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Edexcel GCE

Centre Number | | | | | |

Candidate Number | | | | |

Core Mathematics C4

Advanced

Friday 22 June 2018 – Morning
Time: 1 hour 30 minutes

Paper Reference
6666/01

You must have:
Mathematical Formulae and Statistical Tables (Pink)

Total Marks

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
  – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- The total mark for this paper is 75.
- The marks for **each** question are shown in brackets
  – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1. (a) Find the binomial series expansion of

$$\sqrt{4-9x}, \quad |x| < \frac{4}{9}$$

in ascending powers of x, up to and including the term in x^2
Give each coefficient in its simplest form.

(5)

(b) Use the expansion from part (a), with a suitable value of x, to find an approximate value for $\sqrt{310}$
Show all your working and give your answer to 3 decimal places.

(3)

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Question 1 continued

Q1

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2. The curve C has equation

$$x^2 + xy + y^2 - 4x - 5y + 1 = 0$$

(a) Use implicit differentiation to find $\frac{dy}{dx}$ in terms of x and y.

(5)

(b) Find the x coordinates of the two points on C where $\frac{dy}{dx} = 0$

Give exact answers in their simplest form.
(*Solutions based entirely on graphical or numerical methods are not acceptable.*)

(5)

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Question 2 continued

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Q2

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3. (i) Given that

$$\frac{13 - 4x}{(2x + 1)^2(x + 3)} \equiv \frac{A}{(2x + 1)} + \frac{B}{(2x + 1)^2} + \frac{C}{(x + 3)}$$

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

(4)

(b) Hence find

$$\int \frac{13 - 4x}{(2x + 1)^2(x + 3)} \, dx, \quad x > -\frac{1}{2}$$

(3)

(ii) Find

$$\int (e^x + 1)^3 \, dx$$

(3)

(iii) Using the substitution $u^3 = x$, or otherwise, find

$$\int \frac{1}{4x + 5x^{\frac{1}{3}}} \, dx, \quad x > 0$$

(4)

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Question 3 continued

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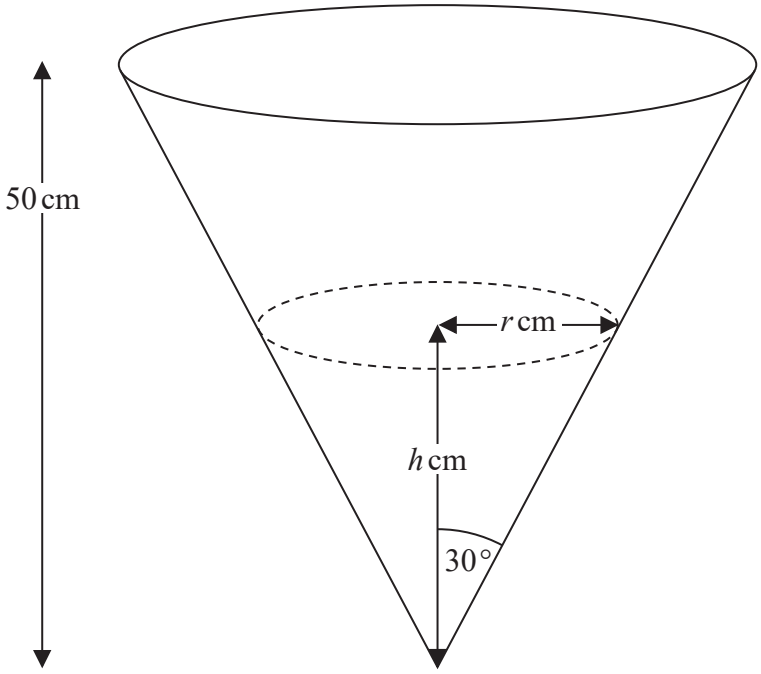

Diagram not drawn to scale

Figure 1

A water container is made in the shape of a hollow inverted right circular cone with semi-vertical angle of 30°, as shown in Figure 1. The height of the container is 50 cm.

When the depth of the water in the container is h cm, the surface of the water has radius r cm and the volume of water is V cm^3.

(a) Show that $V = \frac{1}{9}\pi h^3$

[*You may assume the formula* $V = \frac{1}{3}\pi r^2 h$ *for the volume of a cone.*]

(2)

Given that the volume of water in the container increases at a constant rate of 200 cm^3 s^{-1},

(b) find the rate of change of the depth of the water, in cm s^{-1}, when $h = 15$
Give your answer in its simplest form in terms of π.

