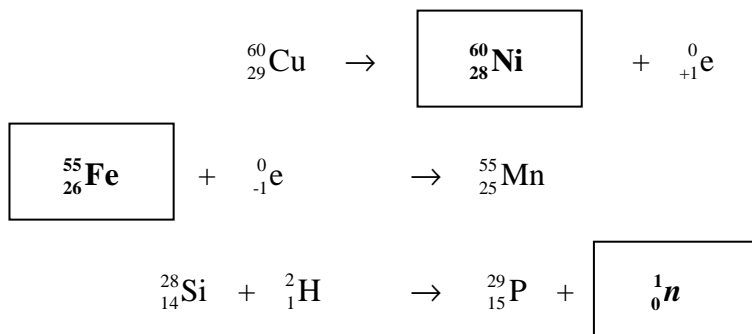


- Balance the following nuclear reactions by identifying the missing nuclear particle or nuclide.

Marks
3



- Calculate the following properties of the ${}^{13}\text{N}$ nuclide, given that its half-life is 9.96 minutes.

3

(a) the decay constant in s^{-1}

9.96 minutes corresponds to $(9.96 \times 60.0) = 598 \text{ s}$.

The half life is related to the decay constant, λ , by $\lambda = \frac{\ln 2}{t_{1/2}} = \frac{\ln 2}{598} = 1.16 \times 10^{-3} \text{ s}^{-1}$

Answer: $\lambda = 1.16 \times 10^{-3} \text{ s}^{-1}$

(b) the molar activity in Ci mol^{-1}

The activity, A , is related to λ by $A = \lambda N$ where N is the number of nuclei. The activity of a mole is thus:

$$A = \lambda N = (1.16 \times 10^{-3}) \times (6.022 \times 10^{23}) = 6.98 \times 10^{20} \text{ Bq mol}^{-1}$$

As $1 \text{ Bq} = 3.70 \times 10^{10} \text{ Ci}$, this corresponds to:

$$A = 6.98 \times 10^{20} \text{ Bq mol}^{-1} = \frac{6.98 \times 10^{20}}{3.70 \times 10^{10}} \text{ Ci mol}^{-1} = 1.89 \times 10^{10} \text{ Ci mol}^{-1}$$

Answer: $1.89 \times 10^{10} \text{ Ci mol}^{-1}$