborn, London, WC1V 7BH