12. (a) Express $\dfrac{1}{V(25-V)}$ in partial fractions.

(2)

The volume, V microlitres, of a plant cell t hours after the plant is watered is modelled by the differential equation

$$\frac{\mathrm{d}V}{\mathrm{d}t} = \frac{1}{10}V(25-V)$$

The plant cell has an initial volume of 20 microlitres.

(b) Find, according to the model, the time taken, in minutes, for the volume of the plant cell to reach 24 microlitres.

(5)

(c) Show that

$$V = \frac{A}{\mathrm{e}^{-kt} + B}$$

where A, B and k are constants to be found.

(3)

The model predicts that there is an upper limit, L microlitres, on the volume of the plant cell.

(d) Find the value of L, giving a reason for your answer.

(2)