Radioactivity

History of Radioactivity

Discovered by: > Becquerel

> Marie & Pierre Curie (discovered Polonium [Po] & Radium [Ra])

Radioactivity

→ The spontaneous breaking up of unstable nuclei with the emission of one or more types of radiation.

Alpha (+) α

- Consist of 2 protons & 2 neutrons (Helium Nuclei)
- Slow moving
- Low penetrating power (stopped by a few cm of air or paper)
- Extremely dangerous if into the body, can lead to cancer
- EXAMPLE: Americium -241 (^{241}Am -------->)
- USE: Smoke Detectors
- Giger-Muller Tube for detection (attracted to -)

Alpha particles result in the loss of 2 protons & 2 neutrons (mass -4 and atomic number -2)

Beta (-) β

- Consists of high energy electrons (1 neutron -----> 1 proton + 1 electron)
- Faster moving then Alpha but slower than Gama
- Fairly penetrative (stopped by 2-5 mm thickness of Aluminium)
- V harmful, can penetrate deep in the body.
- EXAMPLE: Carbon - 14 (C^{6}_{14} --------> $N^{7}_{14} + e^{0}_{-}$)
- USE: Age determination (Carbon dating)
- Geiger Muller Tube/ Electric Field for detection

Beta particle is released when a neutron breaks down into a proton + an electron, proton remains in the nucleus, but the electron is emitted at high speed.

Gama (o) γ

- Consists of high energy electromagnetic radiation
- V fast moving (fastest of all 3)
- Have greatest penetrative effect (stopped by thick concrete or lead)
- Most harmful, leads to cancer
- EXAMPLE: Cobalt - 60 (^{60}Co --------> ^{60}Co + Energy [hf]) **no new element is formed**
- USE: Cancer Treatment (Radiotherapy)
- Geiger-Muller Tube for detection

High energy electromagnetic radiation, emitted when an unstable nucleus loses excess energy (no particles are released)

Ratemeters = measures have the number of radioactive particles entering the Geiger Muller Tube (every s), many have loudspeaker, the presence of radioactivity is indicated by the clicking sound.

Nuclear Reaction

A process that alters the composition, structure or energy of an atomic nucleus.

Nuclear Reactions	Chemical Reactions
New elements may be formed	New elements cannot be formed
Change occur in the Nucleus	No change occurs in the nucleus
No chemical bond formation involved	Transfer or sharing of electrons involved i.e chemical bond formation

Radioactive Decay

A reaction that occurs when a radioisotope naturally breaks down and emits radiation

Radioactivity [P2]

Nuclear fusion

→ The joining together of small light nuclei to form heavier nuclei with the release of large amounts of energy

Nuclear Fission

→ The break-up of large nuclei to form two smaller nuclei of roughly the same size- large amounts of energy released.

Alpha and Beta, a new element is formed this is known as transmutation.

Half Life

→ Half-life of any element is the time it takes for half of the nuclei in any given sample to decay. (time it takes of the atoms of a radioactive material to disintegrate)

Background radiation

- ✧ radiation in the environment e.g radioactive radon gas (from the ground)
- ✧ Man-made = from medical uses/ fall out from nuclear weapon testing.
- ✧ Radiation may cause genetic mutations.

Uses of Radioisotopes

- □ **Medical**: gamma rays can be used to penetrate the body ad kill cancerous cells (Cobalt-60)/ sterilise surgical equipment.
- □ **Archaeological**: to determine age of ancient materials.
- □ **Industry**: Tracers added to liquids in leaking pipes to find the source of the leak.