## Successive Disintegration and Radioactive Equilibrium.

Suppose a radioactive element A disintegrates to form another radioactive element B which intern disintegrates to still another element C; such decays are called successive disintegration.



Rate of disintegration of  $A = \frac{dN_1}{dt} = -\lambda_1 N_1$  (which is also the rate of formation of B)

Rate of disintegration of  $B = \frac{dN_2}{dt} = -\lambda_2 N_2$ 

$$= \lambda 1 N 1 - \lambda 2 N 2$$

## Equilibrium

In radioactive equilibrium, the rate of decay of any radioactive product is just equal to its rate of production from the previous member.

i.e. 
$$\lambda 1 N 1 = \lambda 2 N 2$$
  $\Rightarrow$   $\frac{\lambda_1}{\lambda_2} = \frac{N_2}{N_2} = \frac{\tau_2}{\tau_1} = \frac{(T_{1/2})}{(T_{1/2})_1}$ 

Note: In successive disintegration if N0 is the initial number of nuclei of A at t = 0 then number of nuclei of product

 $N_2 = \frac{\lambda_1 N_0}{(\lambda_2 - \lambda_1)} (e^{-\lambda_1 t} - e^{-\lambda_2 t})$ where  $\lambda 1 \lambda 2$  – decay constant of A and B.

## Uses of radioactive isotopes

- (1) In medicine
- (i) For testing blood-chromium 51 (ii) For testing blood circulation Na 24
- (iii) For detecting brain tumor- Radio mercury 203
- (iv) For detecting fault in thyroid gland Radio iodine 131

(v) For cancer - cobalt - 60







(vii) For skin diseases - Phosphorous- 31

- (2) In Archaeology
- (i) For determining age of archaeological sample (carbon dating)  $C^{14}$
- (ii) For determining age of meteorites  $K^{40}$
- (iii) For determining age of earth-Lead isotopes
- (3) In agriculture
- (i) For protecting potato crop from earthworm-  $CO^{60}$
- (ii) For artificial rains AgI
- (iii) As fertilizers  $P^{32}$
- (4) As tracers (Tracer): Very small quantity of radioisotopes present in a mixture is known as tracer
- (i) Tracer technique is used for studying biochemical reaction in tracer and animals.
- (5) In industries
- (i) For detecting leakage in oil or water pipe lines
- (ii) For determining the age of planets.











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