CHAPTER

26

Nuclear Physics

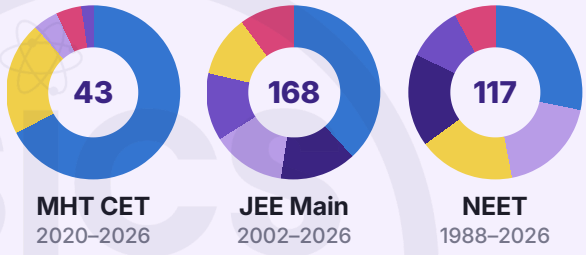
MHT CET · JEE · NEET Physics

PHYSICS CIRCLE

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EXAM WEIGHTAGE



	CET	JEE	NEET
Law of Radioactive Decay	29 67%	64 38%	33 28%
Radioactive Decays: Alpha, Beta, Gamma	9 21%	19 11%	21 18%
Nucleus: Composition, Size & Nuclear Force	2 5%	23 14%	22 19%
Nuclear Fission & Fusion	0 0%	24 14%	20 17%
Mass Defect & Binding Energy	1 2%	21 12%	12 10%
Nuclear Reactions & Q-value	2 5%	17 10%	9 8%

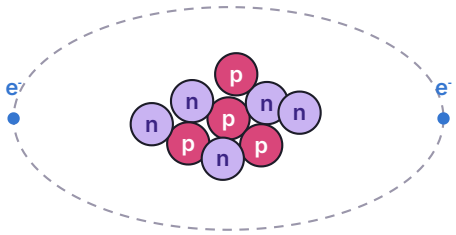
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01 CONCEPT Nucleus: Composition, Size & Nuclear Force

IN ONE LINE

A nucleus is a tiny core of protons and neutrons. Its radius grows as $A^{1/3}$, so its **density is the same** for all nuclei.

26.1.1 What a nucleus contains



Z protons + N neutrons in the core

Protons and neutrons are called nucleons

- Z = atomic number = number of protons.
- N = number of neutrons.
- A = mass number = number of nucleons.

$$A = Z + N$$

- A nuclide is written ${}^{A}_{Z}X$.
- A nucleus has no electrons.

26.1.2 Isotopes, isobars and isotones

Type	Same	Example
isotopes	Z	${}^{1}_{1}H$, ${}^{2}_{1}H$, ${}^{3}_{1}H$
isobars	A	${}^{3}_{1}H$, ${}^{3}_{2}He$
isotones	N = A − Z	${}^{3}_{1}H$, ${}^{4}_{2}He$

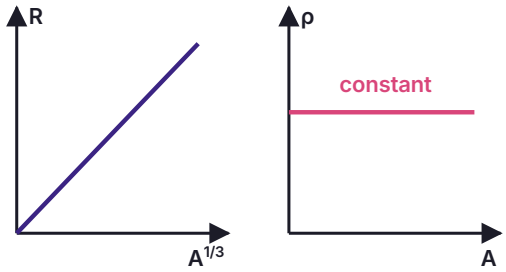
- Isotopes have the same chemical properties.

26.1.3 Radius from mass number

$$R = R_0 A^{1/3}$$

- $R_0 = 1.2 \times 10^{-15}$ m = 1.2 fm.
- Volume $\propto R^3 \propto A$.

$$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3}$$



R grows with A; density does not change

26.1.4 Same for all nuclei

$$\rho = \frac{\text{mass}}{\text{volume}} = \frac{mA}{(4\pi \div 3)\, R_0{}^3 A} = \frac{3m}{4\pi R_0{}^3}$$

- m = mass of a nucleon = 1.67×10^{-27} kg.
- A cancels: ρ does not depend on A.
- $\rho \approx 2.3 \times 10^{17}$ kg m^{-3}.

26.1.5 Velocity and radius ratios

$$m_1 v_1 = m_2 v_2$$

$$\frac{R_1}{R_2} = \left(\frac{m_1}{m_2}\right)^{1/3} = \left(\frac{v_2}{v_1}\right)^{1/3}$$

26.1.6 What holds nucleons together

- Strongest force in nature.
- Short range: acts only up to about 10^{-15} m.
- Attractive, and it makes the nucleus stable.
- Charge independent: same for p–p, n–n and p–n.
- Non-central; does not obey the inverse square law.

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JEE · NEET Corner

The neutron

- Discovered by Chadwick. Charge zero, mass 1.675×10^{-27} kg.
- Present in every nucleus except ordinary hydrogen.
- Free neutron is unstable: half-life about 12 minutes.
- Decay: $n \rightarrow p + e^{-} + \bar{\nu}$.

