Paper Reference(s)

6673

Edexcel GCE

Pure Mathematics P3
Advanced/Advanced Subsidiary

Monday 23 May 2005 – Morning
Time: 1 hour 30 minutes

Materials required for examination	**Items included with question papers**
Mathematical Formulae (Lilac)	Nil

Candidates may only use one of the basic scientific calculators approved by the Qualifications and Curriculum Authority.

Instructions to Candidates

In the boxes on the answer book, write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Pure Mathematics P3), the paper reference (6673), your surname, initials and signature.
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.
This paper has 8 questions.
The total mark for this paper is 75.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner. Answers without working may gain no credit.

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1. A function f is defined as

$$f(x) = 2x^3 - 8x^2 + 5x + 6, \qquad x \in \mathbb{R}.$$

Using the remainder theorem, or otherwise, find the remainder when f(x) is divided by

(a) $(x - 2)$,

(2)

(b) $(2x + 1)$.

(2)

(c) Write down a solution of $f(x) = 0$.

(1)

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2. In the binomial expansion, in ascending powers of x, of $(1 + ax)^n$, where a and n are constants, the coefficient of x is 15. The coefficient of x^2 and of x^3 are equal.

(a) Find the value of a and the value of n.

(6)

(b) Find the coefficient of x^3.

(1)

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3. (a) Use integration by parts to find

$$\int x \cos 2x \, dx .$$

(4)

(b) Hence, or otherwise, find

$$\int x \cos^2 x \, dx .$$

(3)

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4. Two circles C_1 and C_2 have equations

$$(x - 2)^2 + y^2 = 9 \text{ and } (x - 5)^2 + y^2 = 9$$

respectively.

(*a*) For each of these circles state the radius and the coordinates of the centre. **(3)**

(*b*) Sketch the circles C_1 and C_2 on the same diagram. **(3)**

(*c*) Find the exact distance between the points of intersection of C_1 and C_2. **(3)**

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5. The value £V of a car t years after the 1st January 2001 is given by the formula

$$V = 10\,000 \times (1.5)^{-t}.$$

(*a*) Find the value of the car on 1st January 2005. **(2)**

(*b*) Find the value of $\frac{dV}{dt}$ when $t = 4$. **(3)**

(*c*) Explain what the answer to part (*b*) represents. **(1)**

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6. The points A and B have position vectors $5\mathbf{j} + 11\mathbf{k}$ and $c\mathbf{i} + d\mathbf{j} + 21\mathbf{k}$ respectively, where c and d are constants.

The line l, through the points A and B, has vector equation $\mathbf{r} = 5\mathbf{j} + 11\mathbf{k} + \lambda(2\mathbf{i} + \mathbf{j} + 5\mathbf{k})$, where λ is a parameter.

(*a*) Find the value of c and the value of d. **(3)**

The point P lies on the line l, and $\overrightarrow{OP}$ is perpendicular to l, where O is the origin.

(*b*) Find the position vector of P. **(6)**

(*c*) Find the area of triangle OAB, giving your answer to 3 significant figures. **(4)**

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7. A spherical balloon is being inflated in such a way that the rate of increase of its volume, V cm^3, with respect to time t seconds is given by

$$\frac{dV}{dt} = \frac{k}{V}, \text{ where } k \text{ is a positive constant.}$$

Given that the radius of the balloon is r cm, and that $V = \frac{4}{3}\pi r^3$,

(*a*) prove that r satisfies the differential equation

$$\frac{dr}{dt} = \frac{B}{r^5}, \text{ where } B \text{ is a constant.}$$

(4)

(*b*) Find a general solution of the differential equation obtained in part (*a*).

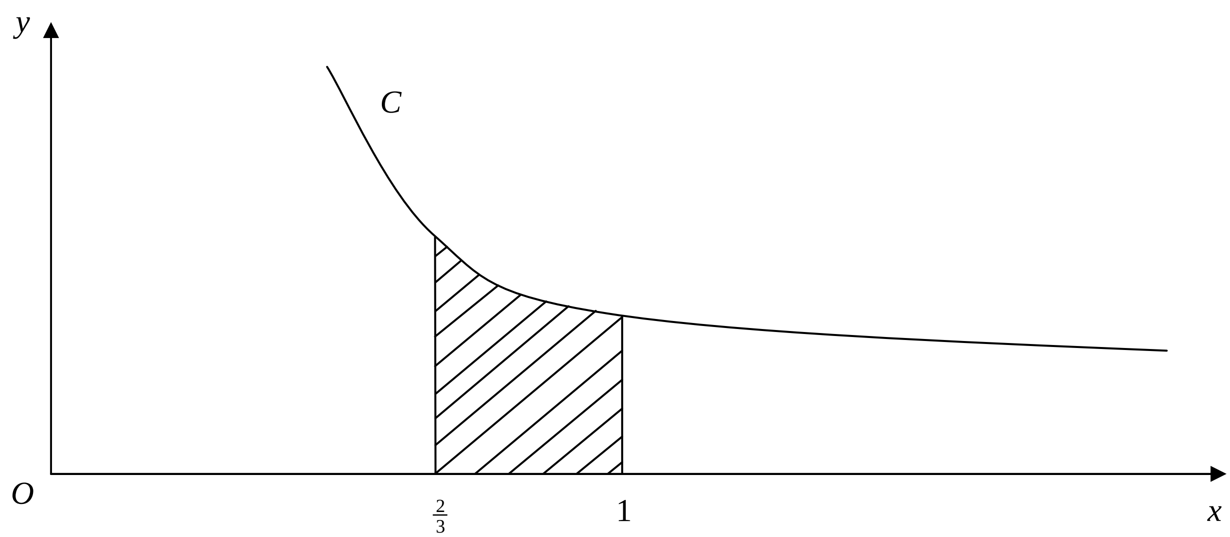
(3)

When $t = 0$ the radius of the balloon is 5 cm, and when $t = 2$ the radius is 6 cm.

(*c*) Find the radius of the balloon when $t = 4$. Give your answer to 3 significant figures.

(5)

8. **Figure 1**



The curve C has parametric equations

$$x = \frac{1}{1+t}, \quad y = \frac{1}{1-t}, \quad |t| < 1.$$

(a) Find an equation for the tangent to C at the point where $t = \frac{1}{2}$.

(7)

(b) Show that C satisfies the cartesian equation $y = \dfrac{x}{2x-1}$.

(3)

The finite region between the curve C and the x-axis, bounded by the lines with equations $x = \frac{2}{3}$ and $x = 1$, is shown shaded in Figure 1.

(c) Calculate the exact value of the area of this region, giving your answer in the form $a + b \ln c$, where a, b and c are constants.

(6)

TOTAL FOR PAPER: 75 MARKS

END