

# Core Mathematics C4                      For Edexcel Advanced Level

## Paper B

**Time: 1 hour 30 minutes**

### *Instructions and Information*

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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*

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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)

(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<sup>2</sup>.

(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  $\pi$ . (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

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

(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

$$(i) \int (e^x + 1)(e^{-x} + 1) dx \quad (2)$$

$$(ii) \int \frac{1}{\sqrt{6x-1}} dx \quad (3)$$

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


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6. The parametric equations of a curve are

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

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

$$(b) \text{ Find the cartesian equation of the curve.} \quad (2)$$


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

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

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

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


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8. The position vectors of three points are

$$A: 5\mathbf{i} + 6\mathbf{j} + 2\mathbf{k}$$

$$B: 7\mathbf{i} + 9\mathbf{j} + 3\mathbf{k}$$

$$C: 6\mathbf{i} + 6\mathbf{j} + 6\mathbf{k}$$

$$(a) \text{ Find a vector equation of the line } AB \quad (3)$$

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

$$(c) \text{ Find the angle } BAC, \text{ giving your answer to the nearest degree.} \quad (4)$$


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9.

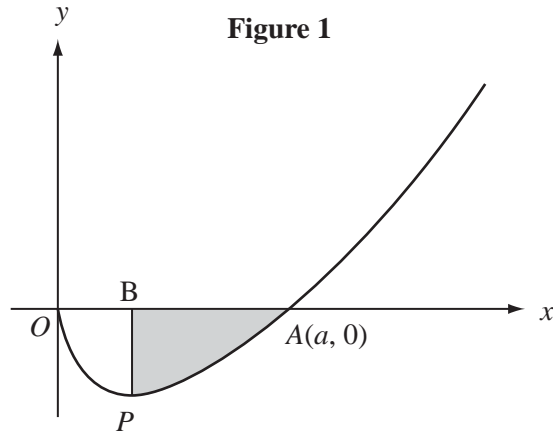


Figure 1 shows the curve with equation  $y = x \ln x$ ,  $x > 0$ . The curve has a minimum point at  $P$  and crosses the  $x$ -axis at  $A(a, 0)$ . The line  $PB$  is parallel to the  $y$ -axis.

- (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