

# Core Mathematics C3 Advanced Level

# For Edexcel

## Paper K

**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. Express as a single fraction

$$\frac{2x^2 + x - 6}{4x^2 - 9} \times \frac{x - 1}{(x + 2)^2}. \quad (5)$$


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2. The functions  $f$  and  $g$  are defined by

$$f: x \mapsto x + 2, \quad x \in \mathbb{R}$$

$$g: x \mapsto \frac{2}{x - 3}, \quad x \in \mathbb{R}, \quad x \neq 3.$$

(a) Express the functions  $gf$  and  $fg$  in the form : ' $x \mapsto$ '. In each case give the domain of the combined function. (4)

(b) Show that there are no real values of  $x$  which satisfy the equation

$$fg(x) = gf(x). \quad (3)$$


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3. Differentiate with respect to  $x$ ,

(a)  $\frac{x}{1 - x^2},$  (3)

(b)  $x^2 \ln x,$  (3)

(c)  $e^{\sin x}.$  (3)

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4. (a) Prove that

$$\operatorname{cosec} \theta - \sin \theta \geq 0 \quad \text{for all } \theta \text{ in the range} \quad 0 < \theta < \pi. \quad (4)$$

(b) Find the values of  $x$ ,  $0 < x \leq 360$ , which satisfy the equation

$$\sec^2 x - 4 \tan x + 2 = 0. \quad (5)$$


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5. The curve

$$y = \frac{1}{4}x^4 + x^3 - 3x$$

has three turning points.

(a) Show that one of these turning points has an  $x$  coordinate of  $\alpha$  where  $\alpha$  lies in the interval  $[0, 1]$ . (4)

(b) Show that the equation

$$x^3 + 3x^2 - 3 = 0$$

can be written as

$$x = \sqrt{\frac{3}{x+3}} \tag{2}$$

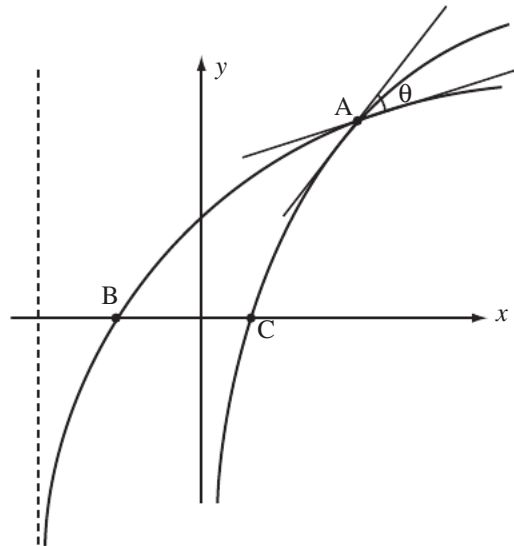
(c) Using the iteration

$$x_{n+1} = \sqrt{\frac{3}{x_n+3}}, \quad \text{with } x_0 = 1,$$

find the values of  $x_1, x_2, x_3$  and  $x_4$ . (2)

(d) Hence give the value of  $\alpha$  to 3 decimal places. (1)

6.



The figure shows the curves  $y = \ln 3x$  and  $y = \ln(x + 2)$  intersecting at  $A$ , and crossing the  $x$ -axis at  $B$  and  $C$ .

(a) Write down the equations of the asymptotes to each curve. (2)

(b) Write down the coordinates of the points  $B$  and  $C$ . (2)

(c) Find the coordinates of the point  $A$ . (1)

The angle between the tangents to both curves at the point  $A$  is  $\theta$ .

(d) Prove that  $\theta = \arctan \left( \frac{1}{2} \right)$ . (6)

7. (a) Letting  $A + B = P$ , and  $A - B = Q$  and using the expansions for  $\sin(A \pm B)$ ,  
prove that

$$\sin P - \sin Q = 2 \cos \left( \frac{P + Q}{2} \right) \sin \left( \frac{P - Q}{2} \right). \quad (5)$$

- (b) Hence or otherwise solve the equation,

$$\sin 4\theta - \sin 2\theta + \cos 3\theta = 0, \quad \text{for } 0 < \theta < 360^\circ. \quad (6)$$

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8. You are given that

$$f(x) = x^2 - 3x, \quad x \in \mathbb{R}, \quad x \geq 1\frac{1}{2}.$$

- (a) Find the range of  $f$ . (1)
- (b) Write down the domain and range of  $f^{-1}$ . (2)
- (c) Sketch the graph of  $f^{-1}$ , indicating clearly the coordinates of any point at which the graph intersects the coordinate axes. (4)

Given that  $g(x) = |x - 4|$ ,  $x \in \mathbb{R}$ ,

- (d) find an expression for  $gf(x)$ . (2)
- (e) Solve  $gf(x) = 6$ . (5)
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**END**

**TOTAL 75 MARKS**