Thermal neutrons

- A moderator (heavy water, graphite, paraffin wax) slows fast neutrons.
- Thermal neutron: energy about 0.025 eV, speed about 2.2 km s^{-1}.

Mirror nuclei

- Same A, with Z and N interchanged.
- Example: ${}^{3}_{1}H$ and ${}^{3}_{2}He$.

Exchange of mesons

- Nuclear force is an exchange force (Yukawa).
- $p \leftrightarrow n$: exchange of a charged π-meson (π^{+}, π^{-}).
- n–n and p–p: exchange of a neutral π-meson (π^{0}).

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Solved Examples 01 Nucleus: Composition, Size & Nuclear Force

SOLVED 1 AIPMT 1991

In the nucleus of $^{23}_{11}Na$, the number of protons, neutrons and electrons are

(a) 11, 12, 0 (b) 23, 12, 11
(c) 12, 11, 0 (d) 23, 11, 12

STEP 1 Protons Z = 11
STEP 2 Neutrons N = A − Z = 23 − 11 = 12
STEP 3 A nucleus has no electrons: **11, 12, 0**

Answer: **(a)**

SOLVED 2 AIPMT 2005

Which one of the following pairs of nuclei are isotones?

(a) $_{34}Se^{74}$, $_{31}Ga^{71}$
(b) $_{38}Sr^{84}$, $_{38}Sr^{86}$
(c) $_{42}Mo^{92}$, $_{40}Zr^{92}$
(d) $_{20}Ca^{40}$, $_{16}S^{32}$

STEP 1 Isotones have the same N = A − Z
STEP 2 Se: 74 − 34 = 40. Ga: 71 − 31 = 40
STEP 3 Same N: **Se and Ga**

Answer: **(a)**

SOLVED 3 JEE Main 2026 · 23 Jan · Shift 2

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

(a) $^{3}_{1}H$ and $^{3}_{2}He$
(b) $^{198}_{80}Hg$ and $^{197}_{79}Au$
(c) $^{2}_{1}H$ and $^{3}_{1}H$
(d) $^{236}_{92}U$ and $^{238}_{92}U$

STEP 1 Isobars have the same A and different Z
STEP 2 $^{3}_{1}H$ and $^{3}_{2}He$: A = 3 for both
STEP 3 **$^{3}_{1}H$ and $^{3}_{2}He$**

Answer: **(a)**

SOLVED 4 NEET 2022 · Phase 1

A nucleus of mass number 189 splits into two nuclei having mass number 125 and 64. The ratio of radius of two daughter nuclei respectively is

(a) 1 : 1 (b) 4 : 5
(c) 5 : 4 (d) 25 : 16

STEP 1 $R \propto A^{1/3}$
STEP 2 $\frac{R_1}{R_2} = (\frac{125}{64})^{1/3}$
STEP 3 $= \frac{5}{4}$ = **5 : 4**

Answer: **(c)**

SOLVED 5 MHT CET 2021 · 22 Sep · Shift 1

A nucleus breaks into two nuclear parts, which have their velocity ratio 2 : 1. The ratio of their nuclear radii will be

(a) $\sqrt{2}$ (b) $\frac{1}{2}$
(c) $\frac{1}{2^{1/3}}$ (d) $\frac{1}{\sqrt{2}}$

STEP 1 Momentum: $m_1v_1 = m_2v_2 \Rightarrow \frac{m_1}{m_2} = \frac{v_2}{v_1} = \frac{1}{2}$
STEP 2 $R \propto A^{1/3} \Rightarrow \frac{R_1}{R_2} = (\frac{1}{2})^{1/3}$
STEP 3 Ratio = $\frac{1}{2^{1/3}}$

Answer: **(c)**

SOLVED 6 AIPMT 2007

If the nucleus $^{27}_{13}Al$ has a nuclear radius of about 3.6 fm, then $^{125}_{52}Te$ would have its radius approximately as

(a) 9.6 fm (b) 12.0 fm
(c) 4.8 fm (d) 6.0 fm

STEP 1 $\frac{R_{Te}}{R_{Al}} = (\frac{125}{27})^{1/3} = \frac{5}{3}$
STEP 2 $R_{Te} = 3.6 \times \frac{5}{3}$
STEP 3 R_{Te} = **6.0 fm**

Answer: **(d)**

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Solved Examples 01 Nucleus: Composition, Size & Nuclear Force (contd.)

