Paper Reference (complete below)	Centre No.	Surname	Initial(s)
6 6 6 3 / 0 1	Candidate No.	Signature	

Paper Reference(s)

6663

Edexcel GCE

Core Mathematics C4

Advanced Subsidiary

Set A: Practice Paper 3

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
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7	
8	
9	
Total	

Materials required for examination
Mathematical Formulae

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature. You must write your answer for each question in the space following the question. If you need more space to complete your answer to any question, use additional answer sheets.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
This paper has nine questions.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the examiner.
Answers without working may gain no credit.

Turn over

1. The following is a table of values for $y = \sqrt{(1 + \sin x)}$, where x is in radians.

x	0	0.5	1	1.5	2
y	1	1.216	p	1.413	q

(a) Find the value of p and the value of q.

(2)

(b) Use the trapezium rule and all the values of y in the completed table to obtain an estimate of I, where

$$I = \int_0^2 \sqrt{(1 + \sin x)}\, dx.$$

(4)

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2. (a) Use integration by parts to find

$$\int x \cos 2x \, dx.$$

(4)

(b) Prove that the answer to part (a) may be expressed as

$$\tfrac{1}{2} \sin x \,(2x \cos x - \sin x) + C,$$

where C is an arbitrary constant.

(3)

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3. (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 term.

(4)

(b) Hence, or otherwise, find the first three terms in the expansion of $\dfrac{x+4}{(1+3x)^2}$ as a series in ascending powers of x.

(4)

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4. Relative to a fixed origin O, the point A has position vector $4\mathbf{i} + 8\mathbf{j} - \mathbf{k}$, and the point B has position vector $7\mathbf{i} + 14\mathbf{j} + 5\mathbf{k}$.

(*a*) Find the vector $\overrightarrow{AB}$.

(1)

(*b*) Calculate the cosine of $\angle OAB$.

(3)

(*c*) Show that, for all values of λ, the point P with position vector $\lambda\mathbf{i} + 2\lambda\mathbf{j} + (2\lambda - 9)\mathbf{k}$ lies on the line through A and B.

(3)

(*d*) Find the value of λ for which OP is perpendicular to AB.

(3)

(*e*) Hence find the coordinates of the foot of the perpendicular from O to AB.

(2)

5.

Figure 1

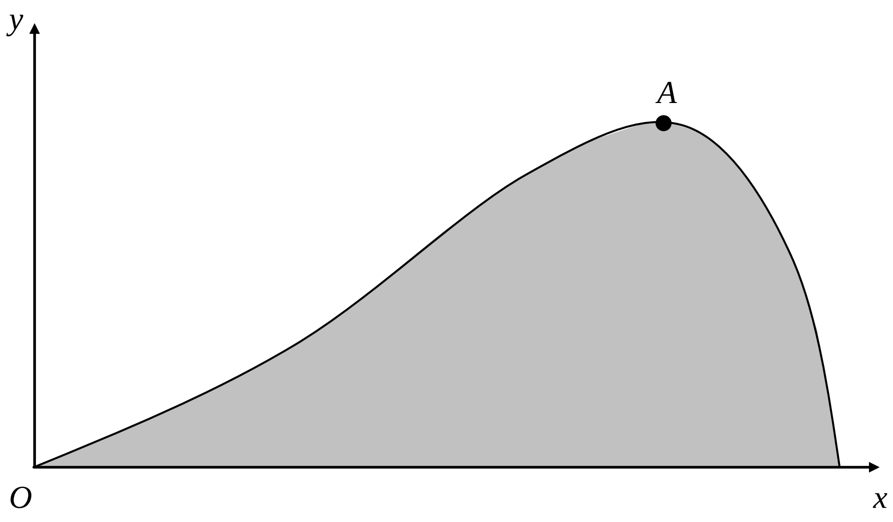

Figure 1 shows a graph of $y = x\sqrt{\sin x}$, $0 < x < \pi$. The maximum point on the curve is A.

