

**Program-M.Sc**  
**Semester- 2<sup>nd</sup>**  
**Sub-Inorganic Chemistry**  
**Topic –Nuclear Chemistry**  
**Sub Topic- Nuclear Reaction**

## **Nuclear Reaction**

Nuclear reaction is a process in which two or more nuclides are produced by the collision between two or more atomic nuclei and a subatomic particles and the nature of the nuclides formed is different from the reacting parent nuclei.

### **Characteristics of nuclear reaction:-**

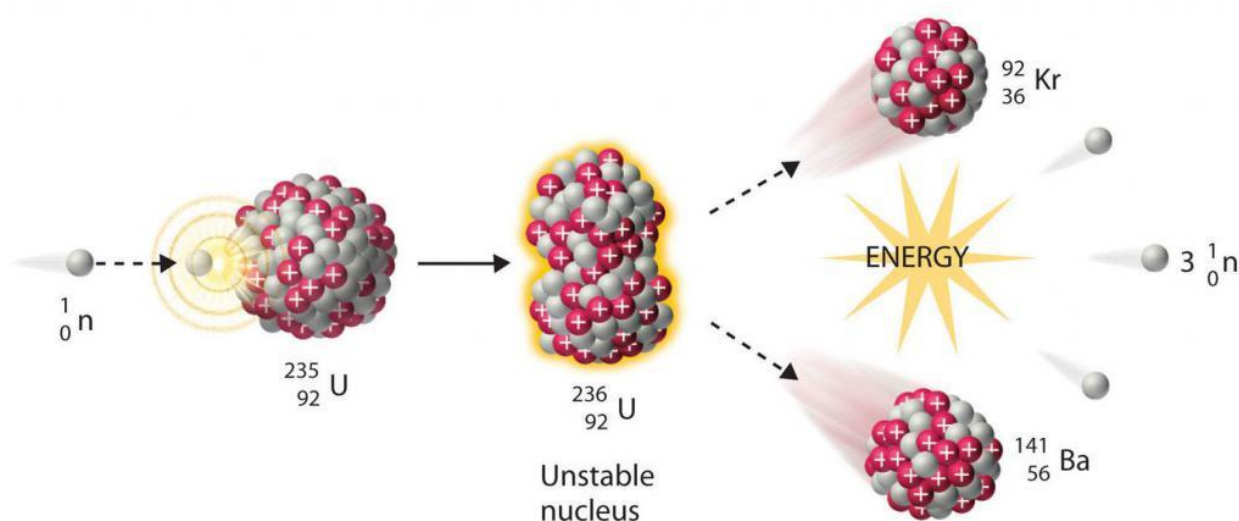
- i) A typical nuclear reaction involves two reacting particles-a heavy target nucleus and a lighter ejected particles.
- ii) Nuclear reaction always follow law of conservation of energy, i.e. total energy before and after reaction remains same.
- iii) Nuclear reaction is entirely different from chemical reaction as in nuclear reaction changes takes place in nucleus of reactant, it is not effected by external factors like temperature , pressure etc and in nuclear reaction large amount of energy is released.

### **Types of Nuclear reaction:-**

**a) Nuclear Fission**

**b) Nuclear Fusion**

**Nuclear Fission:** Nuclear fission may be defined as splitting of a nucleus into nearly two equal parts with release of large amount of energy.



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### Characteristics of nuclear fission:

1. It occurs when a slow moving electron strikes on unstable nucleus. So it is not a spontaneous process.
2. In this process, the nucleus split into two equal nuclei and release huge amount of energy with several free electrons.
3. This nuclei are generally isotopes and if they left without disturbing it will decay and emit radioactive alpha and beta particles.
4. The neutron release, are generally aborbed by other nuclei, this cause chain reaction.
5. For the chain reaction to occur for the nuclei must have critical mass.
6. If the chain reaction is uncontrolled it will cause nuclear explosion and if it is controlled it will generate energy.