SOLVED 7 JEE Main 2024 · 31 Jan · Shift 2

The mass number of nucleus having radius equal to half of the radius of nucleus with mass number 192 is

(a) 32 (b) 24
(c) 20 (d) 40

STEP 1 $\frac{A}{192} = (\frac{1}{2})^3$
STEP 2 $A = \frac{192}{8}$
STEP 3 $A = \mathbf{24}$

Answer: **(b)**

SOLVED 8 MHT CET 2026 · 16 Apr · Shift 2

The ratio of the density of oxygen nucleus ($^{16}_{8}O$) and helium nucleus ($^{4}_{2}He$) is

(a) 1 : 1 (b) 2 : 1
(c) 4 : 1 (d) 8 : 1

STEP 1 Mass $\propto$ A and volume $\propto R^3 \propto$ A
STEP 2 So nuclear density does not depend on A
STEP 3 Ratio = **1 : 1**

Answer: **(a)**

SOLVED 9 AIPMT 1992

The mass density of a nucleus varies with mass number A as

(a) A^2 (b) A
(c) constant (d) $\frac{1}{A}$

STEP 1 Mass $\propto$ A
STEP 2 Volume $\propto$ A
STEP 3 Density is **constant**

Answer: **(c)**

SOLVED 10 JEE Main 2020 · 3 Sep · Shift 2

The radius R of a nucleus of mass number A can be estimated by the formula $R = (1.3 \times 10^{-15})A^{1/3}$ m. It follows that the mass density of a nucleus is of the order of ($M_{prot} \approx M_{neut} \approx 1.67 \times 10^{-27}$ kg)

(a) 10^{24} kg m^{-3} (b) 10^{10} kg m^{-3}
(c) 10^{17} kg m^{-3} (d) 10^{3} kg m^{-3}

STEP 1 $\rho = \frac{3m}{4\pi {R_0}^3}$
STEP 2 $= \frac{3 \times 1.67 \times 10^{-27}}{4\pi \times (1.3 \times 10^{-15})^3}$
STEP 3 $\rho \approx 1.8 \times 10^{17}$, order $\mathbf{10^{17}\ kg\ m^{-3}}$

Answer: **(c)**

SOLVED 11 AIPMT 1990

Which of the following statements is true for nuclear forces?

(a) They obey the inverse square law of distance.
(b) They obey the inverse third power law of distance.
(c) They are short range forces.
(d) They are equal in strength to electromagnetic forces.

STEP 1 Nuclear forces act only up to about 10^{-15} m
STEP 2 They follow no inverse power law and are stronger than electric forces
STEP 3 They are **short range forces**

Answer: **(c)**

SOLVED 12 AIPMT 2008

Two nuclei have their mass numbers in the ratio of 1 : 3. The ratio of their nuclear densities would be

(a) $(3)^{1/3} : 1$ (b) 1 : 1
(c) 1 : 3 (d) 3 : 1

STEP 1 $\rho = \frac{mA}{(4\pi \div 3)\, {R_0}^3 A}$
STEP 2 A cancels, so ρ is the same for all nuclei
STEP 3 Ratio = **1 : 1**

Answer: **(b)**

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02 CONCEPT Mass Defect & Binding Energy

IN ONE LINE

A nucleus weighs **less** than its separate nucleons. The missing mass is the energy that binds it.

26.2.1 Mass and energy

$$1\,u = \frac{1}{12} \times \text{mass of } {}^{12}_{6}C \text{ atom} = 1.66 \times 10^{-27}\ kg$$

$$E = mc^2 \cdot 1\,u = 931\ MeV$$

Particle	Mass (u)
electron	0.0005486
proton	1.007276
neutron	1.00865

26.2.2 Nucleus is lighter than its parts

$$\Delta m = Zm_p + (A - Z)m_n - M$$

- M = mass of the nucleus.
- Using atomic masses, use m_H in place of m_p.

