



Wednesday 18 June 2014 – Afternoon

A2 GCE MATHEMATICS

4724/01 Core Mathematics 4

QUESTION PAPER

Candidates answer on the Printed Answer Book.

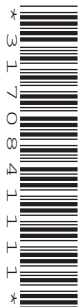
OCR supplied materials:

- Printed Answer Book 4724/01
- 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 **16** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

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1 Express $x + \frac{1}{1-x} + \frac{2}{1+x}$ as a single fraction, simplifying your answer. [3]

2 The points $O(0, 0, 0)$, $A(2, 8, 2)$, $B(5, 5, 8)$ and $C(3, -3, 6)$ form a parallelogram $OABC$. Use a scalar product to find the acute angle between the diagonals of this parallelogram. [5]

3 (i) Find the first three terms in the expansion of $(1 - 2x)^{-\frac{1}{2}}$ in ascending powers of x , where $|x| < \frac{1}{2}$. [3]

(ii) Hence find the coefficient of x^2 in the expansion of $\frac{x+3}{\sqrt{1-2x}}$. [2]

4 Show that $\int_0^{\frac{1}{4}\pi} \frac{1 - 2 \sin^2 x}{1 + 2 \sin x \cos x} dx = \frac{1}{2} \ln 2$. [5]

5 The equations of three lines are as follows.

$$\text{Line } A: \quad \mathbf{r} = \mathbf{i} + 4\mathbf{j} + \mathbf{k} + s(-\mathbf{i} + 2\mathbf{j} + 2\mathbf{k})$$

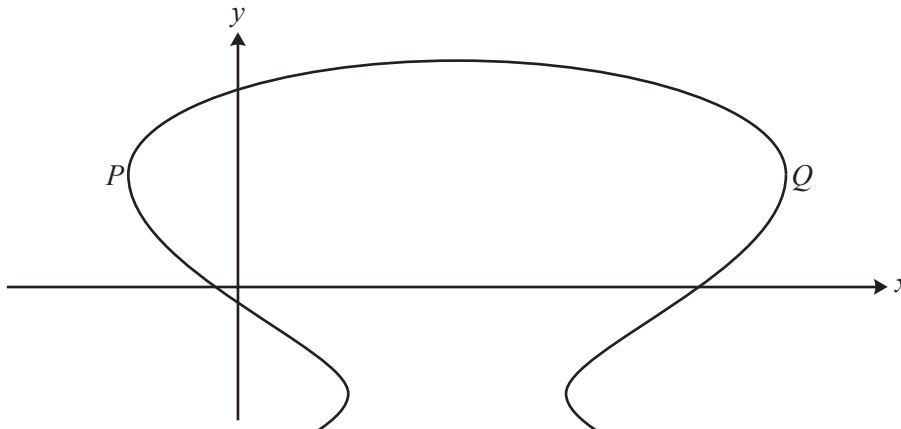
$$\text{Line } B: \quad \mathbf{r} = 2\mathbf{i} + 8\mathbf{j} + 2\mathbf{k} + t(\mathbf{i} + 3\mathbf{j} + 5\mathbf{k})$$

$$\text{Line } C: \quad \mathbf{r} = -\mathbf{i} + 19\mathbf{j} + 15\mathbf{k} + u(2\mathbf{i} - 4\mathbf{j} - 4\mathbf{k})$$

(i) Show that lines A and B are skew. [4]

(ii) Determine, giving reasons, the geometrical relationship between lines A and C . [2]

6



The diagram shows the curve with equation $x^2 + y^3 - 8x - 12y = 4$. At each of the points P and Q the tangent to the curve is parallel to the y -axis. Find the coordinates of P and Q . [8]

7 A curve has parametric equations

$$x = 2 \sin t, \quad y = \cos 2t + 2 \sin t$$

for $-\frac{1}{2}\pi \leq t \leq \frac{1}{2}\pi$.

(i) Show that $\frac{dy}{dx} = 1 - 2 \sin t$ and hence find the coordinates of the stationary point. [5]

(ii) Find the cartesian equation of the curve. [3]

(iii) State the set of values that x can take and hence sketch the curve. [3]

8 (i) Use division to show that $\frac{t^3}{t+2} \equiv t^2 - 2t + 4 - \frac{8}{t+2}$. [3]

(ii) Find $\int_1^2 6t^2 \ln(t+2) dt$. Give your answer in the form $A + B \ln 3 + C \ln 4$. [6]

9 Express $\frac{2+x^2}{(1+2x)(1-x)^2}$ in partial fractions and hence show that $\int_0^{\frac{1}{4}} \frac{2+x^2}{(1+2x)(1-x)^2} dx = \frac{1}{2} \ln \frac{3}{2} + \frac{1}{3}$. [9]

10 A container in the shape of an inverted cone of radius 3 metres and vertical height 4.5 metres is initially filled with liquid fertiliser. This fertiliser is released through a hole in the bottom of the container at a rate of 0.01 m^3 per second. At time t seconds the fertiliser remaining in the container forms an inverted cone of height h metres.

[The volume of a cone is $V = \frac{1}{3}\pi r^2 h$.]

(i) Show that $h^2 \frac{dh}{dt} = -\frac{9}{400\pi}$. [5]

(ii) Express h in terms of t . [4]

(iii) Find the time it takes to empty the container, giving your answer to the nearest minute. [2]

END OF QUESTION PAPER

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