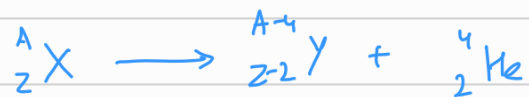


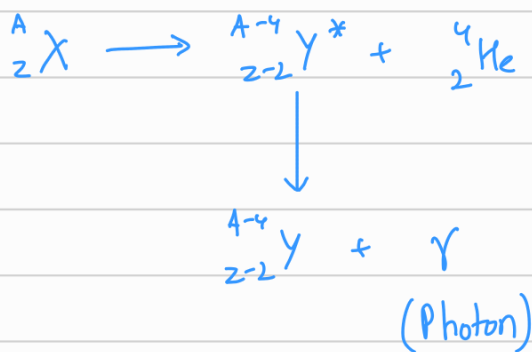
α -Decay

- (n/p ratio increases)

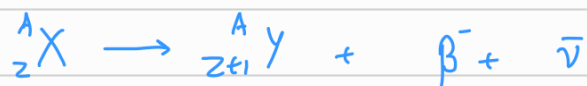


Energy of products < Energy reactants
This loss in energy appears as kinetic energy of the products

γ -particle is released when Y is in excited state of nucleus.



β -decay (n/p decreases)



Some energy is carried by anti-neutrino

Mean life

It is the average life of all the nuclei

Let no. of nuclei at $t=0$ be N_0 and at $t=t$ be N
Then

$$N = N_0 e^{-\lambda t}$$

Let no. of nuclei dissociated in time dt be dN

These dN particles have a life t as they existed upto time t , and not after that.

$$\begin{aligned} \text{Sum of lives of these particles} &= t + t + t + \dots + t \\ &\quad \downarrow dN \text{ times} \\ &= t dN \end{aligned}$$

$$\begin{aligned} \text{Sum of lives of all particles} &= \int_0^{\infty} t dN \\ &= -\lambda \int_0^{\infty} t N_0 e^{-\lambda t} dt \end{aligned}$$

$$\begin{aligned} \int_0^{\infty} t e^{-\lambda t} dt &= t \int_0^{\infty} e^{-\lambda t} dt - \int_0^{\infty} \frac{dt}{dt} \left(\int_0^{\infty} e^{-\lambda t} dt \right) dt \\ &= \left[\frac{t e^{-\lambda t}}{-\lambda} \right]_0^{\infty} - \int_0^{\infty} \frac{e^{-\lambda t}}{-\lambda} dt \\ &= 0 - 0 + \frac{1}{\lambda^2} \left(e^{-\lambda t} \right)_0^{\infty} = -\frac{1}{\lambda^2} \end{aligned}$$

$$\begin{aligned} \text{Sum of lives of } N_0 \text{ particles} &= -\lambda \int_0^{\infty} t N_0 e^{-\lambda t} dt = -N_0 \times \frac{1}{\lambda^2} \\ &= \frac{N_0}{\lambda} \end{aligned}$$

$$\text{Avg life} = \text{Sum} / N_0 = \frac{1}{\lambda} = \tau$$

Radio activity

↳ Rate of emission is called radioactivity of the substance

↳ Radioactivity does not depend on external factors like temperature and pressure

↳ Radioactivity is independent of electronic configuration

↳ $-\frac{dN}{dt} = \lambda N$ (differential equation)

On solving, $N(t) = N_0 e^{-\lambda t}$

↳ Probability that a particle is not decayed at time t
 $= \frac{N_0 e^{-\lambda t}}{N_0} = e^{-\lambda t}$

↳ Half-life, $t_{1/2} = \frac{0.693}{\lambda}$ where λ is decay constant

↳ Activity of the substance = λN