



**Wednesday 18 June 2014 – Afternoon**

**A2 GCE MATHEMATICS**

**4724/01** Core Mathematics 4

**QUESTION PAPER**

Candidates answer on the Printed Answer Book.

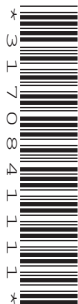
**OCR supplied materials:**

- 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.

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

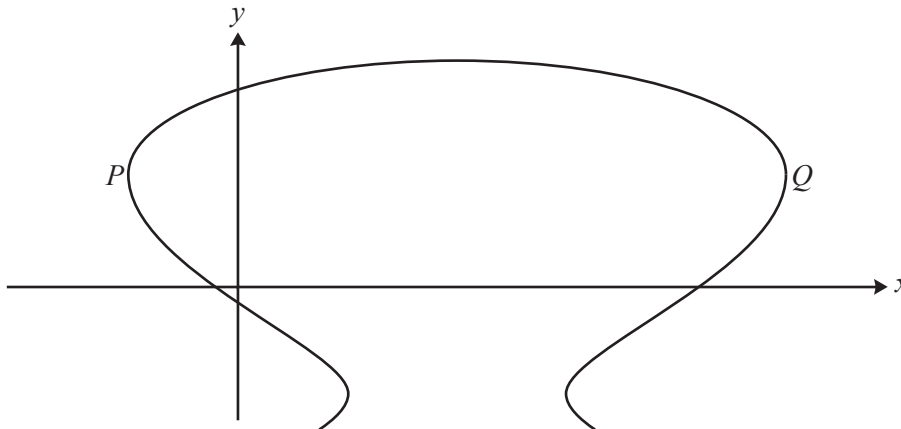
$$\text{Line } B: \quad \mathbf{r} = 2\mathbf{i} + 8\mathbf{j} + 2\mathbf{k} + t(\mathbf{i} + 3\mathbf{j} + 5\mathbf{k})$$

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

(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  $0.01 \text{ m}^3$  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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