

Isotopes

The atoms of the same element, having same atomic number Z , but different mass number A , are called isotopes.

Examples

Hydrogen

Protium



protons

1

neutrons

0

Deuterium



1

1

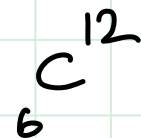
Tritium



1

2

Carbon

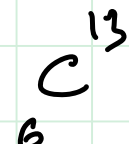


protons

6

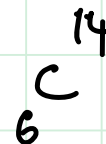
neutrons

6



6

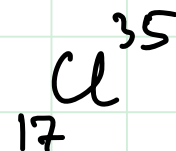
7



6

8

Chlorine

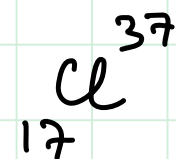


protons

17

neutrons

18



17

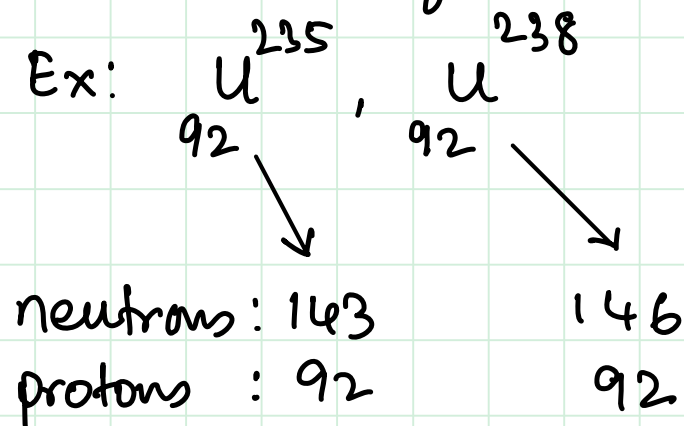
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Stable Isotopes

- Are the ones in which the number of neutrons are almost equal to the number of protons.

Unstable Isotopes

- Are the ones in which the number of neutrons are much more than the number of protons.
- These undergo radioactive decay.



Both are radio isotopes

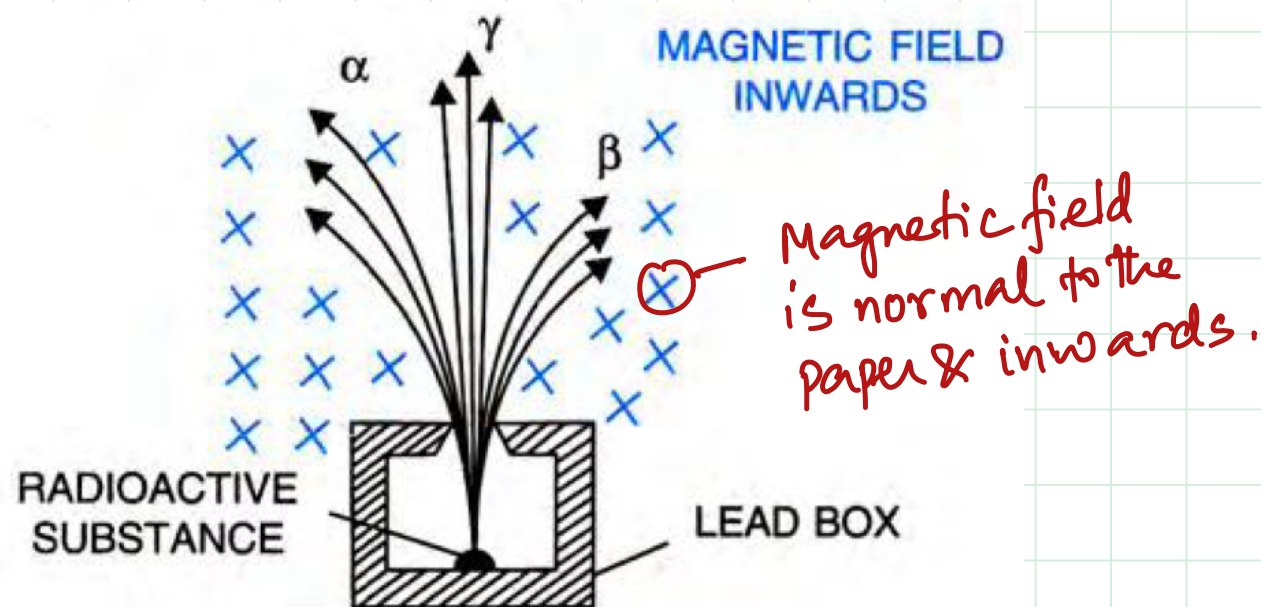
${}^{14}_6\text{C}$ is a radio isotope since