26.2.3 Energy needed to pull a nucleus apart

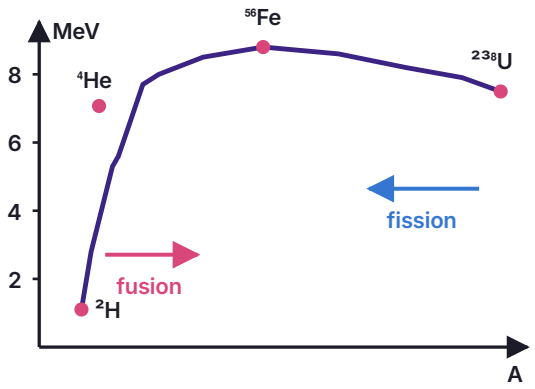
$$B.E. = \Delta m\, c^2$$

$$B.E.\ (\text{in MeV}) = \Delta m\ (\text{in u}) \times 931$$

$$B.E.\ \text{per nucleon} = \frac{\Delta m \times 931}{A}\ MeV$$

- The same energy is released when the nucleus forms.
- Larger B.E. per nucleon ⇒ more stable nucleus.

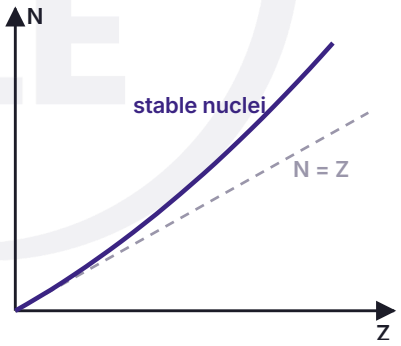
26.2.4 B.E. per nucleon against A



Peak near A = 56; light nuclei fuse, heavy nuclei split

- Rises sharply for light nuclei.
- Maximum 8.8 MeV per nucleon at ^{56}Fe.
- Falls slowly to 7.5 MeV at ^{238}U.
- Nearly constant for A between 30 and 170.
- ^{4}He, ^{12}C, ^{16}O lie above their neighbours.

26.2.5 Neutrons against protons



Heavy stable nuclei have N > Z

- Light stable nuclei: N ≈ Z.
- Heavy stable nuclei: N > Z; extra neutrons balance the electric repulsion.
- No stable nuclide has Z > 83.

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NUCLEAR PHYSICS

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

187	25	6
questions	concepts	topics

CONTENTS

01	Nucleus: Composition, Size & Nuclear Force	Q 1–36	36 Qs
02	Mass Defect & Binding Energy	Q 37–62	26 Qs
03	Nuclear Reactions & Q-value	Q 63–74	12 Qs
04	Nuclear Fission & Fusion	Q 75–102	28 Qs
05	Radioactive Decays: Alpha, Beta, Gamma	Q 103–137	35 Qs
06	Law of Radioactive Decay	Q 138–187	50 Qs
	Answer key		

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TOPIC 01

Nucleus: Composition, Size & Nuclear Force

36 PYQs · Easy 36 · Medium 0 · Difficult 0 | MHT CET 1 · NEET 19 · JEE 16

Concepts covered: Composition of the nucleus (4) · Isotopes, isobars & isotones (3) · Nuclear size: R = R0 A^(1/3) (15) · Nuclear density (11) · Nuclear force (3)

LEVEL 1 · EASY 36 questions

◆ Composition of the nucleus 4 Qs

1. The constituents of atomic nuclei are believed to be
AIPMT 1991
(a) neutrons and protons
(b) protons only
(c) electron and protons
(d) electrons, protons and neutrons

2. In the nucleus of $_{11}Na^{23}$, the number of protons, neutrons and electrons are
AIPMT 1991
(a) 11, 12, 0 (b) 23, 12, 11
(c) 12, 11, 0 (d) 23, 11, 12

3. A nucleus represented by the symbol $^{A}_{Z}X$ has
AIPMT 2004 *(Not in current JEE/NEET syllabus)*
(a) Z neutrons and A − Z protons
(b) Z protons and A − Z neutrons
(c) Z protons and A neutrons
(d) A protons and Z − A neutrons

4. The mass number of a nucleus is
AIPMT 2003 *(Not in current JEE/NEET syllabus)*
(a) always less than its atomic number
(b) always more than its atomic number
(c) sometimes equal to its atomic number
(d) sometimes less than and sometimes more than its atomic number

◆ Isotopes, isobars & isotones 3 Qs

5. The nuclei $_{6}C^{13}$ and $_{7}N^{14}$ can be described as
AIPMT 1990
(a) isotones (b) isobars
(c) isotopes of carbon (d) isotopes of nitrogen

6. Which one of the following pairs of nuclei are isotones?
AIPMT 2005 *(Not in current JEE/NEET syllabus)*
(a) 34Se74, 31Ga71 (b) 38Sr84, 38Sr86
(c) 42Mo92, 40Zr92 (d) 20Ca40, 16S32

