Radioactivity is a property exhibited by certain atomic nuclei due to their nuclear instability. When an atom’s nucleus is unstable, it spontaneously emits energetic subatomic particles. These emissions are called **radioactive radiations**. Here are the three types of radioactive decay:

1. **Alpha Decay (α Decay):**
   * In alpha decay, an unstable nucleus emits an alpha particle (which consists of two protons and two neutrons).
   * The decay process can be represented as:

`X\_{z}^a​→Y\_{z−2}^(a−4) ​+ He\_{2}^4​`

* + Commonly observed in heavy elements like uranium and plutonium.

1. **Beta Decay (β Decay):**
   * In beta decay, a neutron is converted into a proton or vice versa, accompanied by the emission of a beta particle (an electron or positron).
   * The decay process can be represented as:

`X\_{z}^a​→Y\_{z+1}^a ​+ e\_{0}^(−1)​`

1. **Gamma Decay (γ Decay):**
   * Gamma decay involves the emission of high-energy photons (gamma rays).
   * The decay process does not change the atomic number or mass number of the nucleus.
   * Represented as:

X\_{z}^a​→Y\_{z}^a​ + gamma (photon)

**Laws of Radioactivity:**

1. The decay rate of a nucleus is independent of temperature and pressure.
2. Radioactivity follows the law of conservation of charge.
3. The physical and chemical properties of the daughter nucleus differ from those of the mother nucleus.
4. Energy emission during radioactivity is always accompanied by alpha, beta, or gamma particles.

`A\_{c} = (-dN)/(dt) = lambda`

N = no of particles

`N = N\_{0}e^(-lambdat)`

`A\_{c} = A\_{0}e^(-lambdat)`

`Lambda = ((dN)/(dt))/N` it gives the activity per atom

(Half life) ` T = (ln(2))/lambda`

`N = N\_{0} 2^((-t)/T)`

`m = m\_{0} 2^((-t)/T)`

`A = A\_{0} 2^((-t)/T)`

Mean life `T\_{m}`

`T\_{m} = 1/lambda = text(sum of lives of all active nucleus) /text(total no of nucleus)`

`N\_{1}/N\_{2} = lambda\_{2}/lambda\_{1] = T\_{1}/T\_{2}`

`Lambda\_{alpha} = P\_{1}lambda`

`Lambda\_{beta} = P\_{2}lambda`

`P\_{1}, P\_{2}` are probabilities

`lambda\_{eff} = lambda\_{1} +lambda\_{2} + ……..`

Alpha decay: mass number reduces by 4

Series:

Thorium 4n reduces to lead

Neptunium 4n + 1 reduces to bismuth

Uranium 4n +2 reduces to lead

Actinium 4n +3 reduces to lead

`A\_{1} rightarrow A\_{2} rightarrow A\_{3} rightarrow A\_{4}`

`lambda\_{1}` from `A\_{1} to A\_{2} , lambda\_{2}` from `A\_{2} to A\_{3}`

`lambda\_{2}` is smaller in value than `lambda\_{1}` because `A\_{2}` is stable