

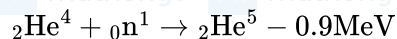
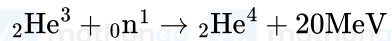
Q1. JEE Main 2026 (28 January Shift 2)

A nucleus has mass number α and radius R_α . Another nucleus has mass number β and radius R_β . If $\beta = 8\alpha$ then R_α/R_β is:

- (1) 8 (2) 0.5 (3) 2 (4) 1

Q2. JEE Main 2026 (24 January Shift 2)

The binding energy for the following nuclear reactions are expressed in MeV.



If X_3, X_4, X_5 denote the stability of ${}_2\text{He}^3, {}_2\text{He}^4$ and ${}_2\text{He}^5$, respectively, then the correct order is :

- (1) $X_4 < X_5 < X_3$ (2) $X_4 > X_5 > X_3$
(3) $X_4 > X_5 < X_3$ (4) $X_4 = X_5 = X_3$

Q3. JEE Main 2026 (22 January Shift 1)

The minimum frequency of photon required to break a particle of mass 15.348 amu into 4α particles is ____ kHz.

[mass of He nucleus = 4.002 amu, 1 amu = 1.66×10^{-27} kg, $h = 6.6 \times 10^{-34}$ J.s and $c = 3 \times 10^8$ m/s]

- (1) 14.94×10^{19} (2) 9×10^{20}
(3) 14.94×10^{20} (4) 9×10^{19}

Q4. JEE Main 2026 (22 January Shift 1)

7.9 MeV α -particle scatters from a target material of atomic number 79. From the given data the estimated diameter of nuclei of the target material is (approximately) ____ m. $\left[\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2/\text{C}^2 \text{ and electron charge} \right.$

$\left. = 1.6 \times 10^{-19} \text{ C} \right]$

- (1) 1.44×10^{-13} (2) 5.76×10^{-14}
(3) 2.88×10^{-14} (4) 1.69×10^{-12}

Q5. JEE Main 2026 (23 January Shift 2)

Which of the following pair of nuclei are isobars of the element?

- (1) ${}_1^3\text{H}$ and ${}_2^3\text{He}$ (2) ${}_1^2\text{H}$ and ${}_1^3\text{H}$
(3) ${}_{80}^{198}\text{Hg}$ and ${}_{79}^{197}\text{Au}$ (4) ${}_{92}^{236}\text{U}$ and ${}_{92}^{238}\text{U}$

Q6. JEE Main 2026 (23 January Shift 2)

The average energy released per fission for the nucleus of ${}_{92}^{235}\text{U}$ is 190 MeV. When all the atoms of 47 g pure ${}_{92}^{235}\text{U}$ undergo fission process, the energy released is $\alpha \times 10^{23}$ MeV. The value of α is ____.

(Avogadro Number = 6×10^{23} per mole)

Q7. JEE Main 2026 (28 January Shift 1)

An atom 8_3X is bombarded by shower of fundamental particles and in 10 s this atom absorbed 10 electrons, 10 protons and 9 neutrons. The percentage growth in the surface area of the nucleons is recorded by:

- (1) 250% (2) 150% (3) 900% (4) 125%

Q8. JEE Main 2026 (24 January Shift 1)

Given below are two statements:

Statement I: For all elements, greater the mass of the nucleus, greater is the binding energy per nucleon.

Statement II: For all elements, nuclei with less binding energy per nucleon transforms to nuclei with greater binding energy per nucleon.

In the light of the above statements, choose the correct answer from the options given below

- (1) Statement I is true but Statement II is false
(2) Both Statement I and Statement II are true
(3) Both Statement I and Statement II are false
(4) Statement I is false but Statement II is true

ANSWERS AND SOLUTIONS

1. (2) 2. (2) 3. (1) 4. (2) 5. (1) 6. 228 7. (4) 8. (4)

1. (2) Nuclear radius follows $R = R_0 A^{1/3}$ where A is mass number.

Given $\beta = 8\alpha$, we have $R_\alpha = R_0 \alpha^{1/3}$ and $R_\beta = R_0 (8\alpha)^{1/3} = R_0 \cdot 2\alpha^{1/3} = 2R_\alpha$.