7. Which of the following pair of nuclei are isobars of the element?
JEE MAIN 2026 · 23 JAN · SHIFT 2
(a) $^{3}_{1}H$ and $^{3}_{2}He$ (b) $^{198}_{80}Hg$ and $^{197}_{79}Au$
(c) $^{2}_{1}H$ and $^{3}_{1}H$ (d) $^{236}_{92}U$ and $^{238}_{92}U$

◆ Nuclear size: R = R0 A^(1/3) 15 Qs

8. Four statements are given (A is mass number):
A. The volume of a nucleus is proportional to $A^{1/3}$.
B. The volume of a nucleus is proportional to A.
C. The difference in mass of an atom and its nucleus is called the mass defect. D. The difference in mass of a nucleus and its constituents is called the mass defect. Choose the correct answer from the options given below:
NEET 2026
(a) A and C are true, but B and D are false
(b) B and C are true, but A and D are false
(c) A and D are true, but B and C are false
(d) B and D are true, but A and C are false

9. A nucleus of mass number 189 splits into two nuclei having mass number 125 and 64. The ratio of radius of two daughter nuclei respectively is
NEET 2022 · PHASE 1
(a) 1: 1 (b) 4: 5 (c) 5: 4 (d) 25: 16

10. The volume occupied by an atom is greater than the volume of the nucleus by a factor of about
AIPMT 2003
(a) 101 (b) 105 (c) 1010 (d) 1015

11. The mass number of He is 4 and that of sulphur is 32. The radius of sulphur nucleus is larger than that of helium by the factor of
AIPMT 1995
(a) 4 (b) 2 (c) 8 (d) $\sqrt{8}$

12. The ratio of the radii of the nuclei $_{13}Al^{27}$ and $_{52}Te^{125}$ approximately
AIPMT 1990
(a) 6 : 10 (b) 13 : 52 (c) 40 : 177 (d) 14 : 73

13. If radius of the $^{27}{}_{13}$ Al nucleus is taken to be RAl, then the radius of $^{125}_{53}Te$ nucleus is nearly
AIPMT 2015 · CANCELLED PAPER *(Not in current JEE/NEET syllabus)*
(a) $\frac{3}{5}R_{Al}$ (b) $\left(\frac{13}{53}\right)^{1/3}R_{Al}$
(c) $\left(\frac{53}{13}\right)^{1/3}R_{Al}$ (d) $\frac{5}{3}R_{Al}$

14. If the nuclear radius of 27Al is 3.6 fermi, the approximate nuclear radius of 64Cu in fermi is
AIPMT 2012 · PRELIMS *(Not in current JEE/NEET syllabus)*
(a) 2.4 (b) 1.2 (c) 4.8 (d) 3.6

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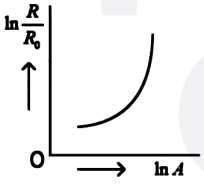
15. If the nucleus $^{27}_{13}Al$ has a nuclear radius of about 3.6 fm, them $^{125}_{32}Te$ would have its radius approximately as
AIPMT 2007 *(Not in current JEE/NEET syllabus)*
(a) 9.6 fm (b) 12.0 fm (c) 4.8 fm (d) 6.0 fm

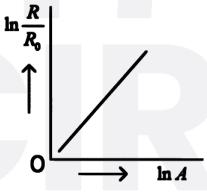
16. The radius of germanium (Ge) nuclide is measured to be twice the radius of $^{9}_{4}$Be. The number of nucleons in Ge are
AIPMT 2006 *(Not in current JEE/NEET syllabus)*
(a) 72 (b) 73 (c) 74 (d) 75

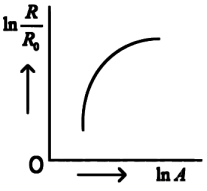
17. A nucleus has mass number α and radius R_α. Another nucleus has mass number β and radius R_β. If $\beta = 8\alpha$ then R_α/R_β is:
JEE MAIN 2026 · 28 JAN · SHIFT 2
(a) 1 (b) 2 (c) 8 (d) 0.5

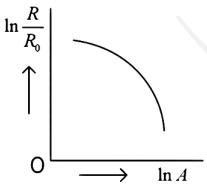
18. The mass number of nucleus having radius equal to half of the radius of nucleus with mass number 192 is:
JEE MAIN 2024 · 31 JAN · SHIFT 2
(a) 32 (b) 24 (c) 20 (d) 40

19. Which of the following figure represents the variation of $\ln\left(\frac{R}{R_0}\right)$ with $\ln A$ (if R = radius of a nucleus and A = its mass number)
JEE MAIN 2022 · 25 JUN · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) 

