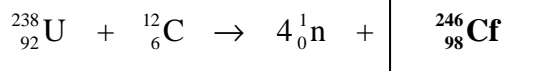
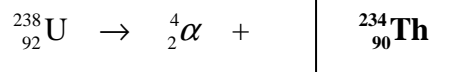
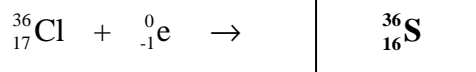


- Balance the following nuclear reactions by identifying the missing nuclide.



Marks
3

- The half life of ${}^{90}\text{Sr}$ is 29 years. Calculate the remaining activity (in Bq) of a sample containing ${}^{90}\text{Sr}$ after 100 years given that the initial activity was 1000 Bq.

2

$$\text{From } t_{1/2} = \frac{\ln 2}{\lambda}, \lambda = \frac{\ln 2}{29} = 0.0239 \text{ yr}^{-1}.$$

The activity after 100 years is related to the initial activity by:

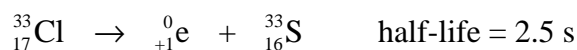
$$\ln\left(\frac{A_0}{A_t}\right) = \lambda t = (0.0239) \times 100 = 2.39 \text{ so } \frac{A_0}{A_t} = e^{2.39}$$

$$\text{As } A_0 = 1000 \text{ Bq, } A_t = \frac{1000}{e^{2.39}} = 92 \text{ Bq}$$

Answer: **92 Bq**

- The three unstable isotopes ${}_{17}^{33}\text{Cl}$, ${}_{36}^{77}\text{Kr}$ and ${}_{12}^{27}\text{Mg}$ are unsuitable for use in medical imaging. For each isotope, provide a reason why it is unsuitable. The following data may be of use:

3



${}_{17}^{33}\text{Cl}$ - the half life of 2.5 s is too short to allow for synthesis of host molecules, administration of the nuclide to the patient and measurement of the radiation emitted.

${}_{36}^{77}\text{Kr}$ - krypton is a noble gas and cannot be incorporated into a suitable host molecule for administration to the patient.

${}_{12}^{27}\text{Mg}$ - this nuclide is a β -emitter so little useful radiation would escape the body and local radiation damage would occur.