(4)

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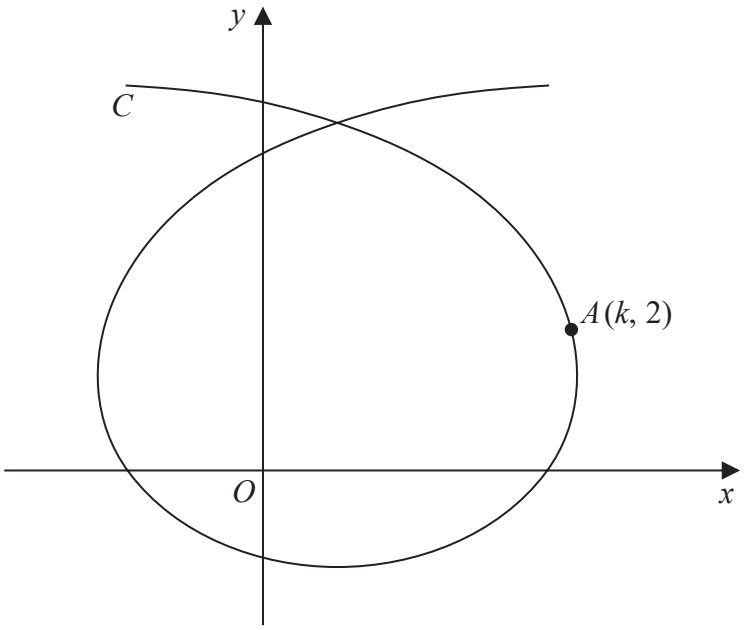

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Figure 2

Figure 2 shows a sketch of the curve C with parametric equations

$$x = 1 + t - 5\sin t, \quad y = 2 - 4\cos t, \quad -\pi \leqslant t \leqslant \pi$$

The point A lies on the curve C.

Given that the coordinates of A are $(k, 2)$, where $k > 0$

(a) find the exact value of k, giving your answer in a fully simplified form.

(2)

(b) Find the equation of the tangent to C at the point A.
Give your answer in the form $y = px + q$, where p and q are exact real values.

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6. Given that $y = 2$ when $x = -\frac{\pi}{8}$, solve the differential equation

$$\frac{dy}{dx} = \frac{y^2}{3\cos^2 2x} \qquad -\frac{1}{2} < x < \frac{1}{2}$$

giving your answer in the form $y = f(x)$.

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7. The point A with coordinates $(-3, 7, 2)$ lies on a line l_1
The point B also lies on the line l_1

Given that $\overrightarrow{AB} = \begin{pmatrix} 4 \\ -6 \\ 2 \end{pmatrix}$,

(a) find the coordinates of point B.

(2)

The point P has coordinates $(9, 1, 8)$

(b) Find the cosine of the angle PAB, giving your answer as a simplified surd.

(3)

(c) Find the exact area of triangle PAB, giving your answer in its simplest form.

(3)

The line l_2 passes through the point P and is parallel to the line l_1

(d) Find a vector equation for the line l_2

(2)

The point Q lies on the line l_2

Given that the line segment AP is perpendicular to the line segment BQ,

(e) find the coordinates of the point Q.

(5)

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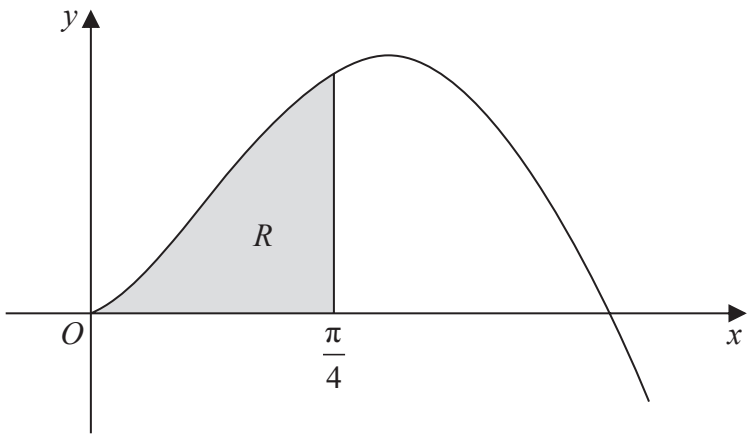

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Figure 3

(a) Find $\int x\cos 4x\,\mathrm{d}x$

(3)

Figure 3 shows part of the curve with equation $y = \sqrt{x}\sin 2x, \quad x \geqslant 0$

The finite region R, shown shaded in Figure 3, is bounded by the curve, the x-axis and the line with equation $x = \frac{\pi}{4}$

The region R is rotated through 2π radians about the x-axis to form a solid of revolution.

(b) Find the exact value of the volume of this solid of revolution, giving your answer in its simplest form.
(*Solutions based entirely on graphical or numerical methods are not acceptable.*)

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TOTAL FOR PAPER: 75 MARKS

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