

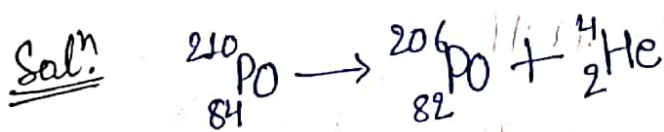
D. B. College (Jaynagar) Lect-15

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Ex:51 ${}_{84}^{210}\text{Po}$ decays with emission of α -Particle to ${}_{82}^{206}\text{Pb}$ with a half-life period of 138.4 days. If 1g of ${}_{84}^{210}\text{Po}$ is placed in a sealed tube, how much Helium will be accumulated in 69.2 days? Express the answer in cm^3 at STP.



Amount of ${}_{84}^{210}\text{Po}$ left after 69.2 days can be

Calculated by applying

$$N = N_0 \left(\frac{1}{2}\right)^n$$

$$n = t/t_{1/2} = \frac{69.2}{138.2} = \frac{1}{2}$$

$$\therefore N = 1 \left(\frac{1}{2}\right)^{1/2} = 0.707 \text{ g}$$

$$\begin{aligned} \text{Amount of Polonium disintegrated} &= 1 - 0.7072 \\ &= 0.2928 \text{ g} \end{aligned}$$

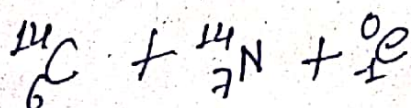
$$\text{Moles of Polonium in } 0.2928 \text{ g} = \frac{0.2928}{210}$$

$$\text{Moles of helium atoms formed} = \frac{0.2928}{210}$$

$$\begin{aligned} \therefore \text{Volume of helium collected} &= \frac{0.2928}{210} \times 22400 \\ &= 31.23 \text{ cm}^3 \end{aligned}$$

26. CARBON DATING:

The cosmic ray generates neutrons in the atmosphere which bombards the nucleus of atmospheric nitrogen to form radioactive ^{14}C hence ^{14}C in the atmosphere has been remaining constant over thousands of years. In living materials, the ratio of ^{14}C to ^{12}C remains relatively constant. When the tissue in an animal or plant dies, assimilation of radioactive ^{14}C ceased to continue. Therefore, in the dead tissue the ratio of ^{14}C to ^{12}C would decrease depending on the age of the tissue.



A sample of dead tissue is burnt to give carbon dioxide and the carbon dioxide is analysed for the ratio of ^{14}C to ^{12}C . From this data, age of dead tissue (plant or animal) can be determined.

$$\text{Age } (t) = \frac{2.303}{\lambda} \log \frac{N_0}{N}$$

$$\Rightarrow \text{Age} = \frac{2.303 t_{1/2} (^{14}\text{C})}{0.693} \log \left(\frac{N_0}{N} \right)$$

N_0 = ratio of $^{14}\text{C}/^{12}\text{C}$ in living plant

N = ratio of $^{14}\text{C}/^{12}\text{C}$ in the wood

$$\text{Age} = \frac{2.303 t_{1/2}}{0.693} \log \left(\frac{A_0}{A} \right)$$

A_0 = original activity

A = final activity

$$\text{Also, } N = \left(\frac{1}{2} \right)^n N_0 \Rightarrow \text{where } n = \frac{t}{t_{1/2}}$$