Core Mathematics C4 For Edexcel Advanced Level

Paper B
Time: 1 hour 30 minutes

Instructions and Information

Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration.

Full marks may be obtained for answers to ALL questions.

The booklet 'Mathematical Formulae and Statistical Tables', available from Edexcel, may be used.

When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Advice to Candidates

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

Published by Elmwood Press
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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)**

(b) Find the equation of the normal to the curve at the point (4, 1). **(3)**

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2. At time t seconds, a circular ink blot has radius r cm and area A cm^2.

(a) Find $\frac{dA}{dr}$ in terms of r. **(1)**

(b) The radius is increasing at a rate of $\frac{1}{4}$ cm per second.
Find the rate at which the area is increasing at the moment when the radius is 3 cm.
Give your answer in terms of π. **(4)**

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3. (a) Expand $(1 + 8x)^{\frac{1}{2}}$ in ascending powers of x, up to and including the term in x^3. **(3)**

(b) State the set of values of x for which the expansion is valid. **(1)**

(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)**

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

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

(a) Find the value of m when $t = 10$. **(1)**

(b) Find the value of t when $m = 300$. **(2)**

(c) Find the rate at which the mass is decreasing when $t = 1$. **(3)**

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5. (*a*) Work out

(i) $\int (e^x + 1)(e^{-x} + 1)\mathrm{d}x$ **(2)**

(ii) $\int \frac{1}{\sqrt{6x - 1}}\,\mathrm{d}x$ **(3)**

(*b*) Evaluate $\int_0^{\frac{\pi}{6}} x \cos x \,\mathrm{d}x$, giving your answer in an exact form. **(5)**

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6. The parametric equations of a curve are

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

(*a*) Find the equation of the tangent to the curve at the point where $\theta = \frac{\pi}{6}$. **(5)**

(*b*) Find the cartesian equation of the curve. **(2)**

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7. (*a*) Express $\frac{1}{(y-1)y}$ in partial fractions. **(3)**

(*b*) Given that $y = 5$ when $x = 0$, show that the solution of the differential equation

$$\frac{\mathrm{d}y}{\mathrm{d}x} = (y^2 - y)\cos x$$

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

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8. The position vectors of three points are

A: $5\mathbf{i} + 6\mathbf{j} + 2\mathbf{k}$
B: $7\mathbf{i} + 9\mathbf{j} + 3\mathbf{k}$
C: $6\mathbf{i} + 6\mathbf{j} + 6\mathbf{k}$

(*a*) Find a vector equation of the line *AB* **(3)**

(*b*) Show that the vector $12\mathbf{i} - 7\mathbf{j} - 3\mathbf{k}$ is perpendicular to the line *AC*. **(2)**

(*c*) Find the angle *BAC*, giving your answer to the nearest degree. **(4)**

9.

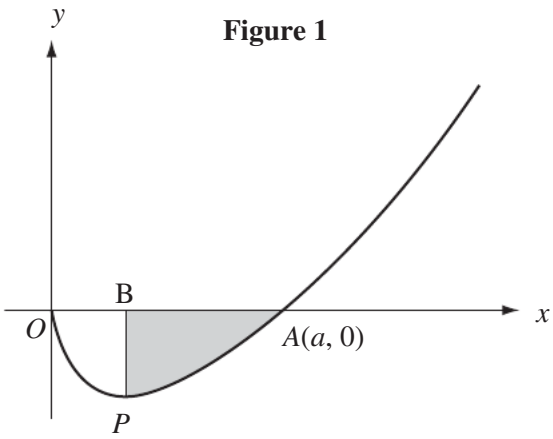

Figure 1

Figure 1 shows the curve with equation $y = x \ln x$, $x > 0$. The curve has a minimum point at P and crosses the x-axis at $A(a, 0)$. The line PB is parallel to the y-axis.

(a) Find the value of a. **(1)**

(b) Show that the x-coordinate of P is $\frac{1}{e}$ and find the y-coordinate of P. **(5)**

(c) Find the area of the shaded region in Figure 1. **(6)**

END **TOTAL 75 MARKS**