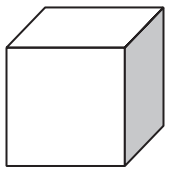
2.



x cm

Figure 1

Figure 1 shows a cube which is increasing in size.

At time t seconds,

- the length of each edge of the cube is x cm
- the surface area of the cube is S cm^2
- the volume of the cube is V cm^3

Given that the surface area of the cube is increasing at a constant rate of $4\,\text{cm}^2\,\text{s}^{-1}$

(a) show that $\dfrac{\mathrm{d}x}{\mathrm{d}t} = \dfrac{k}{x}$ where k is a constant to be found,

(4)

(b) show that $\dfrac{\mathrm{d}V}{\mathrm{d}t} = V^p$ where p is a constant to be found.

(3)

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Question 2 continued

(Total for Question 2 is 7 marks)

3. **In this question you must show all stages of your working.**

Solutions based on calculator technology are not acceptable.

(i) Use integration by parts to find the exact value of

$$\int_0^4 x^2 e^{2x}\, dx$$

giving your answer in simplest form.

(5)

(ii) Use integration by substitution to show that

$$\int_3^{\frac{21}{2}} \frac{4x}{(2x-1)^2}\, dx = a + \ln b$$

where a and b are constants to be found.

(7)

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