



Monday 16 June 2014 – Morning

A2 GCE MATHEMATICS

4723/01 Core Mathematics 3

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:

- Printed Answer Book 4723/01
- List of Formulae (MF1)

Other materials required:

- Scientific or graphical calculator

Duration: 1 hour 30 minutes



INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets [] at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

1 Given that $y = 4x^2 \ln x$, find the value of $\frac{d^2y}{dx^2}$ when $x = e^2$. [5]

2 By first using appropriate identities, solve the equation

$$5 \cos 2\theta \operatorname{cosec} \theta = 2$$

for $0^\circ < \theta < 180^\circ$. [6]

3 (i) Use Simpson's rule with four strips to find an approximation to

$$\int_0^2 e^{\sqrt{x}} dx,$$

giving your answer correct to 3 significant figures. [4]

(ii) Deduce an approximation to $\int_0^2 (1 + 10e^{\sqrt{x}}) dx$. [2]

4 The functions f and g are defined for all real values of x by

$$f(x) = 2x^3 + 4 \quad \text{and} \quad g(x) = \sqrt[3]{x-10}.$$

(i) Evaluate $f^{-1}(-50)$. [2]

(ii) Show that $fg(x) = 2x - 16$. [2]

(iii) Differentiate $gf(x)$ with respect to x . [3]

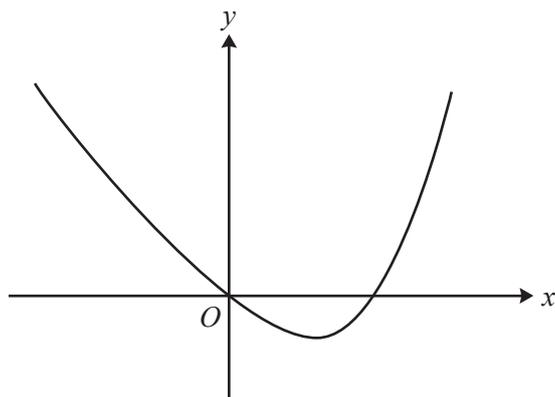
5 (a) The mass, M grams, of a substance at time t years is given by

$$M = 58e^{-0.33t}.$$

Find the rate at which the mass is decreasing at the instant when $t = 4$. Give your answer correct to 2 significant figures. [3]

(b) The mass of a second substance is increasing exponentially. The initial mass is 42.0 grams and, 6 years later, the mass is 51.8 grams. Find the mass at a time 24 years after the initial value. [4]

6



The diagram shows the curve $y = x^4 - 8x$.

- (i) By sketching a second curve on the copy of the diagram, show that the equation

$$x^4 + x^2 - 8x - 9 = 0$$

has two real roots. State the equation of the second curve. [2]

- (ii) The larger root of the equation $x^4 + x^2 - 8x - 9 = 0$ is denoted by α .

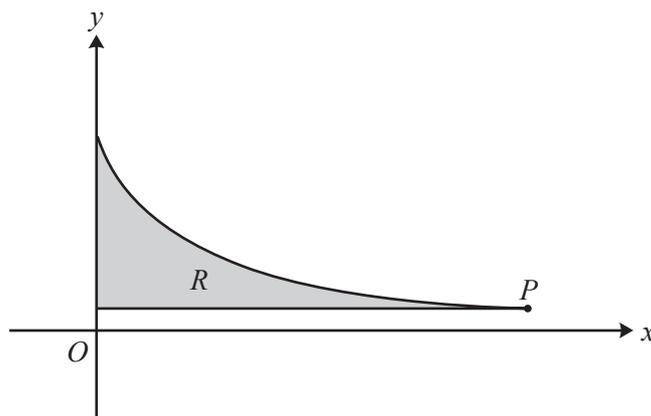
- (a) Show by calculation that $2.1 < \alpha < 2.2$. [2]

- (b) Use an iterative process based on the equation

$$x = \sqrt[4]{9 + 8x - x^2},$$

with a suitable starting value, to find α correct to 3 decimal places. Give the result of each step of the iterative process. [4]

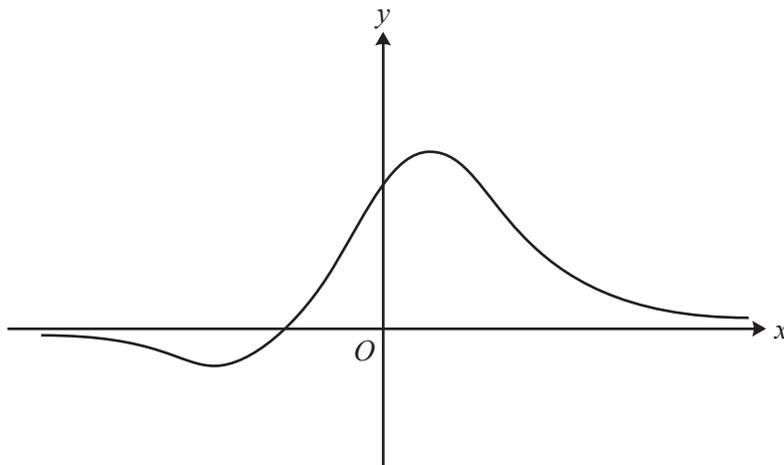
7



The diagram shows the curve $y = \sqrt{\frac{3}{4x+1}}$ for $0 \leq x \leq 20$. The point P on the curve has coordinates $(20, \frac{1}{9}\sqrt{3})$. The shaded region R is enclosed by the curve and the lines $x = 0$ and $y = \frac{1}{9}\sqrt{3}$.

- (i) Find the exact area of R . [4]

- (ii) Find the exact volume of the solid obtained when R is rotated completely about the x -axis. [6]



The diagram shows the curve $y = \frac{2x+4}{x^2+5}$.

(i) Find $\frac{dy}{dx}$ and hence find the coordinates of the two stationary points. [6]

(ii) The function g is defined for all real values of x by

$$g(x) = \left| \frac{2x+4}{x^2+5} \right|.$$

(a) Sketch the curve $y = g(x)$ and state the range of g . [3]

(b) It is given that the equation $g(x) = k$, where k is a constant, has exactly two distinct real roots. Write down the set of possible values of k . [2]

9 (i) Express $5 \cos(\theta - 60^\circ) + 3 \cos \theta$ in the form $R \sin(\theta + \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. [4]

(ii) Hence

(a) give details of the transformations needed to transform the curve $y = 5 \cos(\theta - 60^\circ) + 3 \cos \theta$ to the curve $y = \sin \theta$, [3]

(b) find the smallest positive value of β satisfying the equation

$$5 \cos\left(\frac{1}{3}\beta - 40^\circ\right) + 3 \cos\left(\frac{1}{3}\beta + 20^\circ\right) = 3. \quad [5]$$

END OF QUESTION PAPER



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.