Mark Scheme (Results)
January 2008

GCE

GCE Mathematics (6674/01)

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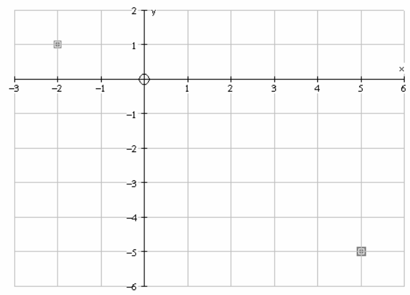
6674 Further Pure Mathematics FP1
Mark Scheme

Question Number	Scheme	Marks
1	Integrating factor = e^{-3x}	B1
	$\therefore \frac{d}{dx}(ye^{-3x}) = xe^{-3x}$	M1
	$\therefore (ye^{-3x}) = \int xe^{-3x}dx = -\frac{x}{3}e^{-3x} + \int \frac{1}{3}e^{-3x}dx$	M1
	$= -\frac{x}{3}e^{-3x} - \frac{1}{9}e^{-3x}(+c)$	A1
	$\therefore y = -\frac{x}{3} - \frac{1}{9} + ce^{3x}$	A1ft
		[5]
	Notes: First M for multiplying through by Integrating Factor and evidence of calculus Second M for integrating by parts 'the right way around'. Be generous – ignore wrong signs and wrong constants. Second M dependent on first. Both As dependent on this M. First A1 for correct expression – constant not required Second A requires constant for follow through. If treated as a second order de with errors then send to review.	

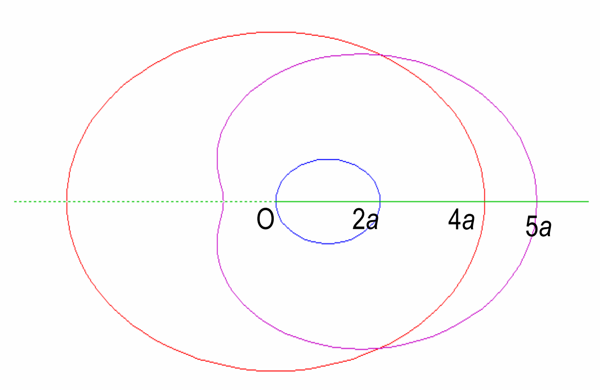
2.	Use (2x+1) as factor to give $f(x)=(2x+1)(x^2-6x+10)$ Attempt to solve quadratic to give $x=\dfrac{6\pm\sqrt{(36-40)}}{2}$ Two complex roots are $=3\pm\text{i}$	M1 A1 M1 A1 M1 A1 (6) **[6]**
	Notes: First M if method results in quadratic expression with 3 terms (even with remainder). Second M for use of correct formula on their quadratic. Third M for using i from negative discriminant.	
3. **(a)**	Consider $\dfrac{(x+3)(x+9)-(3x-5)(x-1)}{(x-1)}$, obtaining $\dfrac{-2x^2+20x+22}{(x-1)}$ Factorise to obtain $\dfrac{-2(x-11)(x+1)}{(x-1)}$.	M1 A1 M1 A1 (4)
(b)	Identify x = 1 and their two other critical values Obtain one inequality *as an answer* involving at least one of their critical values To obtain x < -1, 1 < x < 11	B1ft M1 A1, A1 (4) **[8]**
	Notes: Second M attempt to factorise quadratic expression with 3 terms (usual rules). Second A don't require -2 outside but can be part of factors.	

4. (a)	$f(0.7) = -0.195028497$ and $f(0.8) = 0.297206781$	B1, B1
	Use $\dfrac{0.8-\alpha}{\alpha-0.7} = \dfrac{f(0.8)}{-f(0.7)}$ to obtain $\alpha = \dfrac{-0.8f(0.7)+0.7f(0.8)}{f(0.8)-f(0.7)}$	M1
	(=0.739620991) =0.740 Answer required to 3 dp or better	A1 (4)
(b)	$f'(x) = 6x + 1 - \frac{1}{2}\sec^2(\frac{x}{2})$	M1 A1
	Use $x_2 = 0.75 - \dfrac{f(0.75)}{f'(0.75)}$ (= 0.741087218)=0.741 Answer required to 3 dp or better	M1 A1 (4)
		[8]
	Notes: (a) Bs for 3dp or better First M for reasonable attempt using fractions and differences. (b) First M attempt to differentiate f(*x)*, term in *x* is enough. Lose last A if either or both not to 3 dp	

