

# OCR

Oxford Cambridge and RSA

## Friday 22 June 2018 – Morning

### 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.** If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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 barcodes.
- 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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Answer **all** the questions.

1 (i) Express  $\frac{3}{2x+1} - \frac{2}{x+1}$  as a single algebraic fraction in its simplest form. [2]

(ii) Hence express  $\left(\frac{3}{2x+1} - \frac{2}{x+1}\right)\left(\frac{6x+3}{x^2+x-2}\right)$  as a single algebraic fraction in its lowest terms. [4]

2 The equations of two lines are

$$\mathbf{r} = \begin{pmatrix} 2 \\ -3 \\ 1 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 4 \\ 1 \end{pmatrix} \quad \text{and} \quad \mathbf{r} = \begin{pmatrix} -4 \\ 6 \\ -2 \end{pmatrix} + \mu \begin{pmatrix} 4 \\ -11 \\ 3 \end{pmatrix}.$$

(i) Explain why these lines are not parallel. [1]

(ii) Determine whether these lines are skew or whether they intersect. [4]

3 (i) Find the quotient and the remainder when  $2x^3 - 3x^2 + 3x + 2$  is divided by  $x^2 - 2x + 1$ . [3]

(ii) Hence show that, if  $x$  is small,

$$\frac{2x^3 - 3x^2 + 3x + 2}{1 - 2x + x^2} \approx a + bx + cx^2,$$

where  $a$ ,  $b$  and  $c$  are constants to be determined. [4]

4 The parametric equations of a curve are

$$x = 2 \tan 2t \quad \text{and} \quad y = 1 + \tan t, \quad \text{where} \quad -\frac{1}{2}\pi < t < \frac{1}{2}\pi.$$

(i) Show that a cartesian equation of the curve is  $4y + xy^2 - 2xy = 4$ . [3]

(ii) Find  $\frac{dy}{dx}$  in terms of  $x$  and  $y$ . [4]

(iii) Find the gradient of the curve at the point where the curve intersects the  $y$ -axis. [2]

5 (i) Given that  $u = \ln(\cos x)$ , find  $\frac{du}{dx}$ . [2]

(ii) Hence find  $\int 2 \cos 2x \ln(\cos x) dx$ . [5]

6 Use the substitution  $u = 1 + 2\sqrt{x}$  to find  $\int \frac{\sqrt{x}}{1 + 2\sqrt{x}} dx$ . [7]

7 (i) Express  $\frac{12-6x}{(1+x)(1-2x)^2}$  in partial fractions. [5]

(ii) Find  $\int \frac{12-6x}{(1+x)(1-2x)^2} dx$ . Hence evaluate  $\int_1^2 \frac{12-6x}{(1+x)(1-2x)^2} dx$ , giving your answer in the form  $A - \ln B$ , where  $A$  and  $B$  are integers to be determined. [5]

8  $A$  is the point  $(1, 3, 1)$ ,  $B$  is the point  $(3, 2, 4)$  and  $P$  is the point  $(15, 4, 6)$ . The point  $Q$  is on the line through  $A$  and  $B$  such that angle  $AQP = 90^\circ$ .

(i) Write down a vector equation of the line through  $A$  and  $B$ . [2]

(ii) Find the coordinates of  $Q$ . [5]

(iii) Find the area of triangle  $AQP$ . [3]

9 When a container is partially filled with liquid to a depth of  $x$  centimetres, the volume  $V \text{ cm}^3$  of liquid in the container is given by the formula

$$V = (x+1)^3 - 1.$$

Initially the container is empty. Liquid is poured into the container so that the rate at which  $V$  increases is directly proportional to  $e^{-t}$ , where  $t$  is the time in seconds since the addition of liquid began. When  $t = 2$ , the rate at which  $V$  is increasing is  $10 \text{ cm}^3 \text{ s}^{-1}$ .

(i) Show that  $V = 10e^2(1 - e^{-t})$ . Hence find how long it takes for the depth of liquid in the container to reach 3 cm. [8]

(ii) Find the value that the depth of liquid approaches as  $t$  increases, giving your answer correct to 3 significant figures. [3]

**END OF QUESTION PAPER**

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