

GCE Examinations
Advanced / Advanced Subsidiary

Core Mathematics C4

Paper A

Time: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Answer **all** the questions.
- 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 graphic calculator in this paper.

INFORMATION FOR CANDIDATES

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



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1. Express

$$\frac{2x}{2x^2 + 3x - 5} \div \frac{x^3}{x^2 - x}$$

as a single fraction in its simplest form.

[4]

2. A curve has the equation

$$2x^2 + xy - y^2 + 18 = 0.$$

Find the coordinates of the points where the tangent to the curve is parallel to the x -axis.

[7]

3. The first four terms in the series expansion of $(1 + ax)^n$ in ascending powers of x are

$$1 - 4x + 24x^2 + kx^3,$$

where a , n and k are constants and $|ax| < 1$.

(i) Find the values of a and n .

[6]

(ii) Show that $k = -160$.

[2]

4. Relative to a fixed origin, O , the points A and B have position vectors $\begin{pmatrix} 1 \\ 5 \\ -1 \end{pmatrix}$ and $\begin{pmatrix} 6 \\ 3 \\ -6 \end{pmatrix}$

respectively.

Find, in exact, simplified form,

(i) the cosine of $\angle AOB$,

[4]

(ii) the area of triangle OAB ,

[3]

(iii) the shortest distance from A to the line OB .

[2]

5. (i) Use the derivatives of $\sin x$ and $\cos x$ to prove that

$$\frac{d}{dx}(\tan x) = \sec^2 x. \quad [4]$$

The tangent to the curve $y = 2x \tan x$ at the point where $x = \frac{\pi}{4}$ meets the y -axis at the point P .

- (ii) Find the y -coordinate of P in the form $k\pi^2$ where k is a rational constant. [6]

6. (i) Find

$$\int \cot^2 2x \, dx. \quad [3]$$

- (ii) Use the substitution $u^2 = x + 1$ to evaluate

$$\int_0^3 \frac{x^2}{\sqrt{x+1}} \, dx. \quad [7]$$

7. During a chemical reaction, a compound is being made from two other substances.

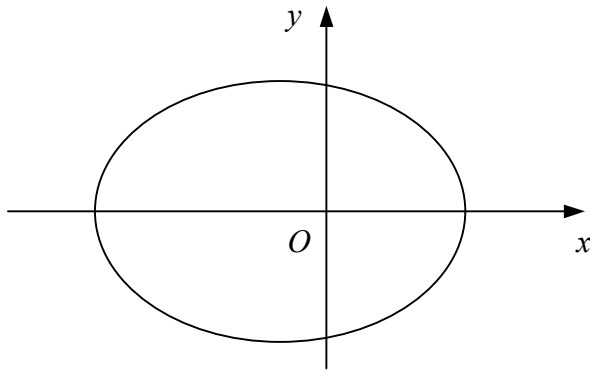
At time t hours after the start of the reaction, x g of the compound has been produced. Assuming that $x = 0$ initially, and that

$$\frac{dx}{dt} = 2(x - 6)(x - 3),$$

- (i) show that it takes approximately 7 minutes to produce 2 g of the compound. [10]
(ii) Explain why it is not possible to produce 3 g of the compound. [2]

Turn over

8.



The diagram shows the curve with parametric equations

$$x = -1 + 4 \cos \theta, \quad y = 2\sqrt{2} \sin \theta, \quad 0 \leq \theta < 2\pi.$$

The point P on the curve has coordinates $(1, \sqrt{6})$.

- (i) Find the value of θ at P . [2]
- (ii) Show that the normal to the curve at P passes through the origin. [7]
- (iii) Find a cartesian equation for the curve. [3]