# Physicsaholics

**DPP – 2 (Nuclear Physics)**

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Q 1. A nucleus of mass number A, originally at rest, emits an a-particle with speed v. The daughter nucleus recoils with a speed-
(a) $2v/(A + 4)$ (b) $4v/(A + 4)$
(c) $4v/(A – 4)$ (d) $2v/(A – 4)$

Q 2. A nucleus of mass 218 amu in free state decays to emit an alpha particle (mass 4 amu). The kinetic energy of the alpha particle is found to be 6.7 MeV. The recoil energy of the daughter nucleus (in MeV) is –
(a) $6.7 \times 4/214$ (b) $6.7 \times (4/214)^2$
(c) $6.7 \times 4/218$ (d) $6.7 \times (4/218)^2$

Q 3. An atom of mass number A and atomic number Z emits successively an α-particle, β-particle and γ-rays. The mass number and atomic number of the end product are
(a) A, Z + 1 (b) A – 1, Z – 4
(c) A – 4, Z – 1 (d) A – 4, Z + 2

Q 4. When a free neutron decays to form a proton and an electron, then choose the incorrect statement -
(a) the relation may be expressed as ${}_0n^1 \rightarrow {}_1p^1 + {}_{-1}e^0$
(b) every electron comes out with the same energy
(c) the electron shares the major part of the energy released
(d) all the above

Q 5. If mass of the fissionable material is less than the critical mass, then -
(a) fission and chain reactions both are impossible
(b) fission is possible but chain reaction is impossible
(c) fission is impossible but chain reaction is possible
(d) fission and chain reaction both are possible

Q 6. During a negative beta decay:
(a) an atomic electron is ejected
(b) an electron which is already present within the nucleus is ejected
(c) a neutron in the nucleus decays emitting an electron
(d) a part of the binding energy of the nucleus is converted into an electron

Q 7. Masses of two isobars ${}_{29}Cu^{64}$ and ${}_{30}Zn^{64}$ are 63.9298 u and 63.9292 u respectively. It can be concluded from these data that:
(a) both the isobars are stable

(b) $Zn^{64}$ is radioactive, decaying to $Cu^{64}$ through α-decay
(c) $Cu^{64}$ is radioactive, decaying to $Zn^{64}$ through γ-decay
(d) $Cu^{64}$ is radioactive, decaying to $Zn^{64}$through β-decay

Q 8. Match The Column

| Column-I | Column-II |
|---|---|
| (A) Nuclear Fusion | (P) Some matter converted into energy |
| (B) Nuclear Fission | (Q) Generally occurs in nuclei having low atomic number. |
| (C) b-decay | (R)Generally occurs in nuclei having higher atomic number. |

**COMPREHENSION (Q 9. To Q 12.)**

A nucleus at rest undergoes a decay emitting an $\alpha$ particle of de-Broglie wavelength $\lambda = 5.76 \times 10–15$ m. The mass of the daughter nucleus is 223.40 amu and that of a particle is 4.002 amu.

Q 9. The linear momentum of α particle and that of daughter nucleus is–
(a) $1.15 \times 10^{-19}$ N-s & $2.25 \times 10^{-19}$ N-s
(b) $2.25 \times 10^{-19}$ N-s & $1.15 \times 10^{-19}$ N-s
(c) both $1.15 \times 10^{-19}$ N-s
(d) both $2.25 \times 10^{-19}$ N-s

Q 10. The kinetic energy of α particle is–
(a) 0.01 MeV (b) 6.22 MeV
(c) 0.21 MeV (d) 0.31 MeV

Q 11. The kinetic energy of daughter nucleus is–
(a) 3.16 MeV (b) 4.16 MeV
(c) 5.16 MeV (d) 0.11 MeV

