Core Mathematics C4 Advanced Level

For AQA

Paper B Time: 1 hour 30 minutes

Instructions and Information

- Full marks may be obtained for answers to ALL questions.
- The formulae booklet, available from AQA, may be used.
- 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 may use a graphical calculator in this paper.
- The total number of marks for this paper is 75.

Advice to Candidates

You must show sufficient working to make your methods clear to an examiner. Answers without working may gain no credit.

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- 1. A curve has equation (x 2)(y + 5) = 12.
 - (a) Find an expression for $\frac{dy}{dx}$ in terms of x and y. (2 marks)
 - (b) Find the equation of the normal to the curve at the point (4, 1). (3 marks)
- **2.** Simplify

$$\frac{4x^2 - 25}{x^2 + x} \div \frac{2x^2 - x - 10}{x^2 + 3x + 2}.$$
 (5 marks)

- 3. (a) Expand $(1+8x)^{\frac{1}{2}}$ in ascending powers of x, up to and including the term in x^3 . (3 marks)
 - (b) State the set of values of x for which the expansion is valid. (1 mark)
 - (c) In the expansion of

$$(1+ax)(1+8x)^{\frac{1}{2}},$$

the coefficients of the x term and the x^2 term are equal.

Find the value of a and hence find the coefficient of the term in x^3 . (6 marks)

4. A radioactive substance is decaying exponentially. After t years its mass m grams is given by

$$m = 500 \,\mathrm{e}^{-0.02t}$$

- (a) Find the value of m when t = 10. (1 mark)
- (b) Find the value of t when m = 300. (2 marks)
- (c) Find the rate at which the mass is decreasing when t = 1. (3 marks)
- 5. (a) Given that $\cot x = \frac{4}{3}$ and that x is a reflex angle, find the exact value of cosec x (4 marks)
 - (b) Find the exact value of $\cos 2x$. (3 marks)
 - (c) Find the exact value of $\tan 2x$. (3 marks)

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6. The parametric equations of a curve are

$$x = \sin \theta$$
, $y = 2\cos^2 \theta$, $0 \le \theta \le \frac{\pi}{2}$.

- (a) Find the equation of the tangent to the curve at the point where $\theta = \frac{\pi}{6}$. (5 marks)
- (b) Find the cartesian equation of the curve. (2 marks)
- 7. (a) Express $\frac{1}{(y-1)y}$ in partial fractions. (3 marks)
 - (b) Given that y = 5 when x = 0, show that the solution of the differential equation

$$\frac{dy}{dx} = (y^2 - y)\cos x$$

may be written as $y = \frac{5}{5 - 4e^{\sin x}}$ (7 marks)

- 8. The position vectors of three points are
 - A: 5i + 6j + 2kB: 7i + 9j + 3kC: 6i + 6j + 6k
 - (a) Find a vector equation of the line AB (3 marks)
 - (b) Show that the vector $12\mathbf{i} 7\mathbf{j} 3\mathbf{k}$ is perpendicular to the line AC. (2 marks)
 - (c) Find the angle *BAC*, giving your answer to the nearest degree. (4 marks)
- 9. (a) Express $f(x) = \sqrt{3} \sin x + \cos x$ in the form $R \cos(x \alpha)$, where R > 0 and $0 < \alpha < \frac{\pi}{2}$. The values of R and α are to be given exactly. (4 marks)
 - (b) Hence solve the equation

$$\sqrt{3}\sin x + \cos x = \sqrt{2}$$
, where $0 < x < \pi$. (6 marks)

(c) You are given that y = 2f(x) + 1. State the maximum and minimum values of y. (3 marks)

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