



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.

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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]

3

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°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 θ and t . [2]

When the liquid was placed in the oven, its temperature was 20°C and 5 minutes later its temperature had risen to 65°C .

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



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