$\therefore$ No of neutrons (8) > No of protons (6)

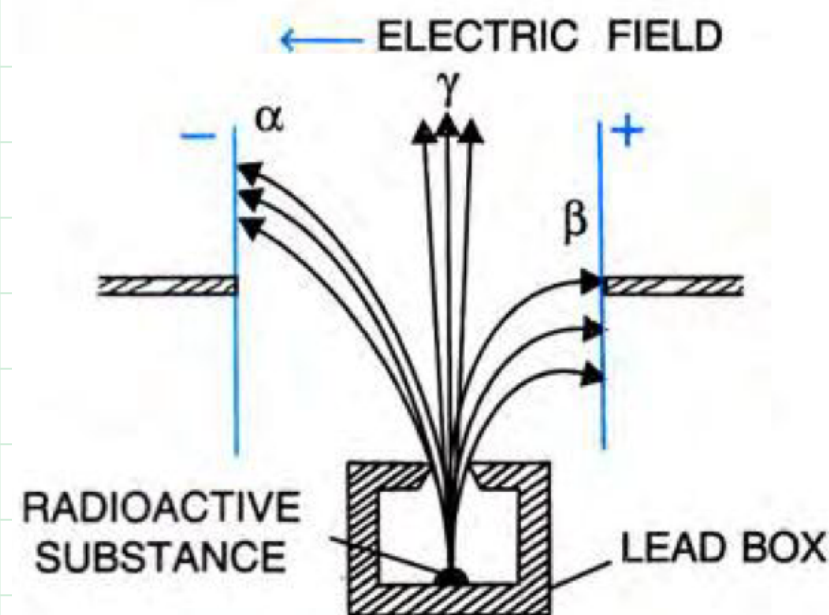
- Radioactivity is a — Random phenomenon : From a radioactive substance containing a large number of atoms, there is no rule to predict when or which nucleus of an atom will decay at any moment.

Radioactivity as Emission of α , β , γ radiations

- Rutherford's Experiment in 1903



- When radiations from a radioactive substance are made to pass perpendicular to a magnetic field, the radiations separate out into three distinct constituents or parts.
 - Positively charged α particles turn left.
 - Negatively charged β particles turn right.
 - Those which pass undeviated are γ radiations.

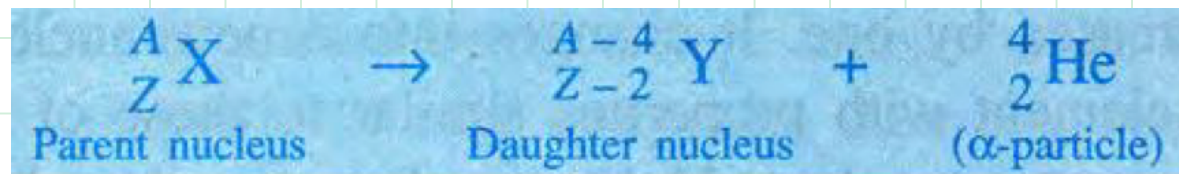


- When radiations are passed normal to an Electric field,
 - α particles turn towards the negative plate
 - β particles turn towards the positive plate
 - γ radiations pass undeviated

