



**ADVANCED GCE**  
**MATHEMATICS**  
 Core Mathematics 4

**4724**

Candidates answer on the Answer Booklet

**OCR Supplied Materials:**

- 8 page Answer Booklet
- List of Formulae (MF1)

**Other Materials Required:**  
 None

**Tuesday 13 January 2009**  
**Morning**

**Duration:** 1 hour 30 minutes



**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- 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.
- You are permitted to use a graphical calculator in this paper.

**INFORMATION FOR CANDIDATES**

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

1 Simplify  $\frac{20 - 5x}{6x^2 - 24x}$ . [3]

2 Find  $\int x \sec^2 x \, dx$ . [4]

3 (i) Expand  $(1 + 2x)^{\frac{1}{2}}$  as a series in ascending powers of  $x$ , up to and including the term in  $x^3$ . [3]

(ii) Hence find the expansion of  $\frac{(1 + 2x)^{\frac{1}{2}}}{(1 + x)^3}$  as a series in ascending powers of  $x$ , up to and including the term in  $x^3$ . [5]

(iii) State the set of values of  $x$  for which the expansion in part (ii) is valid. [1]

4 Find the exact value of  $\int_0^{\frac{1}{4}\pi} (1 + \sin x)^2 \, dx$ . [6]

5 (i) Show that the substitution  $u = \sqrt{x}$  transforms  $\int \frac{1}{x(1 + \sqrt{x})} \, dx$  to  $\int \frac{2}{u(1 + u)} \, du$ . [3]

(ii) Hence find the exact value of  $\int_1^9 \frac{1}{x(1 + \sqrt{x})} \, dx$ . [5]

6 A curve has parametric equations

$$x = t^2 - 6t + 4, \quad y = t - 3.$$

Find

(i) the coordinates of the point where the curve meets the  $x$ -axis, [2]

(ii) the equation of the curve in cartesian form, giving your answer in a simple form without brackets, [2]

(iii) the equation of the tangent to the curve at the point where  $t = 2$ , giving your answer in the form  $ax + by + c = 0$ , where  $a$ ,  $b$  and  $c$  are integers. [5]

7 (i) Show that the straight line with equation  $\mathbf{r} = \begin{pmatrix} 2 \\ -3 \\ 5 \end{pmatrix} + t \begin{pmatrix} 1 \\ 4 \\ -2 \end{pmatrix}$  meets the line passing through  $(9, 7, 5)$  and  $(7, 8, 2)$ , and find the point of intersection of these lines. [6]

(ii) Find the acute angle between these lines. [4]

8 The equation of a curve is  $x^3 + y^3 = 6xy$ .

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

(ii) Show that the point  $(2^{\frac{4}{3}}, 2^{\frac{5}{3}})$  lies on the curve and that  $\frac{dy}{dx} = 0$  at this point. [4]

(iii) The point  $(a, a)$ , where  $a > 0$ , lies on the curve. Find the value of  $a$  and the gradient of the curve at this point. [4]

9 A liquid is being heated in an oven maintained at a constant temperature of  $160^\circ\text{C}$ . It may be assumed that the rate of increase of the temperature of the liquid at any particular time  $t$  minutes is proportional to  $160 - \theta$ , where  $\theta^\circ\text{C}$  is the temperature of the liquid at that time.

(i) Write down a differential equation connecting  $\theta$  and  $t$ . [2]

When the liquid was placed in the oven, its temperature was  $20^\circ\text{C}$  and 5 minutes later its temperature had risen to  $65^\circ\text{C}$ .

(ii) Find the temperature of the liquid, correct to the nearest degree, after another 5 minutes. [9]



Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (OCR) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

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.