Radioactivity

Dr. Atul kumar singh
Chemistry

Radioactive Disintegration :-

The conversion of an element to another due to emission of α and β particles is known as radioactive disintegration.

⇒ Radioactive disintegration is similar to a chemical reaction of first order.

⇒ We have following equations for the radioactive disintegration.

* Initial number of atom N^0

$A \rightarrow B$

No. of atoms after time $= N$

Rate of disintegration $= \frac{d(N)}{dt} = \lambda(N)$ —— (i)

on integration

$$\lambda = \frac{2.303}{t} \log \frac{N^0}{N} \quad \text{—— (ii)}$$

λ (disintegration constant or decay constant)

Simultaneous Disintegration

if an equimolar mixture of the two radioactive substances having decay constant λ_1 & λ_2, the ratio of the nuclides at the end of time t, is given by

$$2.303 \log \frac{N_1}{N_2} = (\lambda_2 - \lambda_1)t$$

Half life Period :-

The time required for half of a radioactive substance to disintegrate is known as the half life period,

⇒ Half life period is represented by $t_{1/2}$

$$t_{1/2} = \frac{0.6932}{\lambda}$$

when $t = t_{1/2}$, $N = \frac{N_0}{2}$

if N_0 and N are the initial number of nuclei and the number of nuclei undecayed at the end of the nth half life

$$N = 2^{-n} \cdot N_0$$

⇒ mass of the undecayed isotope m,

$$m = 2^{-n} \cdot m_0 \qquad m_0 = \text{initial mass of nuclei}$$

Average life Period (λ')

The reciprocal of the disintegration constant is known as the average life period

$$\lambda' = \frac{1}{\lambda} = \frac{t_{1/2}}{0.6932} = 1.44 t_{1/2}$$