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

$$(8 + 32x)^{\frac{1}{3}} \qquad |x| < \frac{1}{4}$$

giving each term in simplest form.

(4)

(Total for Question 1 is 4 marks)

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2. Given that

$$\frac{2x^2 - x + 11}{(x + 2)(2x - 3)} \equiv A + \frac{B}{x + 2} + \frac{C}{2x - 3}$$

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

(4)

(b) Hence find

$$\int \frac{2x^2 - x + 11}{(x + 2)(2x - 3)} \mathrm{d}x$$

(3)

(Total for Question 2 is 7 marks)

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3. A solid metal cube is being heated and is expanding.

The volume of the cube is increasing at a constant rate of $0.085\ \text{cm}^3\,\text{s}^{-1}$

At time t seconds,

- the side length of the cube is x cm
- the volume of the cube is V cm^3

At the instant the volume of the cube is $100\ \text{cm}^3$, the side length is increasing at a rate of $k\ \text{cm}\,\text{s}^{-1}$

Find the value of k, giving your answer to 3 significant figures.

(4)

(Total for Question 3 is 4 marks)

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4. The curve C has parametric equations

$$x = \frac{3}{5t-2} \qquad y = \frac{t}{4-t} \qquad t \in \mathbb{R} \qquad t \neq \frac{2}{5} \qquad t \neq 4$$

(a) Show that the Cartesian equation of C is

$$y = \frac{ax+b}{cx+d} \qquad x \neq -\frac{d}{c}$$

where a, b, c and d are integers to be found.

(3)

The line l has equation $y = -x + 1$

(b) Use algebra to prove by contradiction that l and C do not intersect.

(4)

(Total for Question 4 is 7 marks)

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5. Use the substitution $u = \sqrt{2x-1}$ to show that

$$\int \frac{x}{\sqrt{2x-1}}\,\mathrm{d}x = A(2x-1)^{\frac{1}{2}}(x+B) + k$$

where A and B are constants to be found, and k is an arbitrary constant.

(5)

(Total for Question 5 is 5 marks)

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

The curve C has equation

$$x^2 - xy + y^2 + 4x = 12$$

(a) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$ in terms of x and y.

(4)

Given that the point $P(-4, -6)$ lies on C,

(b) find the equation of the normal to C at P, giving the answer in the form $y = mx + c$ where m and c are constants.

(3)

The normal to C at P intersects C again at the point Q.

(c) Find the exact coordinates of Q.

(3)

(Total for Question 6 is 10 marks)