(b) 

(c) 

(d) 

20. If radius of the $^{27}_{13}Al$ nucleus is estimated to be 3.6 fermi then the radius of $^{125}_{52}Te$ nucleus is estimated to be nearly
AIEEE 2005 *(Not in current JEE/NEET syllabus)*
(a) 8 fermi (b) 6 fermi (c) 5 fermi (d) 4 fermi

21. The radius of a nucleus of mass number 64 is 4.8 fermi. Then the mass number of another nucleus having radius of 4 fermi is $\frac{1000}{x}$, where x is _____.
JEE MAIN 2024 · 1 FEB · SHIFT 1 *(Numerical)*

22. A nucleus has mass number A_1 and volume V_1. Another nucleus has mass number A_2 and Volume V_2. If relation between mass number is $A_2 = 4A_1$, then $\frac{V_2}{V_1}$ = _____.
JEE MAIN 2024 · 31 JAN · SHIFT 2 *(Numerical)*

◆ Nuclear density 11 Qs

23. The ratio of the density of oxygen nucleus ($^{16}_{8}$O) and helium nucleus ($^{4}_{2}$He) is
MHT CET 2026 · 16 APR · SHIFT 2
(a) 1 : 1 (b) 2 : 1 (c) 4 : 1 (d) 8 : 1

24. The mass density of a nucleus varies with mass number A as
AIPMT 1992
(a) A^2 (b) A (c) constant (d) $1/A$

25. Two nuclei have their mass numbers in the ratio of 1: 3. The ratio of their nuclear densities would be
AIPMT 2008 *(Not in current JEE/NEET syllabus)*
(a) $(3)^{1/3}$: 1 (b) 1: 1 (c) 1: 3 (d) 3: 1

26. For a nucleus of mass number A and radius R, the mass density of nucleus can be represented as
JEE MAIN 2025 · 8 APR · SHIFT 2
(a) $A^{\frac{2}{3}}$ (b) Independent of A
(c) A^3 (d) $A^{\frac{1}{3}}$

27. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The density of the copper ($^{64}_{29}$Cu) nucleus is greater than that of the carbon ($^{12}_{6}$C) nucleus.
Reason (R): The nucleus of mass number A has a radius proportional to $A^{1/3}$.
In the light of the above statements, choose the most appropriate answer from the options given below:
JEE MAIN 2025 · 7 APR · SHIFT 2
(a) (A) is correct but (R) is not correct
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
(c) (A) is not correct but (R) is correct
(d) Both (A) and (R) are correct and (R) is the correct explanation of (A)

28. The ratio of the density of oxygen nucleus ($^{16}_{8}O$) and helium nucleus ($^{4}_{2}$He) is
JEE MAIN 2023 · 25 JAN · SHIFT 1
(a) 4: 1 (b) 1: 1 (c) 2: 1 (d) 8: 1

29. The ratio of mass densities of nuclei of 40Ca and 16O is close to :-
JEE MAIN 2019 · 8 APR · SHIFT 2
(a) 1 (b) 5 (c) 0.1 (d) 2

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30. Given below are two statements: one is labelled as Assertion **A** and the other is labelled as Reason **R**

Assertion A: The nuclear density of nuclides $^{10}_{5}\mathrm{B}$, $^{6}_{3}\mathrm{Li}$, $^{56}_{26}\mathrm{F}$ e, $^{\sim}_{10}{}^{20}\mathrm{N}$ e and $^{209}_{83}\mathrm{Bi}$ can be arranged as $\rho^{\mathrm{N}}_{\mathrm{Bi}} > \rho^{\mathrm{N}}_{\mathrm{Fe}} > \rho^{\mathrm{N}}_{\mathrm{Ne}} > \rho^{\mathrm{N}}_{\mathrm{B}} > \rho^{\mathrm{N}}_{\mathrm{Li}}$

Reason R: The radius R of nucleus is related to its mass number A as $R = R_0 A^{1/3}$, where R_0 is a constant.

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

JEE MAIN 2023 · 30 JAN · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) Both **A** and **R** are true and **R** is the correct explanation of **A**
(b) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**
(c) **A** is false but **R** is true
(d) **A** is true but **R** is false

31. Read the following statements:

(A) Volume of the nucleus is directly proportional to the mass number.

(B) Volume of the nucleus is independent of mass number.

(C) Density of the nucleus is directly proportional to the mass number.

