8 Explain Alfa-decay as an example of Potential Barrier.

Sol:- α-decay is the process in which a nucleus loses an α particle and changes into another nucleus having charge number decreased by two and mass number decreased by four, that is,

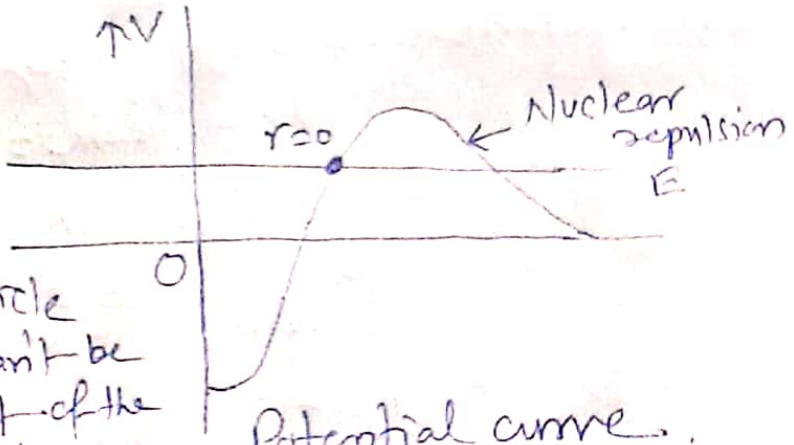
$$_{Z}X^{A} \longrightarrow {}_{Z-2}M^{A-4} + {}_{2}He^{4} \quad (\alpha\text{-particle})$$

When an α-particle is brought from a long distance towards the nucleus then it will be repelled electrically and will possess potential energy which is given by

$$P.E. = \frac{1}{4\pi\epsilon_0}\frac{(2e)(Ze)}{r} \quad \text{---} (1)$$

where Ze is the charge on nucleus, 2e is the charge on α-particle and r is the distance of the α-particle from center of the nucleus.

The potential curve with distance 'r' is shown as



Potential curve.

The energy of α-particle inside the nucleus can't be greater than the height of the potential barrier which exists around the nucleus. It means that α-particle should never come out of the nucleus. According to Classical mechanics, the α-particle once got inside the nucleus will be trapped in it. But as per Q.M., α-particle has a small and finite probability of penetrating the barrier. It has been proved that the α-particle moves back and forth freely with average speed of 10^7 m/sec.