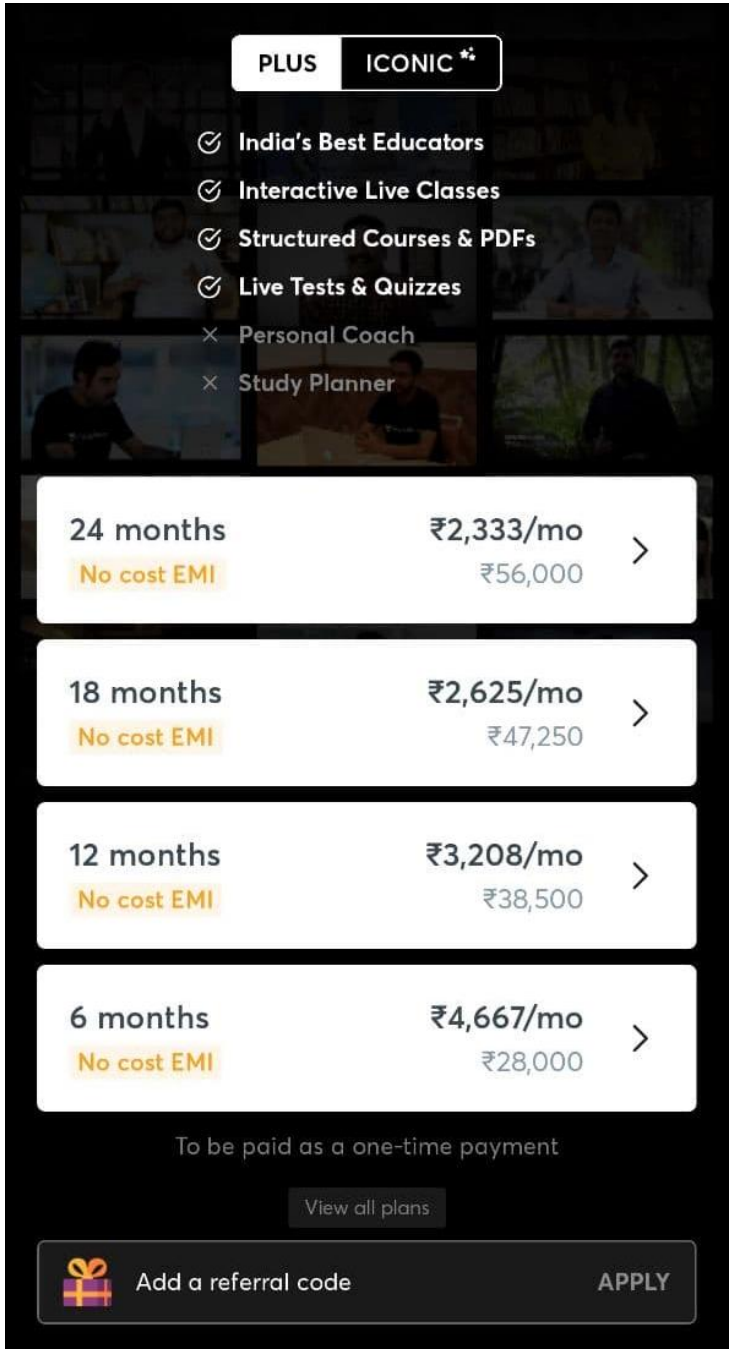
Q 12. The mass of the parent nucleus in amu is–
(a) 227.418 (b) 207.518
(c) 227.618 (d) 227.2



# Answer Key

| | | | | |
|---|---|---|---|---|
| **Q.1 c** | **Q.2 a** | **Q.3 c** | **Q.4 d** | **Q.5 b** |
| **Q.6 c** | **Q.7 d** | **Q.9 c** | **Q.10 b** | **Q.11 d** |
| **Q.12 a** | | | | |

