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Mark Scheme (Results)
January 2011

GCE

GCE Core Mathematics C4 (6666) Paper 1

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Publications Code UA026241

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

   - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)
   - Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\surd$ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - $*$ The answer is printed on the paper
   - $\sqsubset$ The second mark is dependent on gaining the first mark

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Core Mathematics C4 6666
Mark Scheme

Question Number	Scheme	Marks
1.	$\int x\sin 2x\,\mathrm{d}x = -\frac{x\cos 2x}{2} + \int \frac{\cos 2x}{2}\,\mathrm{d}x$ $= \quad \ldots \quad + \frac{\sin 2x}{4}$ $\left[\ \ldots \ \right]_0^{\frac{\pi}{2}} = \frac{\pi}{4}$	M1 A1 A1 M1 M1 A1 **[6]**
2.	$\frac{\mathrm{d}I}{\mathrm{d}t} = -16\ln(0.5)0.5^t$ At $t=3$ $\quad \frac{\mathrm{d}I}{\mathrm{d}t} = -16\ln(0.5)0.5^3$ $= -2\ln 0.5 = \ln 4$	M1 A1 M1 M1 A1 **[5]**

Question Number	Scheme	Marks
3. **(a)**	$\dfrac{5}{(x-1)(3x+2)} = \dfrac{A}{x-1} + \dfrac{B}{3x+2}$ $5 = A(3x+2) + B(x-1)$ $x \to 1 \qquad 5 = 5A \Rightarrow A = 1$ $x \to -\dfrac{2}{3} \qquad 5 = -\dfrac{5}{3}B \Rightarrow B = -3$	M1 A1 A1 (3)
(b)	$\displaystyle\int \frac{5}{(x-1)(3x+2)}\,dx = \int \left(\frac{1}{x-1} - \frac{3}{3x+2}\right)dx$ $= \ln(x-1) - \ln(3x+2) \quad (+C)$ ft constants	M1 A1ft A1ft (3)
(c)	$\displaystyle\int \frac{5}{(x-1)(3x+2)}\,dx = \int \left(\frac{1}{y}\right)dy$ $\ln(x-1) - \ln(3x+2) = \ln y \quad (+C)$ $y = \dfrac{K(x-1)}{3x+2}$ depends on first two Ms in (c) Using $(2, 8)$ $8 = \dfrac{K}{8}$ depends on first two Ms in (c) $y = \dfrac{64(x-1)}{3x+2}$	M1 M1 A1 M1 dep M1 dep A1 (6) **[12]**

Question Number	Scheme	Marks
4. **(a)**	$\overrightarrow{AB} = -2\mathbf{i} + 2\mathbf{j} - \mathbf{k} - (\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}) = -3\mathbf{i} + 5\mathbf{j} - 3\mathbf{k}$	M1 A1 (2)
(b)	$\mathbf{r} = \mathbf{i} - 3\mathbf{j} + 2\mathbf{k} + \lambda(-3\mathbf{i} + 5\mathbf{j} - 3\mathbf{k})$ or $\mathbf{r} = -2\mathbf{i} + 2\mathbf{j} - \mathbf{k} + \lambda(-3\mathbf{i} + 5\mathbf{j} - 3\mathbf{k})$	M1 A1ft (2)
(c)	$\overrightarrow{AC} = 2\mathbf{i} + p\mathbf{j} - 4\mathbf{k} - (\mathbf{i} - 3\mathbf{j} + 2\mathbf{k})$ $= \mathbf{i} + (p+3)\mathbf{j} - 6\mathbf{k}$ or $\overrightarrow{CA}$ $\overrightarrow{AC}.\overrightarrow{AB} = \begin{pmatrix} 1 \\ p+3 \\ -6 \end{pmatrix}.\begin{pmatrix} -3 \\ 5 \\ -3 \end{pmatrix} = 0$ $-3 + 5p + 15 + 18 = 0$ Leading to $p = -6$	B1 M1 M1 A1 (4)
(d)	$AC^2 = (2-1)^2 + (-6+3)^2 + (-4-2)^2 \quad (= 46)$ $AC = \sqrt{46}$ accept awrt 6.8	M1 A1 (2) **[10]**