(D) Density of the nucleus is directly proportional to the cube root of the mass number. (E) Density of the nucleus is independent of the mass number.

Choose the correct option from the following options.

JEE MAIN 2022 · 29 JUL · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) (A) and (D) only. (b) (A) and (E) only.
(c) (B) and (E) only. (d) (A) and (C) only.

32. Mass numbers of two nuclei are in the ratio of 4 : 3. Their nuclear densities will be in the ratio of

JEE MAIN 2022 · 26 JUL · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) 4: 3 (b) $\left(\frac{3}{4}\right)^{\frac{1}{3}}$ (c) 1: 1 (d) $\left(\frac{4}{3}\right)^{\frac{1}{3}}$

33. Consider the following statements:

A. Atoms of each element emit characteristics spectrum.

B. According to Bohr's Postulate, an electron in a hydrogen atom, revolves in a certain stationary orbit.

C. The density of nuclear matter depends on the size of the nucleus.

D. A free neutron is stable but a free proton decay is possible.

E. Radioactivity is an indication of the instability of nuclei.

Choose the correct answer from the options given below:

JEE MAIN 2021 · 27 JUL · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) A, B, C, D and E (b) A, B and E only
(c) B and D only (d) A, C and E only

◆ Nuclear force 3 Qs

34. If the nuclear force between two protons, two neutrons and between proton and neutron is denoted by F_{pp}, F_{nn} and F_{pn} respectively, then

AIPMT 1991

(a) $F_{pp} \approx F_{nn} \approx F_{pn}$
(b) $F_{pp} \neq F_{nn}$ and $F_{pp} = F_{nn}$
(c) $F_{pp} = F_{nn} = F_{pn}$
(d) $F_{pp} \neq F_{nn} \neq F_{pn}$

35. Which of the following statements is true for nuclear forces?

AIPMT 1990

(a) They obey the inverse square law of distance.
(b) They obey the inverse third power law of distance.
(c) They are short range forces.
(d) They are equal in strength to electromagnetic forces.

36. From the statements given below:

(A) The angular momentum of an electron in n^{th} orbit is an integral multiple of $\hbar$. (B) Nuclear forces do not obey inverse square law.

(C) Nuclear forces are spin dependent.

(D) Nuclear forces are central and charge independent.

(E) Stability of nucleus is inversely proportional to the value of packing fraction. Choose the correct answer from the options given below:

JEE MAIN 2024 · 1 FEB · SHIFT 2

(a) (B), (C), (D), (E) only
(b) (A), (C), (D), (E) only
(c) (A), (B), (C), (E) only
(d) (A), (B), (C), (D) only

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TOPIC 02

Mass Defect & Binding Energy

26 PYQs · Easy 26 · Medium 0 · Difficult 0 | MHT CET 1 · NEET 11 · JEE 14

Concepts covered: Mass-energy equivalence & atomic mass unit (7) · Mass defect (2) · Binding energy from masses (10) · Binding energy curve & stability (7)

LEVEL 1 · EASY 26 questions

◆ Mass-energy equivalence & atomic mass unit 7 Qs

37. The energy equivalent of 0.5 g of a substance is:
NEET 2020 · PHASE 1
(a) $4.5 \times 10^{13} J$ (b) $1.5 \times 10^{13} J$
(c) $0.5 \times 10^{13} J$ (d) $4.5 \times 10^{16} J$

38. The energy equivalent of one atomic mass unit is
AIPMT 1992
(a) 1.6×10^{-19} J (b) 6.02×10^{23} J
(c) 931 MeV (d) 9.31 MeV

39. The energy equivalent of 1 g of substance is:
JEE MAIN 2024 · 9 APR · SHIFT 1
(a) 5.6×10^{26} MeV (b) 5.6×10^{12} MeV
(c) 5.6 eV (d) 11.2×10^{24} MeV

40. Binding energy of a certain nucleus is 18×10^8 J. How much is the difference between total mass of all the nucleons and nuclear mass of the given nucleus:
JEE MAIN 2024 · 8 APR · SHIFT 1
(a) 20 μg (b) 2 μg (c) 10 μg (d) 0.2 μg

41. Imagine that a reactor converts all given mass into energy and that it operates at a power level of 109 watt. The mass of the fuel consumed per hour in the reactor will be: (velocity of light, c is 3×108 m/s)
JEE MAIN 2017 · 9 APR · SHIFT 1
(a) 0.96 gm (b) 0.8 gm
(c) 4 $\times$ 10−2 gm (d) 6.6 $\times$ 10−5 gm

