Elmwood Press

Core Mathematics C4

Paper F

(Question Paper)

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Core Mathematics C4 For Edexcel Advanced Level

Paper F
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.

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1. The parametric equations of a curve are

$$x = 2t - \cos t, \quad y = 1 + \sin t, \quad 0 \leq t \leq 2\pi.$$

Find the coordinates of the stationary points on the curve.

(5)

2.

$$\mathrm{f}(x) = \frac{2+x}{3+x} - \frac{2-x}{3-x}.$$

(*a*) Show that $\mathrm{f}(x)$ may be expressed as $\dfrac{2x}{9-x^2}$.

(2)

(*b*) Show that, when the term in x^7 and higher powers of x are neglected,

$$\mathrm{f}(x) = \frac{2}{9}x + \frac{2}{81}x^3 + \frac{2}{729}x^5.$$

(4)

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3. At time t hours the mass of bacteria in a culture is m milligrams. At time $t = 0$, $m = 4$ and $\dfrac{\mathrm{d}m}{\mathrm{d}t} = 8$.

A model for the growth of the bacteria is given by $m = A\mathrm{e}^{kt}$, where A and k are constants.

(*a*) Work out $\dfrac{\mathrm{d}m}{\mathrm{d}t}$ in terms of A, k and t and hence find the values of A and k.

(5)

(*b*) Find the value of t when $m = 20$.

(3)

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4. Find the equation of the tangent to the curve

$$x^2 + xy + y^2 = 7$$

at the point (1, 2).

(6)

5.

Figure 1

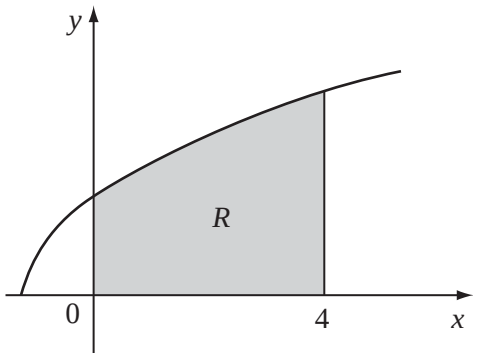

Figure 1 shows a sketch of the curve $y = \sqrt{2x + 1}$. The region R is bounded by the curve, the x-axis and the lines $x = 0$ and $x = 4$.

(a) Find the area of R. **(4)**

(b) The region R is rotated through 360° about the x-axis. Find the volume of the solid formed. **(4)**

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6. (a) Find the coordinates of the point of intersection of the lines

$$\mathbf{r} = \begin{pmatrix} 2 \\ 3 \\ -1 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 4 \\ 2 \end{pmatrix} \quad \text{and} \quad \mathbf{r} = \begin{pmatrix} -3 \\ 4 \\ -2 \end{pmatrix} + \mu \begin{pmatrix} 2 \\ 1 \\ 1 \end{pmatrix}$$ **(4)**

(b) Find the angle, to the nearest degree, between the two lines in part (a). **(4)**

(c) Find the coordinates of the point where the line

$$\mathbf{r} = \begin{pmatrix} 2 \\ 3 \\ -1 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 4 \\ 2 \end{pmatrix} \text{ meets the } yz - \text{plane.}$$ **(2)**

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7. (a) Show that

$$\int_a^{a+h} \left(x^2 - a^2\right) \mathrm{d}x = \frac{h^2}{3}(3a + h).$$ **(4)**

(b) Find $\int \tan^2 x \ \mathrm{d}x$. **(2)**

(c) Find $\int_0^{\frac{\pi}{3}} x \sec^2 x \ \mathrm{d}x$. **(5)**

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8. (*a*) Use the trapezium rule, with three strips, to show that

$$\int_0^3 \frac{4}{x+3}\,\mathrm{d}x \approx \frac{14}{5}.$$

(4)

(*b*) Show that the exact value of $\int_0^3 \frac{4}{x+3}\,\mathrm{d}x$ is $\ln 16$.

(3)

(*c*) Sketch the graph of $y = \frac{4}{x+3}$, for $x \geq 0$, and explain how it shows that $\ln 16 < \frac{14}{5}$.

(3)

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9. (*a*) Evaluate $\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \cot x\,\mathrm{d}x$.

(4)

(*b*) Solve the differential equation

$$(1+x)\frac{\mathrm{d}y}{\mathrm{d}x} = (1-x)y,$$

given that $y = 4$ when $x = 0$.

(7)

END **TOTAL 75 MARKS**