

- **LESSON 4**

LAW OF RADIOACTIVE DECAY

$$\Rightarrow \quad -\frac{dN}{dt} \propto N$$
$$\Rightarrow \quad -\frac{dN}{dt} = \lambda N, \quad \lambda = \text{Decay constant}$$

$$-\frac{dN}{N} = \lambda dt,$$

$$-\int \frac{dN}{N} = \int \lambda dt,$$

$$\ln N = -\lambda t$$

When $N = N_0$, $t = 0$ and when $N = N$, $t = t$

$$\therefore \left[\ln N \right]_{N_0}^N = -\lambda t$$

$$\ln N - \ln N_0 = -\lambda t$$

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

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

Where N_0 = initial number of nuclides or particles

N = Number particles or nuclides remaining after time t

HALF – LIFE ($T_{1/2}$)

This is defined as the time required for half of the nuclides initial present in the source to decay.

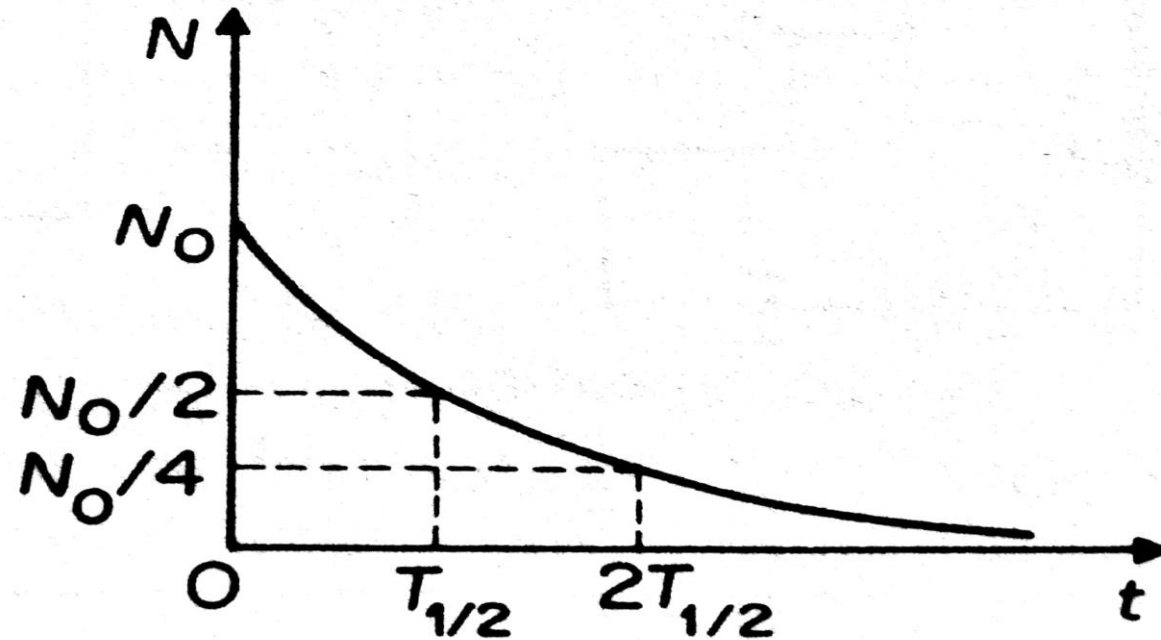
$$N = N_0 e^{-\lambda t}$$

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

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

The decay curve for a radioactive substance is illustrated below.

DECAY CURVE



ACTIVITY (A) or DECAY RATE

The activity of a radioactive material or substance is defined as the number of disintegration per unit time. It is measured in Becquerel (Bq)

$$\text{Activity } A = - \frac{dN}{dt} = \lambda N = \text{count rate}$$

$$A = \lambda N$$

Note; 50 Bq = 50 disintegrations per sec.

Or Count rate = 50 disintegrations per sec

DECAY CONSTANT (λ)

The number of particles emitted per sec per unit number of atoms present in the sample at the at any particular instant

MEAN LIFE OF A RADIOACTIVE MATERIAL

The average life time of a radioactive material to undergo a radioactive decay

APPLICATIONS OF RADIOACTIVITY

(a) IN MEDICINE

1. Radiology departments in hospitals
2. Radio-isotope of iodine

(b) IN ENGINEERING

- (1) In the detection of wear and tear of machine parts
- (2) Location of blockades in sewage pipes

(c) IN AGRICULTURE

Sterilization and preservation against bacterial infection

OTHER APPLICATION

Archaeological dating

Geological dating of rocks

HEALTH HAZARDS OF RADIOACTIVITY

The damage caused by any type of radiation depends on its specific ionization and penetrability

DISPOSAL OF UNWANTED RADIOACTIVE WASTE

Damping of unwanted lethal radioactive fragments takes place in a carefully controlled process in which the unwanted radioactive is encased by thick layers of concrete blocks and taken out to sea and sunk in deep waters

End of lesson 4