

## Types of Nuclear Reactions

There are following two types -

1.  $R_{ex}^{hs}$  based <sup>on</sup> reaction mechanism
2.  $R_{ex}^{ns}$  based on mass of projectile

①  $R_{ex}^{ns}$  based on mech<sup>ns</sup>

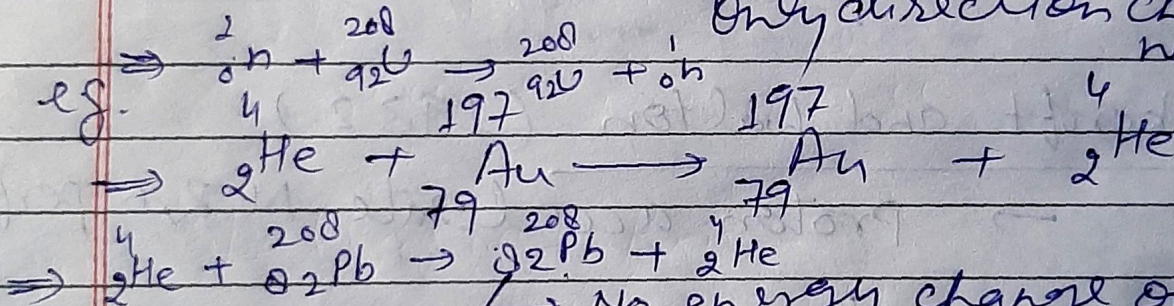
There are following as -

(i) Elastic scattering -

Incident particle  $\xrightarrow{\text{hit to}}$  Target nucleus

without loss or gain energy  
(i.e. energy is maintained)

Only direction change of nucleus (target)



( $\Rightarrow$  No energy change only direction change in N.Rx i.e. Rx. is same)  
~~mass Rx. is change~~

(ii) Inelastic scattering

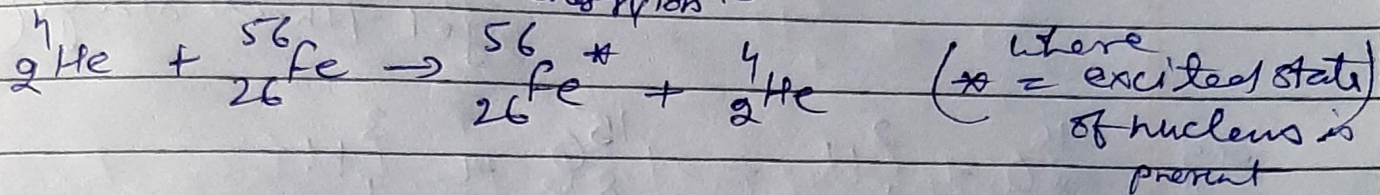
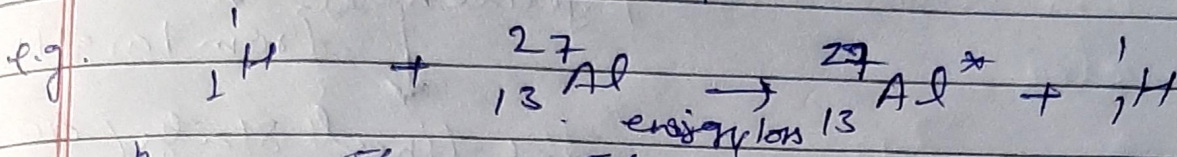
Incident particle  $\xrightarrow{\text{hit to}}$  target nucleus

