| Centre No. | | | | | | Paper Reference | | | | | | | Surname | Initial(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Candidate No. | | | | | | 6 | 6 | 6 | 6 | / | 0 | 1 | Signature | |

Paper Reference(s)

**6666/01**

# Edexcel GCE

## Core Mathematics C4

## Advanced

Monday 15 June 2009 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

| | | |
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Team Leader's use only

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| Question Number | Leave Blank |
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**Materials required for examination**

Mathematical Formulae (Orange or Green)

**Items included with question papers**

Nil

**Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

### Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer for each question in the space following the question.
When a calculator is used, the answer should be given to an appropriate degree of accuracy.

### Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 8 questions in this question paper. The total mark for this paper is 75.
There are 28 pages in this question paper. Any blank pages are indicated.

### Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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**1.** $$f(x) = \frac{1}{\sqrt{(4+x)}}, \qquad |x| < 4$$

Find the binomial expansion of $f(x)$ in ascending powers of $x$, up to and including the term in $x^3$. Give each coefficient as a simplified fraction.

**(6)**





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**Question 1 continued**

Q1

**(Total 6 marks)**



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**2.**

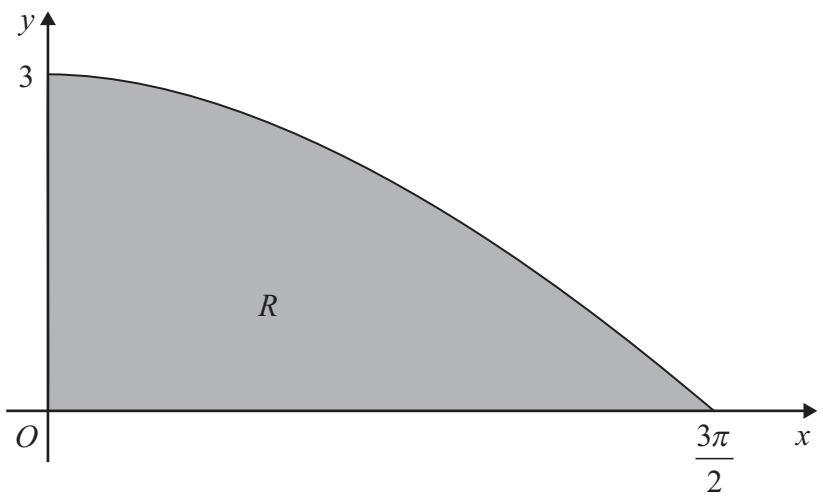


**Figure 1**

Figure 1 shows the finite region $R$ bounded by the $x$-axis, the $y$-axis and the curve with equation $y = 3\cos\left(\frac{x}{3}\right)$, $0 \leqslant x \leqslant \frac{3\pi}{2}$.

The table shows corresponding values of $x$ and $y$ for $y = 3\cos\left(\frac{x}{3}\right)$.

| $x$ | 0 | $\frac{3\pi}{8}$ | $\frac{3\pi}{4}$ | $\frac{9\pi}{8}$ | $\frac{3\pi}{2}$ |
|---|---|---|---|---|---|
| $y$ | 3 | 2.77164 | 2.12132 | | 0 |

(a) Complete the table above giving the missing value of $y$ to 5 decimal places.

**(1)**

(b) Using the trapezium rule, with all the values of $y$ from the completed table, find an approximation for the area of $R$, giving your answer to 3 decimal places.

**(4)**

(c) Use integration to find the exact area of $R$.

**(3)**





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**Question 2 continued**

**(Total 8 marks)**

Q2



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**3.** $$\mathrm{f}(x) = \frac{4-2x}{(2x+1)(x+1)(x+3)} = \frac{A}{2x+1} + \frac{B}{x+1} + \frac{C}{x+3}$$

(a) Find the values of the constants $A$, $B$ and $C$.

**(4)**

(b) (i) Hence find $\int \mathrm{f}(x)\,\mathrm{d}x$.

