HALF – LIFE OF RADIACTIVE ELEMENT

- The decay of individual atoms of a radioactive substance has been found to be irregular. If a certain amount of radionuclide is taken and the number of disintegrations per second is measured.
- It is found that, after certain time, half of the original atoms would have got disintegrated and only half of the original active atoms would be left behind. The number of disintegrations per second will now be half of the original value.
- The decay time of radionuclide to its half has been constant irrespective of the quantity present. This time is termed as half-life of the radionuclide.

Therefore; the time in which a given quantity of a radionuclide decays to half its initial value is termed as half-life **($T_{1/2}$).**

Formula for Half-life: $$(T_{1/2}) = \frac{0.693}{\lambda}$$

Where; λ = disintegration constant in unit of sec^{-1}

Half - life of various radionuclides are:

- Polonium -212 has half – life of 3×10^{-7} seconds.
- Iodine 131 has 8 days
- ^{32} P has 14.3 days
- Zinc has 65-150 days
- Na has 22-2.6 years.
- U_{238} has 4.5×10^{4} years

ISOTOPES: Nuclides having the same number of protons but different numbers of neutrons are termed as isotopes. Or, the isotopes have been differing in nuclear masses and thus in atomic weights and also in nuclear properties.

- Radio isotopes undergo nuclear changes or rearrangements that cause the emission of radioactive radiations. As atoms and molecules undergo chemical reactions so do nuclei with one another and with neutrons which are termed as nuclear reactions.
- When the radioactive isotopes undergo nuclear reactions, they produce alpha, beta and gamma particles.
- The nucleus obtained after the nuclear changes or rearrangement may be that of a different element which may be stable.
- The original nuclide is called the parent and the product is called the decay or the daughter nuclide.
- The phenomenon of nuclear changes is termed as disintegration or radioactive decay.

Stability of isotopes: The naturally occurring nuclides are having favorable ratio of protons and neutrons in most elements. Any deviation from the natural ratio, i.e., increase or decrease in the number of neutrons alters the atomic number and the stability of the nucleus.

Example:

- The stable ratio for potassium is 1: 1.115. If one more neutron is added to the nucleus, the ratio is disturbed and the nuclide becomes unstable.
- An addition or removal of neutron from the nucleus of iodine causes instability.

Types of radionuclide:

Any nuclide which is not radioactive in nature is regarded to be stable or in order to be stable, a nuclide must possess appropriate energy. Those nuclides which undergo spontaneous nuclear change so as to attain stability by emitting radioactivity are termed as radionuclides or radioisotopes.

Radionuclides are of two types:

1. Natural radionuclide
2. Artificial radionuclide.

- Natural radionuclide include about forty high atomic weight elements such as Uranium 238, radium 226, which may be α, β or γ emitters and also some moderate weight elements such as potassium 40, rubidium 87 etc.