(*a*) Show that the x-coordinate of the point A satisfies the equation $2\tan x + x = 0$.

(4)

The finite region enclosed by the curve and the x-axis is shaded as shown in Fig. 1.

A solid body S is generated by rotating this region through 2π radians about the x-axis.

(*b*) Find the exact value of the volume of S.

(7)

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6. A radioactive isotope decays in such a way that the rate of change of the number N of radioactive atoms present after t days, is proportional to N.

(*a*) Write down a differential equation relating N and t.

(2)

(*b*) Show that the general solution may be written as $N = Ae^{-kt}$, where A and k are positive constants.

(5)

Initially the number of radioactive atoms present is 7×10^{18} and 8 days later the number present is 3×10^{17}.

(*c*) Find the value of k.

(3)

(*d*) Find the number of radioactive atoms present after a further 8 days.

(2)

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7. Given that

$$\frac{10(2-3x)}{(1-2x)(2+x)} \equiv \frac{A}{1-2x} + \frac{B}{2+x},$$

(*a*) find the values of the constants A and B.

(3)

(*b*) Hence, or otherwise, find the series expansion in ascending powers of x, up to and including the term in x^3, of $\frac{10(2-3x)}{(1-2x)(2+x)}$, for $|x| < \frac{1}{2}$.

(5)

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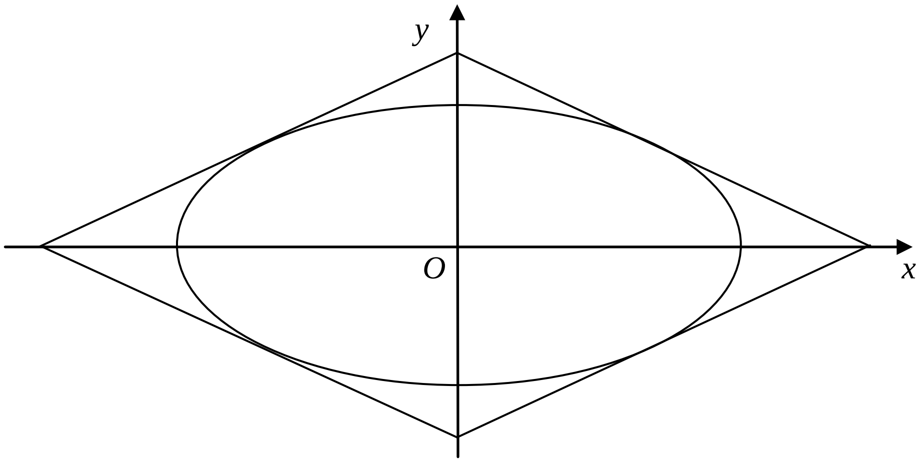
8. **Figure 1**



A table top, in the shape of a parallelogram, is made from two types of wood. The design is shown in Fig. 1. The area inside the ellipse is made from one type of wood, and the surrounding area is made from a second type of wood.

The ellipse has parametric equations,

$$x = 5\cos\theta, \quad y = 4\sin\theta, \quad 0 \le \theta < 2\pi.$$

The parallelogram consists of four line segments, which are tangents to the ellipse at the points where $\theta = \alpha$, $\theta = -\alpha$, $\theta = \pi - \alpha$, $\theta = -\pi + \alpha$.

(*a*) Find an equation of the tangent to the ellipse at $(5\cos\alpha, 4\sin\alpha)$, and show that it can be written in the form

$$5y\sin\alpha + 4x\cos\alpha = 20.$$

(4)

(*b*) Find by integration the area enclosed by the ellipse.

(4)

(*c*) Hence show that the area enclosed between the ellipse and the parallelogram is

$$\frac{80}{\sin 2\alpha} - 20\pi.$$

(4)

(*d*) Given that $0 < \alpha < \frac{\pi}{4}$, find the value of α for which the areas of two types of wood are equal.

(3)

END