**(3)**

(ii) Find $\int_0^2 \mathrm{f}(x)\,\mathrm{d}x$ in the form $\ln k$, where $k$ is a constant.

**(3)**



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**Question 3 continued**



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**Question 3 continued**



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**Question 3 continued**

**(Total 10 marks)**

Q3



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**4.** The curve $C$ has the equation $ye^{-2x} = 2x + y^2$.

(a) Find $\frac{dy}{dx}$ in terms of $x$ and $y$.

**(5)**

The point $P$ on $C$ has coordinates (0, 1).

(b) Find the equation of the normal to $C$ at $P$, giving your answer in the form $ax + by + c = 0$, where $a$, $b$ and $c$ are integers.

**(4)**



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**Question 4 continued**



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**Question 4 continued**



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**Question 4 continued**

**(Total 9 marks)**

Q4



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**5.**

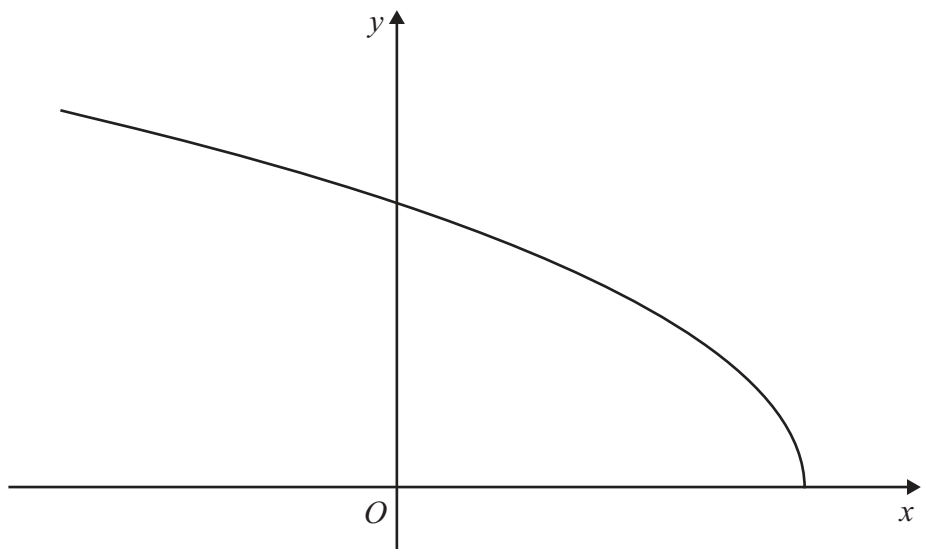


**Figure 2**

Figure 2 shows a sketch of the curve with parametric equations

$$x = 2\cos 2t, \qquad y = 6\sin t, \qquad 0 \leqslant t \leqslant \frac{\pi}{2}$$

(a) Find the gradient of the curve at the point where $t = \frac{\pi}{3}$.

**(4)**

(b) Find a cartesian equation of the curve in the form

$$y = \mathrm{f}(x), \quad -k \leqslant x \leqslant k,$$

stating the value of the constant $k$.

**(4)**

(c) Write down the range of $\mathrm{f}(x)$.

**(2)**



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**Question 5 continued**



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**Question 5 continued**





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**Question 5 continued**

Q5

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**6.** (a) Find $\int \sqrt{(5-x)}\,\mathrm{d}x$.

