- A solution of sodium iodide containing the radioisotope ^{131}I has an activity of 20 mCi L^{-1} when freshly prepared. Fifteen days later, a patient is given 0.50 mL of this solution. Calculate the dose of ^{131}I (in microcurie, μCi) received by the patient. The half-life of ^{131}I is 8.04 days.

Marks 3

The decay constant, λ, is related to the half life, $\lambda = \frac{\ln 2}{t_{1/2}} = \frac{\ln 2}{8.04\ \text{days}} = 0.0862$ days^{-1}

The activity is proportional to the number of radioactive nuclei, $A = \lambda N$, and the activity reduces with time according to:

$$\ln\left(\frac{A_0}{A_t}\right) = \lambda t$$

With an initial activity of 20 mCi L^{-1}, the activity after 15 days is given by,

$$\ln\left(\frac{20\times10^{-3}\ \text{mCi L}^{-1}}{A_t}\right) = (0.0862) \times 15$$

Hence A_t = 0.00549 Ci L^{-1} = 5.49 mCi L^{-1}

Hence, a solution of 0.50 mL will have a dosage of:

dosage = activity × volume

$$= (5.49 \times 10^{-3}\ \text{mCi L}^{-1}) \times \left(\frac{0.50}{1000}\ \text{L}\right) = 2.7 \times 10^{-6}\ \text{Ci} = 2.7\ \mu\text{Ci}$$

Answer: **2.7 μCi**