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1. The curve C has equation

$$2x - 4y^2 + 3x^2y = 4x^2 + 8$$

The point $P(3, 2)$ lies on C.

Find the equation of the normal to C at the point P, writing your answer in the form $ax + by + c = 0$ where a, b and c are integers to be found.

(7)

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1.

$$f(x) = \frac{5x + 10}{(1 - x)(2 + 3x)}$$

(a) Write $f(x)$ in partial fraction form.

(3)

(b) (i) Hence find, in ascending powers of x up to and including the terms in x^2, the binomial series expansion of $f(x)$. Give each coefficient as a simplified fraction.

(5)

(ii) Find the range of values of x for which this expansion is valid.

(1)

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1. (a) Find the first 4 terms of the binomial expansion, in ascending powers of x, of

$$\frac{2}{\sqrt{9 - 2x}} \qquad |x| < \frac{9}{2}$$

giving each coefficient as a simplified fraction.

(5)

By substituting $x = 1$ into the answer to part (a),

(b) find an approximation for $\sqrt{7}$, giving your answer to 4 decimal places.

(2)

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8. (a) Find, in ascending powers of x, the first three non-zero terms of the binomial series expansion of

$$\frac{1}{\sqrt{4+x}}$$

giving each coefficient as a simplified fraction.

(4)

Using the expansion from part (a),

(b) state the first three non-zero terms of the binomial series expansion of $\frac{1}{\sqrt{4-x}}$

(1)

(c) Hence, or otherwise, show that

$$\frac{1}{\sqrt{4+x}} \times \frac{1}{\sqrt{4-x}} \approx a + bx^2$$

where a and b are fully simplified fractions to be found.

(2)

(d) Use

$$\frac{1}{\sqrt{4+x}} \times \frac{1}{\sqrt{4-x}} = a + bx^2$$

with $x = 1$ and the values of a and b to find a fully simplified rational approximation for $\sqrt{135}$

Show your working and make your method clear.

(3)

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9.

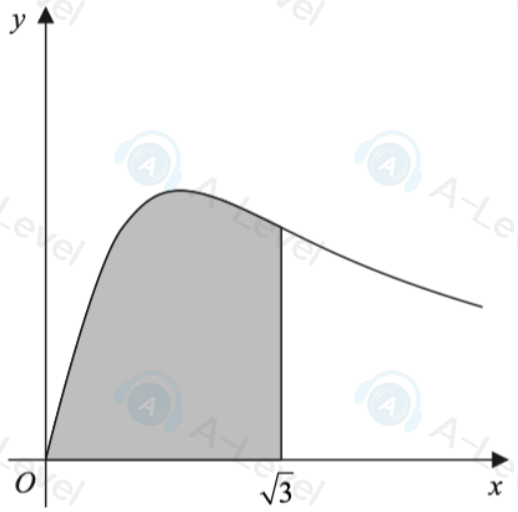

Figure 3

Figure 3 shows a sketch of part of the curve with parametric equations

$$x = \tan\theta \qquad y = 2\sin 2\theta \qquad \theta \geqslant 0$$

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

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

(a) Show that the exact volume of this solid of revolution is given by

$$\int_0^k p(1 - \cos 2\theta)\, \mathrm{d}\theta$$

where p and k are constants to be found.

(7)

(b) Hence find, by algebraic integration, the exact volume of this solid of revolution.

(3)

1. Find, in ascending powers of x up to and including the term in x^3, the binomial expansion of

$$(1 - 4x)^{-3} \qquad |x| < \frac{1}{4}$$

fully simplifying each term.

(4)

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3. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

A curve C has equation

$$3^x + 6y = \frac{3}{2}xy^2$$

Find the exact value of $\frac{dy}{dx}$ at the point on C with coordinates $(2, 3)$. Give your answer in the form $\frac{a + \ln b}{8}$, where a and b are integers.

(7)

(Total for Question 3 is 7 marks)