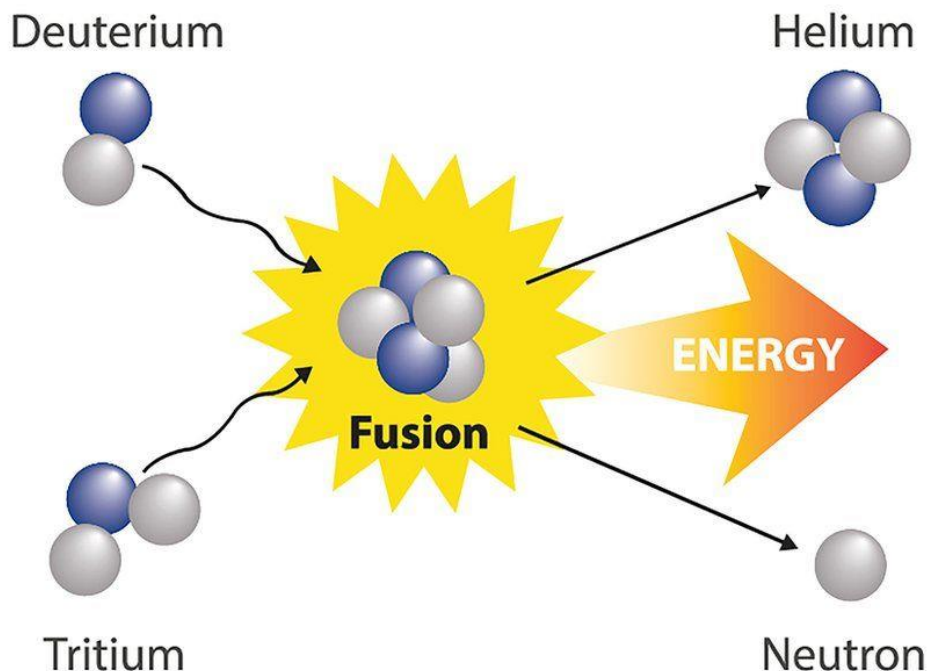
7. Nuclear fission is basically of two types:- i)Controlled Nuclear Fission ii)Uncontrolled Nuclear Fission

In controlled nuclear fission, chain reaction do not lead to any explosive effects and energy released is used in constructive purpose like nuclear power plant whereas in uncontrolled reaction leads to explosive energy release like atom bomb.



- Balance of mass number:  $235 + 1 = 141 + 92 + 3$
- Balance of atomic number:  $92 = 56 + 36$
- Three neutron in average are released.

**Nuclear Fusion:** The process in which very light nuclei combine to form heavier is known as nuclear fusion.

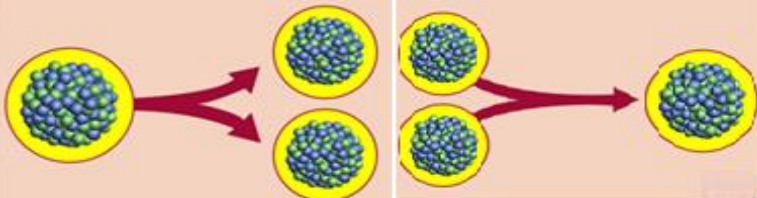


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## Characteristics of nuclear fusion:

1. In fusion, the product will have a larger binding energy than the reactants. This will cause mass defect that results in the release of huge amount of energy.
2. It generally produce no by products.
3. For fusion energy is required to overcome the force of repulsion occurs when two nuclei come closer to one another.
4. Nuclear fusion is the energy producing process which take place in the core of sun and stars.
5. The hydrogen bomb is a typical example of nuclear fusion.

## Difference between nuclear fission and fusion

|   | Nuclear Fission   | Nuclear Fusion  |
|---|---|---|
| <b>Definition:</b>                        | Fission is the splitting of a large atom into two or more smaller ones.   | Fusion is the fusing of two or more lighter atoms into a larger one.  |
| <b>Natural occurrence of the process:</b> | Fission reaction does not normally occur in nature.   | Fusion occurs in stars, such as the sun.  |
| <b>Byproducts of the reaction:</b>        | Fission produces many highly radioactive particles.   | Few radioactive particles are produced by fusion reaction, but if a fission "trigger" is used, radioactive particles will result from that. |
| <b>Conditions:</b>                        | Critical mass of the substance and high-speed neutrons are required.  | High density, high temperature environment is required.   |
| <b>Energy Requirement:</b>                | Takes little energy to split two atoms in a fission reaction.   | Extremely high energy is required to bring two or more protons close enough that nuclear forces overcome their electrostatic repulsion.     |
| <b>Energy Released:</b>                   | The energy released by fission is a million times greater than that released in chemical reactions; but lower than the energy released by nuclear fusion. | The energy released by fusion is three to four times greater than the energy released by fission.   |
| <b>Nuclear weapon:</b>                    | One class of nuclear weapon is a fission bomb, also known as an atomic bomb or atom bomb.   | One class of nuclear weapon is the hydrogen bomb, which uses a fission reaction to "trigger" a fusion reaction.                             |
| <b>Example</b>                            |   |   |

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## **References:**

1. **Inorganic Chemistry by “Keemti Lal Sharma” Pragati Publication.**
2. **Modern Nuclear Chemistry by “Walter D. Loveland” Willey Publication.**