2:

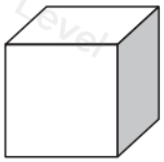

Figure 1

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 volume of the cube is V cm^3

Given that the volume of the cube is increasing at a constant rate of $5\,\text{cm}^3\text{s}^{-1}$

(a) find $\frac{dx}{dt}$ giving your answer in terms of x.

(3)

(b) Hence find the value of $\frac{dx}{dt}$ when $V = 64$

(2)

7. The current, x amps, at time t seconds after a switch is closed in a particular electric circuit is modelled by the equation

$$\frac{dx}{dt} = k - 3x$$

where k is a constant.

Initially there is zero current in the circuit.

(a) Solve the differential equation to find an equation, in terms of k, for the current in the circuit at time t seconds.
Give your answer in the form $x = f(t)$.

(6)

Given that in the long term the current in the circuit approaches 7 amps,

(b) find the value of k.

(2)

(c) Hence find the time in seconds it takes for the current to reach 5 amps, giving your answer to 2 significant figures.

(3)

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

Use the substitution $x = 4\sin\theta$ to find the exact value of

$$\int_2^{2\sqrt{3}} \frac{1}{\left(16 - x^2\right)^{\frac{3}{2}}}\,dx$$

(6)