Ans 8. A→ P, Q ; B → P,R ; C → P

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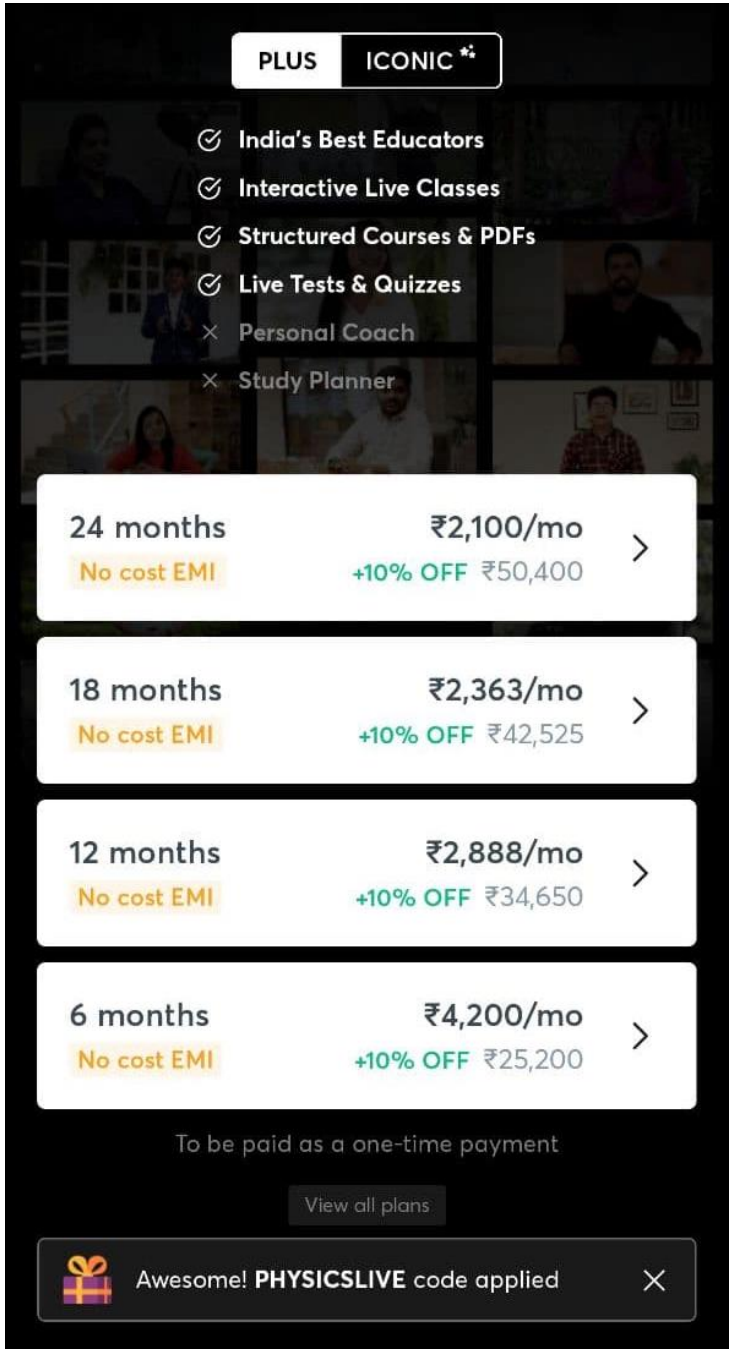
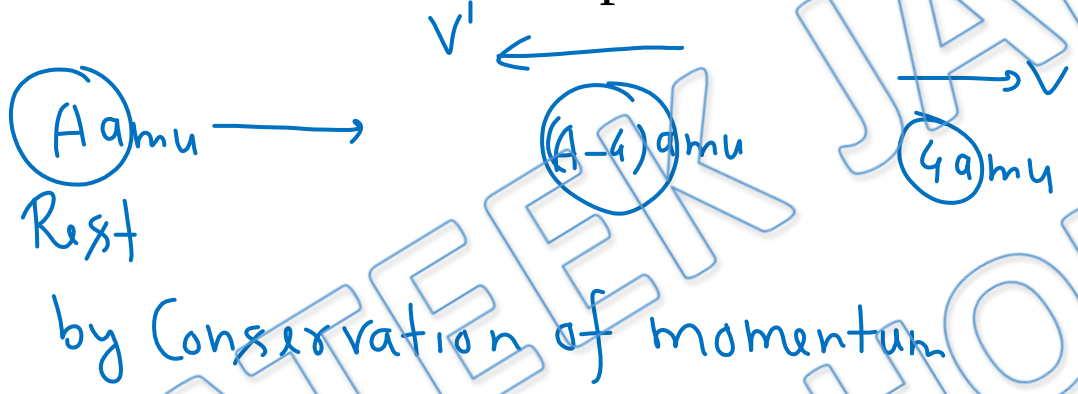


# JEE Main & Advanced, NSEP, INPhO, IPhO
# Physics DPP - Solution

## DPP – 2 Nuclear Physics : Fusion & Fission Reactions & Nuclear Decay

## By Physicsaholics Team

Q1) A nucleus of mass number A, originally at rest, emits an α-particle with speed v. The daughter nucleus recoils with a speed-




by Conservation of momentum

$$0 = 4V - (A-4)V'$$

$$V' = \frac{4V}{A-4}$$

(a) 2v/(A + 4)

(b) 4v/(A + 4)

(c) 4v/(A – 4)

(d) 2v/(A – 4)

