DPP 05

1. A nucleus moving with velocity $\vec{v}$ emits an α-particle. Let the velocities of the α-particle and the remaining nucleus be $\vec{v}_1$ and $\vec{v}_2$ and their masses be m_1 and m_2, then

(A) $\vec{v}, \vec{v}_1$, and $\vec{v}_2$ must be parallel to each other

(B) none of the two of $\vec{v}, \vec{v}_1$, and $\vec{v}_2$ should be parallel to each other

(C) $\vec{v}_1 + \vec{v}_2$ must be parallel to $\vec{v}$

(D) $m_1\vec{v}_1 + m_2\vec{v}_2$ must be parallel to $\vec{v}$

2. In an α-decay, the kinetic energy of α-particle is 48 MeV and Q value of the reaction is 50 MeV. The mass number of the mother nucleus is (assume that daughter nucleus is in ground state)

(A) 96 (B) 100 (C) 104 (D) none of these

3. In which of the following processes, the number of protons in the nucleus increase?

(A) α-decay (B) β^--decay (C) β^+- decay (D) k-capture

4. Atomic masses of two isobars $^{64}_{29}Cu$ and $^{64}_{30}Zn$ are 63.9298 u and 63.9292 u, respectively. It can be concluded from this data that

(A) both the isobars are stable

(B) ^{64}Zn is radioactive, decaying to ^{64}Cu through β-decay

(C) ^{64}Cu is radioactive, decaying to ^{64}Zn through β-decay

(D) ^{64}Cu is radioactive, decaying to ^{64}Zn through γ-decay

5. If a nucleus such as ^{226}Ra that is initially at rest undergoes α-decay, then which of the following statements is true?

(A) The alpha particle has more kinetic energy than the daughter nucleus.

(B) The alpha particle has less kinetic energy than the daughter nucleus.

(C) The alpha particle and daughter nucleus both have same kinetic energy

(D) We cannot say anything about kinetic energy of alpha particle and daughter nucleus.

6. Consider one of fission reactions of ^{235}U by thermal neutrons $^{235}_{92}U + n \rightarrow {}^{94}_{38}Sr + {}^{140}_{54}Xe + 2n$. The fission fragments are however unstable and they undergo successive β-decay until $^{94}_{38}Sr$ becomes $^{94}_{40}Zr$ and $^{140}_{54}Xe$ becomes $^{140}_{58}Ce$. The energy released in this process is

[Given: $m(^{235}U) = 235.439\text{ u}, m(n) = 1.00866\text{ u}, m(^{94}Zr) = 93.9064\text{ u}, m(^{140}Ce)$
$= 139.9055\text{ u}, 1\text{u} = 931\text{ MeV}$]

(A) 156 MeV (B) 208 MeV

(C) 456 MeV (D) cannot be computed

7. The binding energies of nuclei X and Y are E_1 and E_2, respectively. Two atoms of X fuse to give one atom of Y and an energy Q is released. Then,

(A) $Q = 2E_1 - E_2$
(B) $Q = E_2 - 2E_1$
(C) $Q < 2E_1 - E_2$
(D) $Q > E_2 - 2E_1$

8. In the disintegration series

$${}^{238}_{92}U \xrightarrow{\alpha} X \xrightarrow{\beta^-} {}^{A}_{Z}Y$$

the values of Z and A, respectively, will be

(A) 92,326
(B) 88,230
(C) 90,234
(D) 91,234

9. In the case of thorium ($A = 232$ and $Z = 90$), we obtain an isotope of lead ($A = 208$ and $Z = 82$) after some radioactive disintegrations. The number of α - and β-particles emitted are, respectively,

(A) 6,3
(B) 6,4
(C) 5,5
(D) 4,6

ANSWER KEY

1. (D)
2. (B)
3. (B)
4. (C)
5. (A)
6. (B)
7. (B)
8. (D)
9. (B)