**(2)**

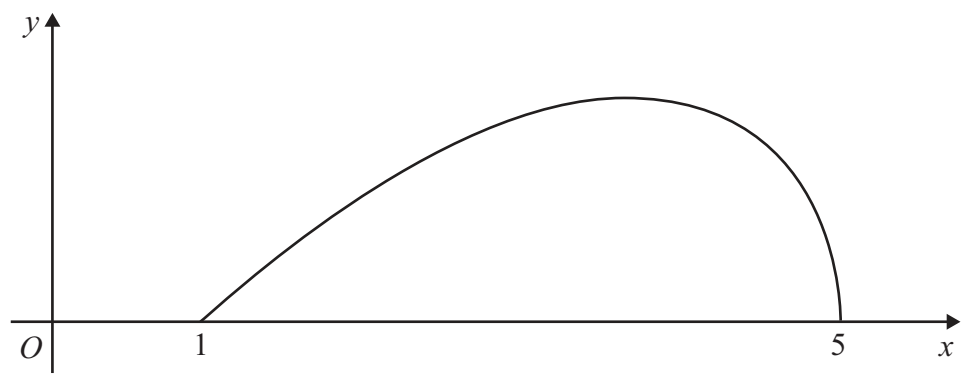


**Figure 3**

Figure 3 shows a sketch of the curve with equation

$$y = (x-1)\sqrt{(5-x)}, \qquad 1 \leqslant x \leqslant 5$$

(b) (i) Using integration by parts, or otherwise, find

$$\int (x-1)\sqrt{(5-x)}\,\mathrm{d}x$$

**(4)**

(ii) Hence find $\int_1^5 (x-1)\sqrt{(5-x)}\,\mathrm{d}x$.

**(2)**



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**Question 6 continued**



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**Question 6 continued**





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**Question 6 continued**

**(Total 8 marks)**

Q6



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**7.** Relative to a fixed origin $O$, the point $A$ has position vector $(8\mathbf{i} + 13\mathbf{j} - 2\mathbf{k})$, the point $B$ has position vector $(10\mathbf{i} + 14\mathbf{j} - 4\mathbf{k})$, and the point $C$ has position vector $(9\mathbf{i} + 9\mathbf{j} + 6\mathbf{k})$.

The line $l$ passes through the points $A$ and $B$.

(a) Find a vector equation for the line $l$.

**(3)**

(b) Find $|\overrightarrow{CB}|$.

**(2)**

(c) Find the size of the acute angle between the line segment $CB$ and the line $l$, giving your answer in degrees to 1 decimal place.

**(3)**

(d) Find the shortest distance from the point $C$ to the line $l$.

**(3)**

The point $X$ lies on $l$. Given that the vector $\overrightarrow{CX}$ is perpendicular to $l$,

(e) find the area of the triangle $CXB$, giving your answer to 3 significant figures.

**(3)**





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**Question 7 continued**



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**Question 7 continued**





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**Question 7 continued**

**(Total 14 marks)**

Q7



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**8.** (a) Using the identity $\cos 2\theta = 1 - 2\sin^2\theta$, find $\int \sin^2\theta \, d\theta$.

**(2)**

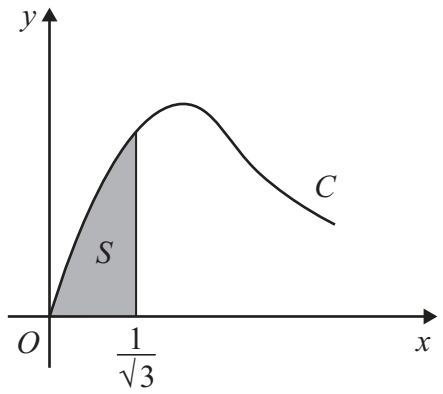


**Figure 4**

Figure 4 shows part of the curve $C$ with parametric equations

$$x = \tan\theta, \qquad y = 2\sin 2\theta, \qquad 0 \leqslant \theta < \frac{\pi}{2}$$

The finite shaded region $S$ shown in Figure 4 is bounded by $C$, the line $x = \frac{1}{\sqrt{3}}$ and the $x$-axis. This shaded region is rotated through $2\pi$ radians about the $x$-axis to form a solid of revolution.

(b) Show that the volume of the solid of revolution formed is given by the integral

$$k\int_0^{\frac{\pi}{6}} \sin^2\theta \, d\theta$$

where $k$ is a constant.

**(5)**

(c) Hence find the exact value for this volume, giving your answer in the form $p\pi^2 + q\pi\sqrt{3}$, where $p$ and $q$ are constants.

**(3)**



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**Question 8 continued**



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**Question 8 continued**

Q8

**(Total 10 marks)**

**TOTAL FOR PAPER: 75 MARKS**

**END**



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