



DPP 05

Solution

1. There is no external force, so momentum conservation concept is completely applicable.

$$\therefore m\vec{v} = m_1\vec{v}_1 + m_2\vec{v}_2$$

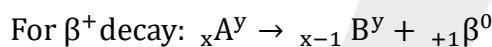
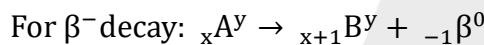
$$\text{or } (m_1 + m_2)\vec{v} = m_1\vec{v}_1 + m_2\vec{v}_2$$

2. Let, ${}_{Z}^{A}X \rightarrow {}_{A-2}^{A-4}Y + {}_2^4\text{He}$

$$K_\alpha = \frac{m_y}{m_y + m_\alpha} Q = \frac{A-4}{A} Q$$

$$\text{or } 48 = \frac{A-4}{A} \times 50 \Rightarrow A = 100$$

3. For α -decay: ${}_x^A Y \rightarrow {}_{x-2}^{A-4} B + \alpha$



For k-capture, number of protons will not change. So, only case in which number of protons increases is β^- -decay.

4. Expected atomic mass of Cu must be less than that of Zn, but it is not so. So, it means Cu is radioactive and unstable and decays to Zn through β -decay.

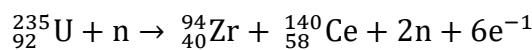
5. As the alpha particle decays, the daughter nucleus recoils. In such a process, the momentum conservation holds.

$$\text{So, } p_\alpha = p_D = p$$

$$K_\alpha = \frac{p^2}{2M_\alpha} \text{ and } K_D = \frac{p^2}{2M_D}$$

As $M_D > M_\alpha$, so, $K_\alpha > K_D$.

6. The complete fission reaction is



$$Q = [m({}_{92}^{235}\text{U}) - m({}_{40}^{94}\text{Zr}) - m({}_{58}^{140}\text{Ce}) - m(n)]c^2 = 208 \text{ MeV}$$

7. During fusion, binding energy of daughter nucleus is always greater than the total binding energy of the parent nuclei. The difference of binding energies is released.

$$\text{So, } Q = E_2 - 2E_1$$

8. α -decay reduces mass number by 4 and decreases charge number by 2. Where, β -decay keeps mass number unchanged and increases charge by 1.



9. Decrease in mass number = $232 - 208 = 24$

$$\text{Number of } \alpha\text{-particles emitted} = \frac{24}{4} = 6$$

Due to emission of 6 particles, decrease in charge number is 12. But actual decrease in charge number is 8. Clearly, 4 β -particles are emitted.

