FOR EDEXCEL

## GCE Examinations Advanced Subsidiary

## **Core Mathematics C4**

Paper K

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.

Mathematical formulae and statistical tables are available.

This paper has seven questions.

## 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.

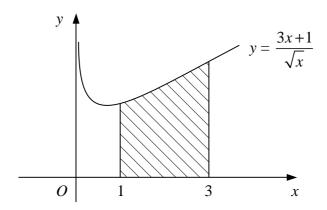


Figure 1

Figure 1 shows the curve with equation  $y = \frac{3x+1}{\sqrt{x}}$ , x > 0.

The shaded region is bounded by the curve, the x-axis and the lines x = 1 and x = 3.

Find the volume of the solid formed when the shaded region is rotated through  $2\pi$  radians about the x-axis, giving your answer in the form  $\pi(a + \ln b)$ , where a and b are integers. (6)

2.	(a)	Expand $(1-3x)^{-2}$ , $ x  < \frac{1}{3}$ , in ascending powers of x up to and including the	
		term in $x^3$ , simplifying each coefficient.	(4)
	<i>(b)</i>	Hence, or otherwise, show that for small $x$ ,	
		$\left(\frac{2-x}{1-3x}\right)^2 \approx 4 + 20x + 85x^2 + 330x^3.$	(3)

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3.	$f(x) = \frac{7 + 3x + 2x^2}{(1 - 2x)(1 + x)^2},$	$ x  > \frac{1}{2}$
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- (a) Express f(x) in partial fractions. (4)
- (b) Show that

$$\int_1^2 f(x) dx = p - \ln q,$$

where p is rational and q is an integer. (7)

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**4.** Relative to a fixed origin, two lines have the equations

$$\mathbf{r} = \begin{pmatrix} 7 \\ 0 \\ -3 \end{pmatrix} + \lambda \begin{pmatrix} 5 \\ 4 \\ -2 \end{pmatrix}$$

and

$$\mathbf{r} = \begin{pmatrix} a \\ 6 \\ 3 \end{pmatrix} + \mu \begin{pmatrix} -5 \\ 14 \\ 2 \end{pmatrix},$$

where a is a constant and  $\lambda$  and  $\mu$  are scalar parameters.

Given that the two lines intersect,

- (a) find the position vector of their point of intersection, (5)
- (b) find the value of a. (2)

Given also that  $\theta$  is the acute angle between the lines,

(c)	find the value of $\cos \theta$ in the form $k\sqrt{5}$ where k is rational.	(4)

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**(4)** 

**5.** A curve has the equation

(c)

$$x^2 - 4xy + 2y^2 = 1.$$

- (a) Find an expression for  $\frac{dy}{dx}$  in its simplest form in terms of x and y. (5)
- (b) Show that the tangent to the curve at the point P(1, 2) has the equation

$$3x - 2y + 1 = 0. (3)$$

The tangent to the curve at the point Q is parallel to the tangent at P.

Find the coordinates of Q.

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6.	The rate of increase in the number of bacteria in a culture, $N$ , at time $t$ hours is		Leave blank
	proportional to $N$ .		
	(a) Write down a differential equation connecting N and t.	(1)	
	Given that initially there are $N_0$ bacteria present in a culture,		
	(b) Show that $N = N_0 e^{kt}$ , where k is a positive constant.	(6)	
	Given also that the number of bacteria present doubles every six hours,		
	(c) find the value of $k$ ,	(3)	
	(d) find how long it takes for the number of bacteria to increase by a factor of ten, giving your answer to the nearest minute.	(3)	

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7. A curve has parametric equations

$$x = \sec \theta + \tan \theta$$
,  $y = \csc \theta + \cot \theta$ ,  $0 < \theta < \frac{\pi}{2}$ .

(a) Show that 
$$x + \frac{1}{x} = 2 \sec \theta$$
. (5)

Given that  $y + \frac{1}{y} = 2 \csc \theta$ ,

(c) Show that 
$$\frac{\mathrm{d}x}{\mathrm{d}\theta} = \frac{1}{2}(x^2 + 1)$$
. (3)

(d) Find an expression for 
$$\frac{dy}{dx}$$
 in terms of x and y. (4)

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