kinetic energy loss ~~of~~ of incident particle

target nucleus raise the internal energy of nucleus

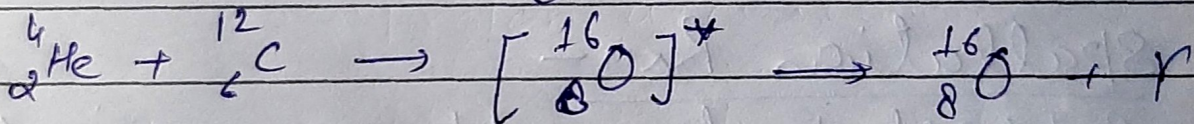
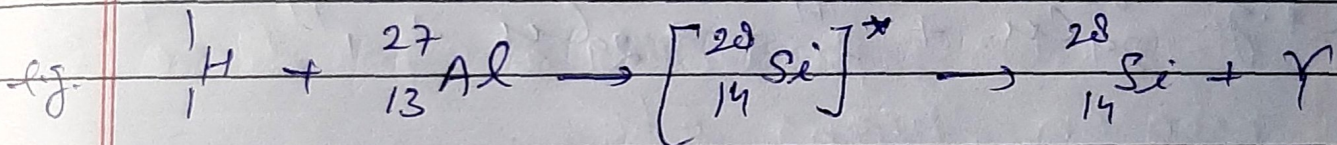
i.e. incident particle, loses some of its kinetic energy to the target nucleus, which raises the internal energy of nucleus.

The target nucleus is raised to higher excited state which decays by  $\gamma$ -emission.



### (iii) Radiative capture -

Incident particle is captured by the nucleus with the emission of  $\gamma$ -rays.

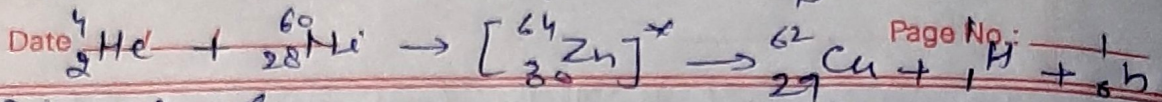
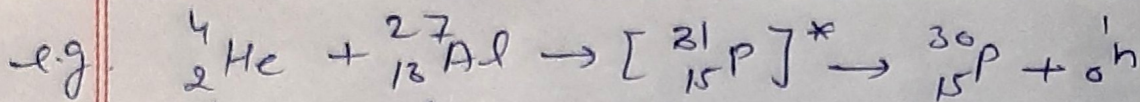


### (iv) compound nuclear rxn -

Incident particle is absorbed by the target nucleus and a compound system is formed.

This system lives for a long  $\sim 10^{-14}$  -  $10^{-16}$  sec.

(as compare to the low energy particles duration i.e. 5 mevs energy  $10^{-21}$  -  $10^{-22}$  sec) and then particle or 2<sup>o</sup> of particles is ~~not~~ ejected.

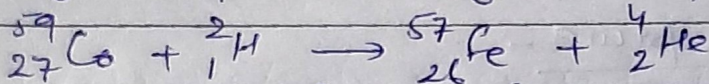
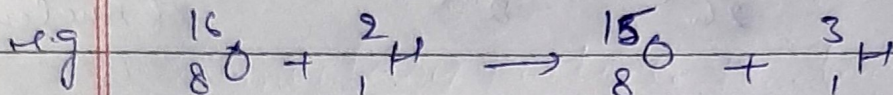


(V) Direct Rxn - In some cases fast moving incident particle while crossing through the nucleus - Two types

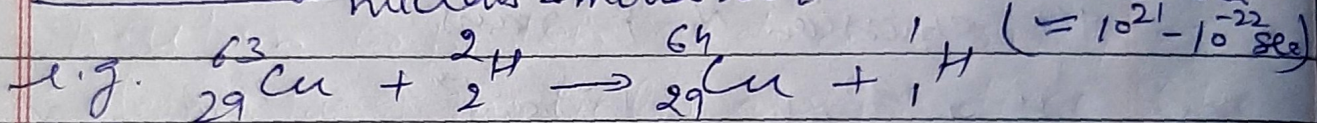
(i) Pickup rxn - either picks up one or more nucleons & moves in forward direction  
 projectile nucleus  $\xrightarrow{\text{hit to}}$  target nucleus

projectile nucleus  $\downarrow$  gain some energy from target nucleus

get final state (अंतिम अवस्था)

