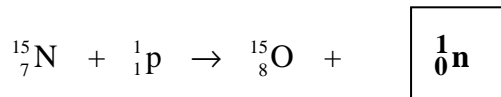
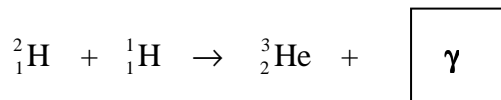
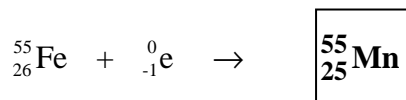


- Balance the following nuclear reactions by identifying the missing nuclear particle or nuclide.

Marks
3



- Calculate the atomic mass of silicon from the isotope information provided.

2

Isotope	Mass of isotope (a.m.u.)	Relative abundance
${}^{28}\text{Si}$	27.97693	92.21%
${}^{29}\text{Si}$	28.97649	4.70%
${}^{30}\text{Si}$	29.97376	3.09%

The relative atomic mass of silicon is the weighted average of the masses of its isotopes:

$$\left(27.97693 \times \frac{92.21}{100}\right) + \left(28.97649 \times \frac{4.70}{100}\right) + \left(29.97376 \times \frac{3.09}{100}\right) = 28.09 \text{ g mol}^{-1}$$

Answer: **28.09 g mol⁻¹**

- Calculate the molar activity of ${}^3\text{H}$ (in Curie), given its half-life of 12.26 years.

3

The molar activity is given by $A_{\text{mol}} = \lambda N_{\text{a}}$ where λ is the decay constant which is related to the half life $t_{1/2}$ by $\lambda = \frac{\ln 2}{t_{1/2}}$.

The half life = 12.26 years or $12.26 \times 365 \times 24 \times 3600 \text{ s} = 3.866 \times 10^8 \text{ s}$. Hence the molar activity is:

$$A_{\text{mol}} = \frac{\ln(2)}{3.87 \times 10^8 \text{ s}} \times (6.022 \times 10^{23} \text{ disintegrations mol}^{-1})$$

$$= 1.080 \times 10^{15} \text{ disintegration s}^{-1} \text{ mol}^{-1}$$

As $1 \text{ Ci} = 3.70 \times 10^{10} \text{ disintegrations s}^{-1}$, the molar activity in Curie is:
 $1.080 \times 10^{15} / 3.70 \times 10^{10} = 2.92 \times 10^4 \text{ Ci mol}^{-1}$.

Answer: **$2.92 \times 10^4 \text{ Ci mol}^{-1}$**