Nuclear Emission

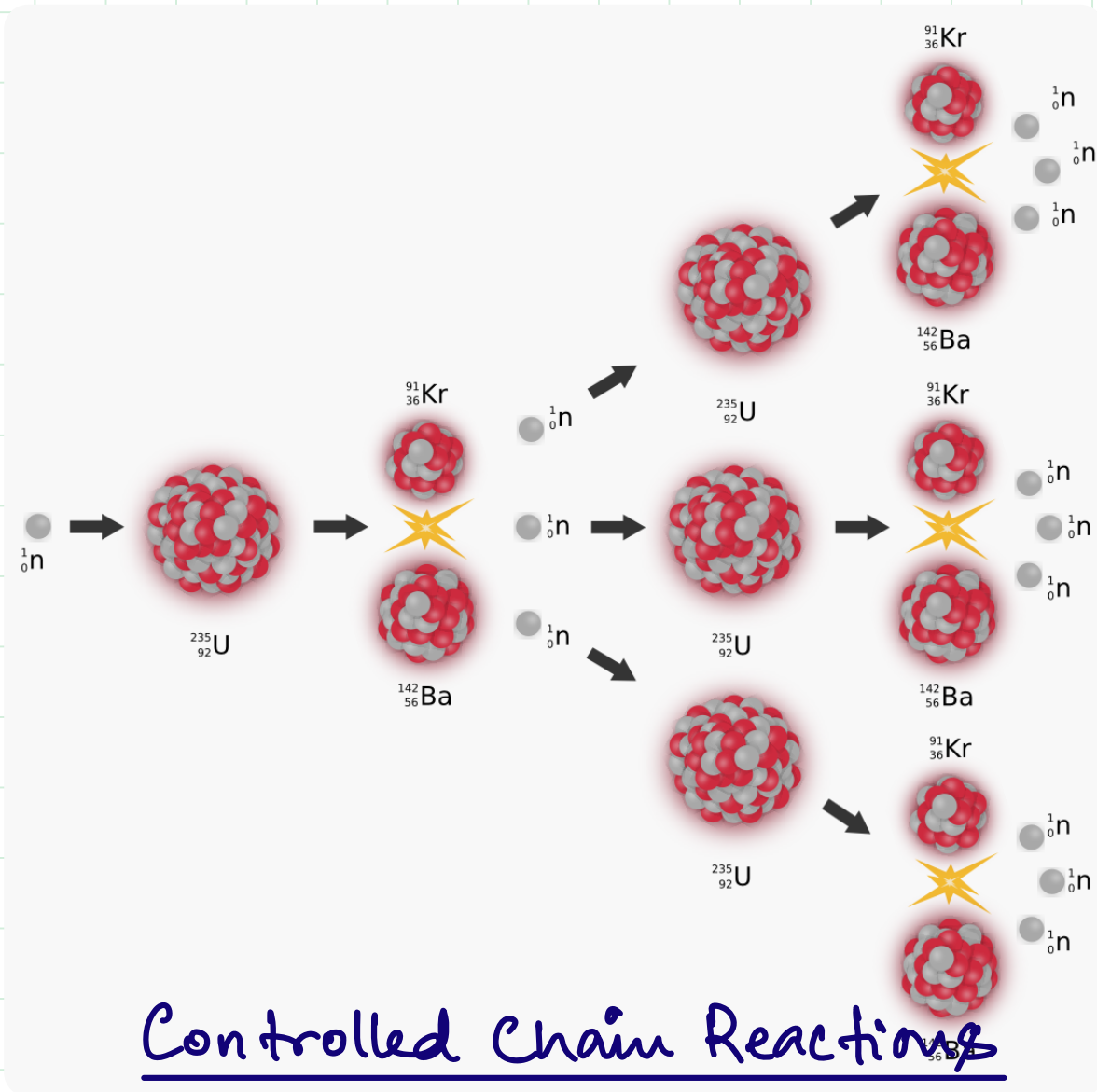
- Nuclei of radioactive substances undergo **spontaneous decay by self emission** of either α or β and γ radiation.
- In a single radioactive decay, there can only be either an α emission or a β emission, which may be accompanied by a γ emission.
- The purpose of radioactive emission is to obtain a stable nucleus.
- The daughter product formed after a radioactive emission may further undergo decay; and this would continue until a stable nucleus is formed.

Alpha emission



- After emission of an α particle, a new element is formed with **Mass No (A-4)** and **atomic No (Z-2)**, where
 A - Mass No. of the parent nucleus.
 Z - Atomic No. of the parent nucleus.
- The new element formed has properties similar to the element two places left of the parent element in the periodic table.

Uncontrolled Chain Reaction



- In an uncontrolled fission reaction, each of the three neutrons produced in one reaction cause fission in 3 other U^{235} nuclei to produce 3 more neutrons and so on.
- Thus a chain of fissions continue until the entire uranium is complete.
- The energy released in such a chain reaction goes on increasing resulting in a large explosion.
- This is the basis of the Nuclear bomb.

Controlled Chain Reactions

- Some of the neutrons emitted in the fission reactions are absorbed by means of cadmium rods.
- The speed of neutrons are slowed down by moderators such as graphite, heavy water etc.
- Such controlled reactions form the principle of a nuclear reactor.