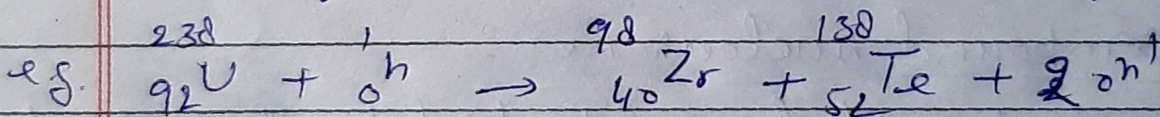


(ii) stripping Rxn - loses one or more nucleons to nucleus & moves in forward direction

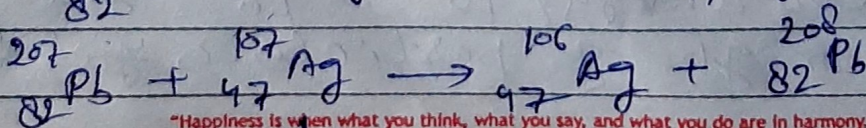
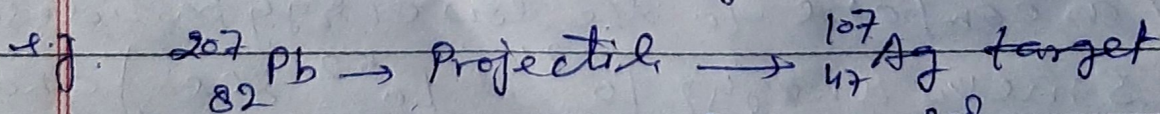


(vi) Spallation Rxn -

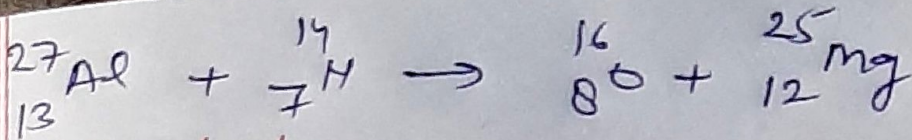
A target nucleus captures a projectile nucleus



(vii) Heavy Ion Rn - Rxn in which an incident is a fast moving heavy ion

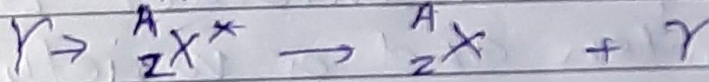
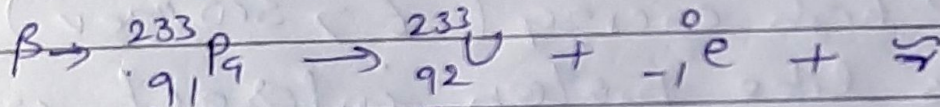
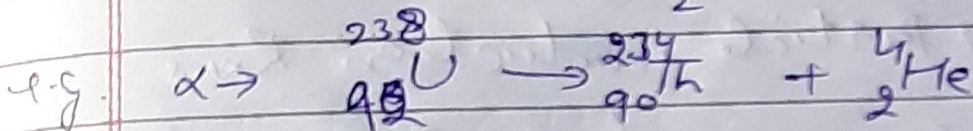
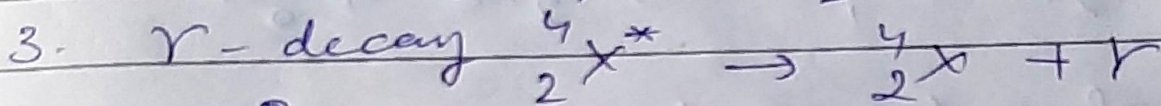
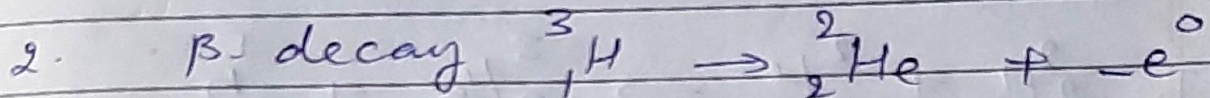
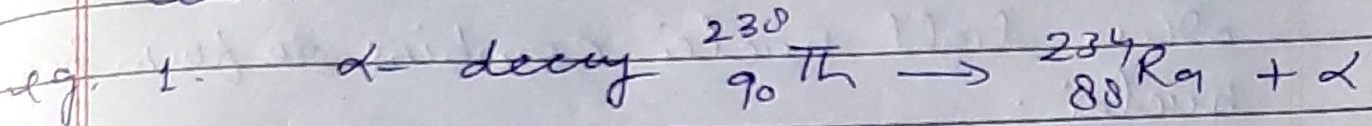