Question Number	Scheme	Marks
5.		
(a)	$(2-3x)^{-2} = 2^{-2}\left(1-\frac{3}{2}x\right)^{-2}$	B1
	$\left(1-\frac{3}{2}x\right)^{-2} = 1+(-2)\left(-\frac{3}{2}x\right)+\frac{-2.-3}{1.2}\left(-\frac{3}{2}x\right)^2+\frac{-2.-3.-4}{1.2.3}\left(-\frac{3}{2}x\right)^3+\ ...$	M1 A1
	$=1+3x+\frac{27}{4}x^2+\frac{27}{2}x^3+\ ...$	
	$(2-3x)^{-2} = \frac{1}{4}+\frac{3}{4}x+\frac{27}{16}x^2+\frac{27}{8}x^3+\ ...$	M1 A1 (5)
(b)	$f(x) = (a+bx)\left(\frac{1}{4}+\frac{3}{4}x+\frac{27}{16}x^2+\frac{27}{8}x^3+\ ...\right)$	
	Coefficient of x; $\frac{3a}{4}+\frac{b}{4}=0 \quad (3a+b=0)$	M1
	Coefficient of x^2; $\frac{27a}{16}+\frac{3b}{4}=\frac{9}{16} \quad (9a+4b=3)$ A1 either correct	M1 A1
	Leading to $a=-1,\ b=3$	M1 A1 (5)
(c)	Coefficient of x^3 is $\frac{27a}{8}+\frac{27b}{16}=\frac{27}{8}\times(-1)+\frac{27}{16}\times 3$	M1 A1ft
	$=\frac{27}{16}$ cao	A1 (3)
		[13]

Question Number	Scheme	Marks
6. **(a)**	$\frac{dx}{dt}=\frac{1}{t}, \quad \frac{dy}{dt}=2t$	
	$\frac{dy}{dx}=2t^2$	M1 A1
	Using $mm'=-1$, at $t=3$	
	$m'=-\frac{1}{18}$	M1 A1
	$y-7=-\frac{1}{18}(x-\ln 3)$	M1 A1 (6)
(b)	$x=\ln t \Rightarrow t=e^x$	B1
	$y=e^{2x}-2$	M1 A1 (3)
(c)	$V=\pi\int\left(e^{2x}-2\right)^2 dx$	M1
	$\int\left(e^{2x}-2\right)^2 dx=\int\left(e^{4x}-4e^{2x}+4\right)dx$	M1
	$=\frac{e^{4x}}{4}-\frac{4e^{2x}}{2}+4x$	M1 A1
	$\pi\left[\frac{e^{4x}}{4}-\frac{4e^{2x}}{2}+4x\right]_{\ln 2}^{\ln 4}=\pi\left[(64-32+4\ln 4)-(4-8+4\ln 2)\right]$	M1
	$=\pi(36+4\ln 2)$	A1
		(6) **[15]**
	Alternative to (c) *using parameters*	
	$V=\pi\int\left(t^2-2\right)^2\frac{dx}{dt}dt$	M1
	$\int\left(\left(t^2-2\right)^2\times\frac{1}{t}\right)dt=\int\left(t^3-4t+\frac{4}{t}\right)dt$	M1
	$=\frac{t^4}{4}-2t^2+4\ln t$	M1 A1
	The limits are $t=2$ and $t=4$	
	$\pi\left[\frac{t^4}{4}-2t^2+4\ln t\right]_2^4=\pi\left[(64-32+4\ln 4)-(4-8+4\ln 2)\right]$	M1
	$=\pi(36+4\ln 2)$	A1
		(6)

Question Number	Scheme	Marks
7. **(a)**	$x=3 \Rightarrow y=0.1847$ awrt $x=5 \Rightarrow y=0.1667$ awrt or $\frac{1}{6}$	B1 B1 (2)
(b)	$I \approx \underline{\underline{\frac{1}{2}}}\left[0.2+0.1667+2\left(0.1847+0.1745\right)\right]$ ≈ 0.543 0.542 or 0.543	B1 M1 A1ft A1 (4)
(c)	$\frac{\mathrm{d}x}{\mathrm{d}u}=2\left(u-4\right)$ $\int \frac{1}{4+\sqrt{\left(x-1\right)}}\mathrm{d}x=\int \frac{1}{u}\times 2\left(u-4\right)\mathrm{d}u$ $=\int\left(2-\frac{8}{u}\right)\mathrm{d}u$ $=2u-8\ln u$ $x=2 \Rightarrow u=5,\ x=5 \Rightarrow u=6$ $\left[2u-8\ln u\right]_5^6=\left(12-8\ln 6\right)-\left(10-8\ln 5\right)$ $=2+8\ln\left(\frac{5}{6}\right)$	B1 M1 A1 M1 A1 B1 M1 A1 (8) **[14]**

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Order Code UA026241 January 2011

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