Q2) A nucleus of mass 218 amu in free state decays to emit an alpha particle (mass 4 amu). The kinetic energy of the alpha particle is found to be 6.7 MeV. The recoil energy of the daughter nucleus (in MeV) is -


(a) $6.7 \times 4/214$

(b) $6.7 \times (4/214)^2$

(c) $6.7 \times 4/218$

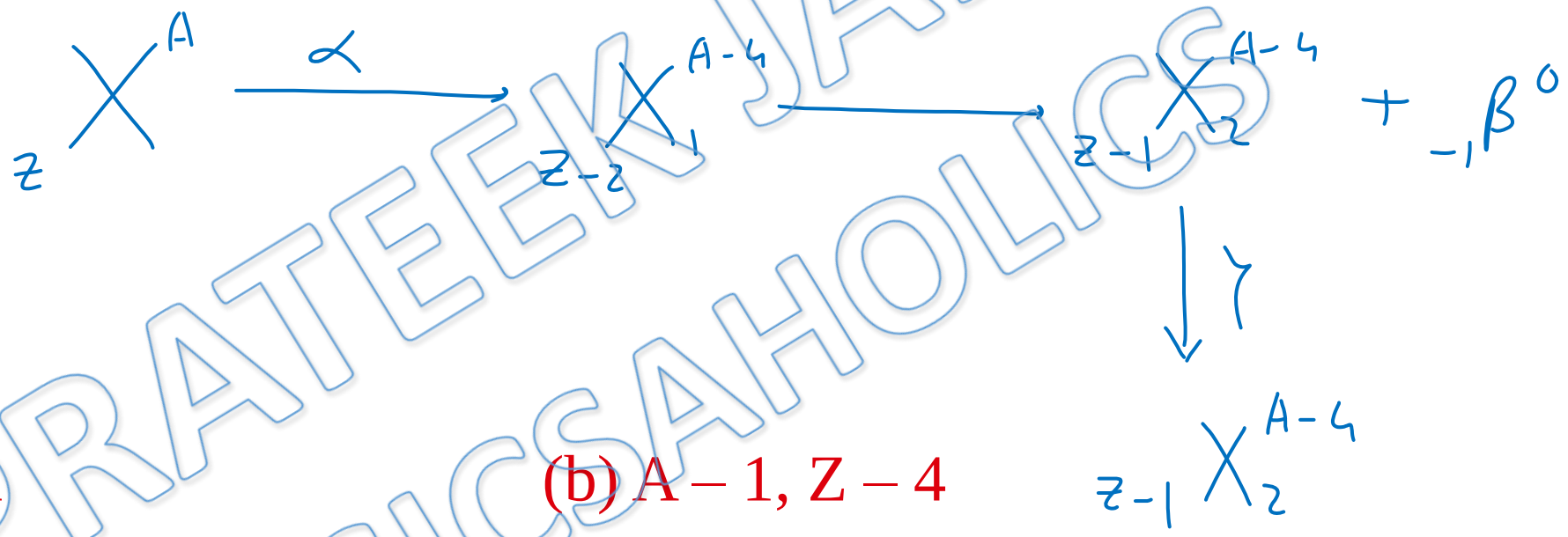
(d) $6.7 \times (4/218)^2$

$= \frac{214}{218} Q = 6.7 \text{ MeV}$

$Q = \frac{6.7 \times 218}{214} \text{ MeV}$

$K_{Du} = \frac{4}{A} Q = \frac{4}{218} \times \frac{6.7 \times 218}{214} \text{ MeV}$

Q3) An atom of mass number A and atomic number Z emits successively an α-particle, β-particle and γ-rays. The mass number and atomic number of the end product are



(a) A, Z + 1

(b) A – 1, Z – 4

(c) A – 4, Z – 1

(d) A – 4, Z + 2

Q4) When a free neutron decays to form a proton and an electron, then choose the incorrect statement -

$$n \longrightarrow p + e^- + \bar{\nu}$$

(a) the relation may be expressed as ${}_0n^1 \rightarrow {}_1p^1 + {}_{-1}e^0$

(b) every electron comes out with the same energy

(c) the electron shares the major part of the energy released

(d) all the above

Q5) If mass of the fissionable material is less than the critical mass, then -

(a) fission and chain reactions both are impossible

(b) fission is possible but chain reaction is impossible

(c) fission is impossible but chain reaction is possible

(d) fission and chain reaction both are possible

Q6) During a negative beta decay:

$$n \longrightarrow p + e^- + \bar{\nu}$$

(a) an atomic electron is ejected

(b) an electron which is already present within the nucleus is ejected

(c) a neutron in the nucleus decays emitting an electron

(d) a part of the binding energy of the nucleus is converted into an electron

Q7) Masses of two isobars $_{29}Cu^{64}$ and $_{30}Zn^{64}$ are 63.9298 u and 63.9292 u respectively. It can be concluded from these data that:

(a) both the isobars are stable

(b) $Zn^{64}$ is radioactive, decaying to $Cu^{64}$ through α-decay

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

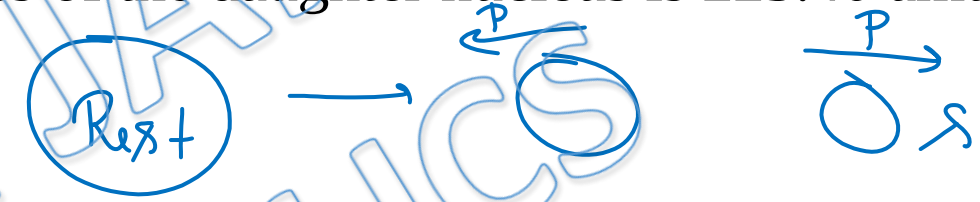
(d) $Cu^{64}$ is radioactive, decaying to $Zn^{64}$through β-decay

Q8) Match The Column

| Column-I | Column-II |
| --- | --- |
| (A) Nuclear Fusion | (P) Some matter converted into energy |
| (B) Nuclear Fission | (Q) Generally occurs in nuclei having low atomic number. |
| (C) β-decay | (R) Generally occurs in nuclei having higher atomic number. |

**COMPREHENSION (Q9 to Q12)**

A nucleus at rest undergoes a decay emitting an α particle of de-Broglie wavelength $\lambda = 5.76 \times 10–15$ m. The mass of the daughter nucleus is 223.40 amu and that of α particle is 4.002 amu.




Q9) The linear momentum of α particle and that of daughter nucleus is–

(a) $1.15 \times 10^{-19}$ N-s & $2.25 \times 10^{-19}$ N-s

(b) $2.25 \times 10^{-19}$ N-s & $1.15 \times 10^{-19}$ N-s

(c) both $1.15 \times 10^{-19}$ N-s

(d) both $2.25 \times 10^{-19}$ N-s

$$P = \frac{h}{\lambda_{De}} = \frac{6.6 \times 10^{-34}}{5.76 \times 10^{-15}}$$

$$= 1.15 \times 10^{-19}$$

Q10) The kinetic energy of $\alpha$ particle is–

$$K_\alpha = \frac{p^2}{2m_\alpha} = \frac{(1.15 \times 10^{-19})^2}{2 \times 4 \times 1.67 \times 10^{-27}} J$$

$$= \frac{1.15 \times 10^{-38} \times 1.15}{8 \times 1.67 \times 10^{-27} \times 1.6 \times 10^{-13}} = \frac{1.15 \times 1.15}{12.8 \times 1.67} \times 100 \text{ MeV}$$

$$= \frac{1.15 \times 1.15}{12.8 \times 1.68} \text{ MeV}$$

(a) 0.01 MeV (b) 6.22 MeV

(c) 0.21 MeV (d) 0.31 MeV

Q11) The kinetic energy of daughter nucleus is–

$$K_\alpha = \frac{p^2}{2m_\alpha} = 6.22\ \text{MeV}$$

$$K_{Da} = \frac{p^2}{2m_D} = \frac{p^2}{2m_\alpha} \times \frac{m_\alpha}{m_D} = 6.22 \times \frac{4}{234} = \frac{6.22}{54.8}\ \text{MeV}$$

$$= .11\ \text{MeV}$$

(a) 3.16 MeV (b) 4.16 MeV

(c) 5.16 MeV (d) 0.11 MeV

Q12) The mass of the parent nucleus in amu is–

total KE = (6.22 + .11) MeV = 6.33 MeV

loss in mass = $\frac{6.33}{931}$ amu

931) 6330 (.68
5586
0744
7448

(a) 227.418 (b) 207.518

(c) 227.618 (d) 227.2

Mass of parent = $223.4 + 4.002 + \frac{6.33}{931} \times \frac{1}{100}$

$= 227.402 + .0068$

$= 227.4088$

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