Question Number	Scheme	Marks
5. (a)	Method to obtain partial fractions e.g. $5r+4 = A(r+1)(r+2)+Br(r+2)+Cr(r+1)$ And equating coefficients, or substituting values for x.	M1
	$A=2,\ B=1,\ C=$-3 or $\frac{2}{r}+\frac{1}{r+1}-\frac{3}{r+2}$	A1 A1 A1 (4)
(b)	$\sum_{r=1}^{n}\ldots=\frac{2}{1}+\frac{1}{2}-\frac{3}{3}$ $+\frac{2}{2}+\frac{1}{3}-\frac{3}{4}$ $+\frac{2}{3}+\frac{1}{4}-\frac{3}{5}$ $\quad = \quad 2+\frac{3}{2},\ -\frac{2}{n+1}-\frac{3}{n+2}$ or equivalent $+\ldots.$ $+\frac{2}{n-1}+\frac{1}{n}-\frac{3}{n+1}$ $+\frac{2}{n}+\frac{1}{n+1}-\frac{3}{n+2}$	M1 A1, A1
	$=\dfrac{7(n+1)(n+2)-4(n+2)-6(n+1)}{2(n+1)(n+2)}=\dfrac{7n^2+11n}{2(n+1)(n+2)}$ *	M1 A1 (5)
	Notes: (a) Require three constants for method. (b) Require first 3 and last 2 of their terms for first method Second method - dependent on first - for attempt to combine to single fraction. Expansion of $(n+1)(n+2)$ in numerator and correct solution required for final A1	

Question Number	Scheme	Marks
6(a)	(i) Multiply top and bottom by conjugate to give $\frac{-2-i}{5}$ (ii) Expand and simplify using $i^2 = -1$ to give $3-4\text{i}$	M1 A1 M1 A1 (4)
(b)	$z^2 - z = 5-5i, \quad \lvert z^2 - z\rvert = 5\sqrt{2}$ *	M1A1 (2)
(c)	$\arg(z^2 - z) = -\frac{\pi}{4}$ or -45^0 or $7\pi/4$ or 315^0 or -0.7853…or 5.497…	M1 A1 (2)
(d)	 one mark for each point	B1, B1 ft (2) **[10]**
	Notes: (a) -2-*i* or 2+*i* OK for method. Attempt to expand required. (b) square root required for method (c) 2 for correct answer only, tan required for method. 2dp or better. (d) Position of points not clear but both quadrants correct first B1 only.	

Question Number	Scheme	Marks
7 (a)	Solve auxiliary equation $3m^2 - m - 2 = 0$ to obtain $m = -\frac{2}{3}$ *or* 1	M1 A1
	C.F is $Ae^{-\frac{2}{3}x} + Be^x$	A1ft
	Let PI $= \lambda x^2 + \mu x + \nu$. Find $y' = 2\lambda x + \mu$, and $y'' = 2\lambda$ and substitute into d.e.	M1
	Giving $\lambda = -\frac{1}{2},\ \mu = \frac{1}{2}$ *and* $\nu = -\frac{7}{4}$	A1 A1A1
	$\therefore y = -\frac{1}{2}x^2 + \frac{1}{2}x - \frac{7}{4} + Ae^{-\frac{2}{3}x} + Be^x$	A1ft **(8)**
(b)	Use boundary conditions:	
	2= $-\frac{7}{4} + A + B$	M1A1ft
	$y' = -x + \frac{1}{2} - \frac{2}{3}Ae^{-\frac{2}{3}x} + Be^x$ and 3 = $\frac{1}{2} - \frac{2}{3}A + B$	M1 M1
	Solve to give *A*=3/4 , $B = 3$ ($\therefore y = -\frac{1}{2}x^2 + \frac{1}{2}x - \frac{7}{4} + \frac{3}{4}e^{-\frac{2}{3}x} + 3e^x$)	M1 A1 **(6)** **[14]**
	Notes: (a) Attempt to solve quadratic expression with 3 terms (usual rules) Both values required for first accuracy. Real values only for follow through Second M 3 term quadratic for PI required Final A1ft for their CF+ their PI dependent upon at least one M (b) Second M for attempt to differentiate their *y* and third M for substitution	

Question Number	Scheme	Marks
8 (a)	$a(3+2\cos\theta)=4a$	M1
	Solve to obtain $\cos\theta=\frac{1}{2}$	M1
	$\theta=\pm\frac{\pi}{3}$ and points are $(4a,\frac{\pi}{3})$ and $(4a,\frac{5\pi}{3})$	A1, A1 (4)
(b)	Use area = $\frac{1}{2}\int r^2 d\theta$ to give $\frac{1}{2}a^2\int(3+2\cos\theta)^2 d\theta$	M1
	Obtain $\int(9+12\cos\theta+2\cos 2\theta+2)d\theta$	A1
	Integrate to give $11\theta+12\sin\theta+\sin 2\theta$	M1 A1
	Use limits $\frac{\pi}{3}$ and π, then double or $\frac{\pi}{3}$ and $\frac{5\pi}{3}$ or theirs	M1
	Find a third area of circle $=\frac{16\pi a^2}{3}$	B1
	Obtain required area = $\frac{38\pi a^2}{3}-\frac{13\sqrt{3}a^2}{2}$	A1 , A1 (8)
(c)		
	correct shape	B1
	5a and 4a marked	B1
	2a marked and passes through O	B1 (3)
		[15]
	Notes: (a) First A for r=4a second for both values in radians. Accept 1.0471…and 5.2359….2 dp or better for final A (b) First M for substitution, expansion and attempt to use double angles. Second M for integrating expression of the form $a+b\cos\theta+c\cos 2\theta$ Lose final A only if a^2 missing in last line (c) First B for approximately symmetrical shape about initial line, only 1 loop which is convex strictly within shaded region	