

**Marks**  
**2**

- If a medical procedure calls for 2.0 mg of  $^{48}\text{V}$ , what mass of isotope would be required to be able to use it exactly one week later? The half life of  $^{48}\text{V}$  is 1.61 days.

The decay constant is related to the half life as  $t_{1/2} = \frac{\ln 2}{\lambda}$ . Thus,

$$\lambda = \frac{\ln 2}{1.61} = 0.431 \text{ days}^{-1}$$

The number of radioactive nuclei decreases with time according to the equation,

$$\ln\left(\frac{N_0}{N_t}\right) = \lambda t$$

If  $N_t = 2.0 \text{ mg}$  after  $t = 7 \text{ days}$ ,

$$\ln\left(\frac{N_0}{2.0 \times 10^{-3}}\right) = (0.431) \times 7.00 \quad \text{so } N_0 = 0.041 \text{ g} = 41 \text{ mg}$$

Answer: **4.1 mg**