"Happiness is when what you think, what you say, and what you do are in harmony." - Mahatma Gandhi  
 (heavy ion projectile)



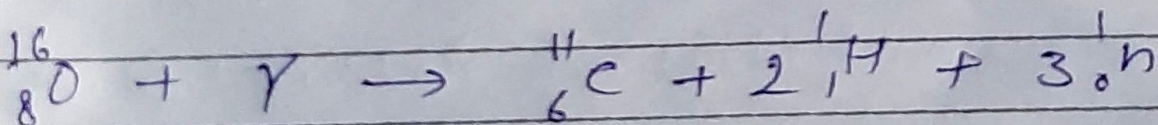
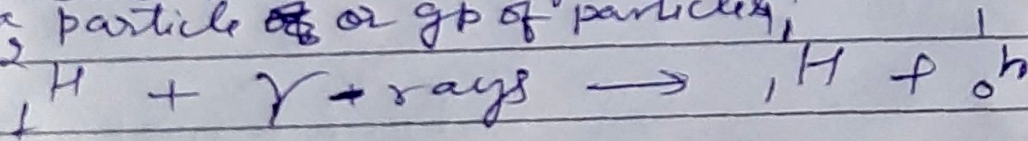
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(VII) Spontaneous type  $R_{\alpha}^n$  or Radioactive decay  
 It have  $\alpha$ ,  $\beta$  &  $\gamma$  particles. It's type  $R_{\alpha}^n$  spontaneous  $R_{\alpha}^n$ , which is not-controlled.



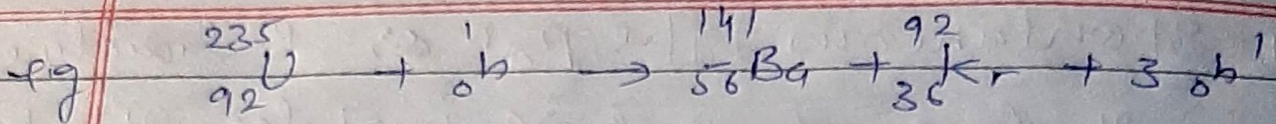
(VIII) Photodisintegration

A target nucleus absorbs  $\gamma$ -rays, gets excited to a higher state and nucleus ejects a particle or group of particles;



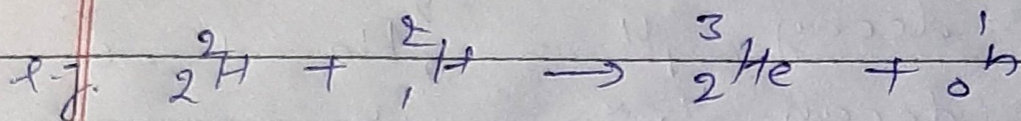
(X) Fission Reactions -

When heavy nuclei capture an incident particle, they break into two fragments with the emission of few particles.



### Fusion Rxns -

When light nuclei combine to form heavy nuclei.



### Elementary Particle Production Rxns.

When v. high energy ( $E > 300 \text{ mev}$ ) incident particles like proton interact with neutron or proton and a variety of elementary particles are produced like meson, pions etc.