Thus $R_\alpha/R_\beta = 1/2 = 0.5$.

2. (2) $BE_{He^4} - BE_{He^3} = 20 \text{ MeV} \dots (1)$

$BE_{He^5} - BE_{He^4} = -0.9 \text{ MeV} \dots (2)$

From eq (1) & (2)

$BE_{He^4} > BE_{He^5} > BE_{He^3}$

$X_4 > X_5 > X_3$

3. (1) $h\nu = (4 \times 4.002 - 15.348) \times 1.66 \times 10^{-27} \times (3 \times 10^8)^2$

$\nu = 14.94 \times 10^{19} \text{ kHz}$

4. (2) For Rutherford scattering, at the closest approach all kinetic energy converts to electrostatic potential energy.

For alpha particle-nucleus collision:

$$K.E. = \frac{1}{4\pi\epsilon_0} \frac{Z_1 Z_2 e^2}{r_{min}}$$

Where: $Z_1 = 2$ (alpha), $Z_2 = 79$ (gold), $K.E. = 7.9 \text{ MeV}$

$$r_{min} = \frac{9 \times 10^9 \times 2 \times 79 \times (1.6 \times 10^{-19})^2}{7.9 \times 10^6 \times 1.6 \times 10^{-19}}$$

$$r_{min} = 2.88 \times 10^{-14} \text{ m}$$

The estimated nuclear diameter is approximately:

$$d = 2 \times r_{min} = 5.76 \times 10^{-14} \text{ m}$$

5. (1) Isobars are atoms of different chemical elements that have the same number of nucleons (mass number A), but different atomic numbers (Z).

In the given options:

(1) ${}^3_1\text{H}$ and ${}^3_2\text{He}$: Both have the same mass number $A = 3$. Since they have different atomic numbers ($Z = 1$ and $Z = 2$), they are isobars.

(2) ${}^2_1\text{H}$ and ${}^3_1\text{H}$: These have the same atomic number ($Z = 1$) but different mass numbers. They are isotopes.

(3) ${}^{198}_{80}\text{Hg}$ and ${}^{197}_{79}\text{Au}$: These have different mass numbers (198 and 197).

(4) ${}^{236}_{92}\text{U}$ and ${}^{238}_{92}\text{U}$: These have the same atomic number ($Z = 92$) but different mass numbers. They are isotopes.

Thus, the pair ${}^3_1\text{H}$ and ${}^3_2\text{He}$ are isobars.

6. (228) The number of ${}^{235}\text{U}$ atoms in 47 g is determined using Avogadro's number.

Molar mass of ${}^{235}\text{U}$ is 235 g/mol, so the number of moles is $n = 47/235 \text{ mol}$.

The total number of atoms is $N = (47/235) \times 6 \times 10^{23}$.

Since each fission releases 190 MeV, the total energy released is:

$$E_{total} = N \times 190 = \frac{47 \times 6 \times 10^{23}}{235} \times 190 = \frac{47 \times 6 \times 190}{235} \times 10^{23} \text{ MeV}.$$

Calculating the numerator: $47 \times 6 \times 190 = 282 \times 190 = 53580$.

Therefore: $E_{total} = \frac{53580}{235} \times 10^{23} = 228 \times 10^{23} \text{ MeV}$, giving $\alpha = 228$.

7. (4) Surface area $x \propto A^{2/3}$

$$X_i = 8^{2/3} K = 4K$$

$$X_f = (8 + 10 + 9)^{2/3} K = 9K$$

% increase in surface area of nucleus

$$x_i = \frac{9K - 4K}{4K} \times 100 = 125\%$$

8. (4) Statement I is false because binding energy per nucleon does not increase monotonically with mass number. It peaks at Iron-56 and decreases for heavier elements.

Statement II is true. It describes the fundamental principle of nuclear reactions: fission of heavy nuclei (low BE/A) and fusion of light nuclei (low BE/A) both produce nuclei with higher binding energy per nucleon, releasing energy in the process. Both processes are energetically favorable for the same reason: moving toward higher stability (higher BE/A).