42. If mass-energy equivalence is taken into account, when water is cooled to form ice, the mass of water should
AIEEE 2002
(a) increase
(b) remain unchanged
(c) decrease
(d) first increase then decrease

43. The mass defect in a particular reaction is 0.4 g. The amount of energy liberated is $n \times 10^7$ kWh, where $n =$ _____. (speed of light $= 3 \times 10^8$ m/s)
JEE MAIN 2024 · 31 JAN · SHIFT 1 *(Numerical)*

◆ Mass defect 2 Qs

44. Mn and Mp represent the mass of neutron and proton respectively. An element having mass M has N neutrons and Z protons, then the correct relation will be
AIPMT 2001
(a) M < {N · Mn + Z · Mp} (b) M > {N · Mn + Z · Mp}
(c) M = {N · Mn + Z · Mp} (d) M = N {Mn + Mp}

45. The mass of α-particle is
AIPMT 1992
(a) less than the sum of masses of two protons and two neutrons
(b) equal to mass of four protons
(c) equal to mass of four neutrons
(d) equal to sum of masses of two protons and two neutrons

◆ Binding energy from masses 10 Qs

46. If M_O is the mass of an oxygen isotope ${}_8O^{17}$ and M_p and M_N are the mass of proton and mass of neutron respectively, then the nucleus binding energy of the isotope is
MHT CET 2024 · 16 MAY · SHIFT 1
(a) M_oC^2
(b) $(M_o - 8M_P)C^2$
(c) $(M_o - 17M_N)C^2$
(d) $(M_o - 8M_P - 9M_N)C^2$

47. The mass of a ${}^7_3Li$ Li nucleus is 0.042 u less than the sum of the masses of all its nucleons. The binding energy per nucleon of ${}^7_3Li$ nucleus is nearly
AIPMT 2010 · PRELIMS
(a) 46 MeV (b) 5.6 MeV (c) 3.9 MeV (d) 23 MeV

48. If M(A; Z), Mp and Mn denote the masses of the nucleus ${}^A_ZX$, proton and neutron respectively in units of u (1 u = 931.5 MeV/c2) and BE represents its bonding energy in MeV, then
AIPMT 2008
(a) M(A, Z) = ZMp + (A − Z)Mn − BE
(b) M(A, Z) = ZMp + (A − Z)Mn + BE/c2
(c) M(A, Z) = ZMp + (A − Z)Mn − BE/c2
(d) M(A, Z) = ZMp + (A − Z)Mn + BE

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49. A nucleus ${}^{A}_{Z}X$ has mass represented by M(A, Z). If Mp and Mn denote the mass of proton and neutron respectively and B.E. the binding energy in MeV, then
AIPMT 2007
(a) B.E. = [ZMp + (A − Z)Mn − M(A, Z)]c2
(b) B.E. = [ZMp + AMp − M(A, Z)]c2
(c) B.E. = M(A, Z) − ZMp − (A − Z)Mn
(d) B.E. = [M(A, Z) − ZMp − (A − Z)Mn]c2

50. If M(A; Z), Mp and Mn denote the masses of the nucleus ${}^{A}_{Z}X$, proton and neutron respectively in units of u (1 u = 931.5 MeV/c2) and BE represents its bonding energy in MeV, then
AIPMT 2004
(a) M(A, Z) = ZMp + (A − Z)Mn − BE
(b) M(A, Z) = ZMp + (A − Z)Mn + BE/c2
(c) M(A, Z) = ZMp + (A − Z)Mn − BE/c2
(d) M(A, Z) = ZMp + (A − Z)Mn + BE

51. The binding energy per nucleon of ${}^{209}_{83}Bi$ is _____ MeV.
[Take $m({}^{209}_{83}Bi) = 208.980388$ u, $m_p = 1.007825$ u, $m_n = 1.008665$ u, $1_u = 931_{MeV}/c^2$]
JEE MAIN 2026 · 2 APR · SHIFT 2
(a) 7.48 (b) 7.84 (c) 8.79 (d) 6.94

52. If M_0 is the mass of isotope ${}^{12}_{5}B$, M_p and M_n are the masses of proton and neutron, then nuclear binding energy of isotope is:
JEE MAIN 2024 · 8 APR · SHIFT 2
(a) $(5M_p + 7M_n - M_0)C^2$
(b) $(M_0 - 5M_p - 7M_n)C^2$
(c) $(M_0 - 5M_p)C^2$
(d) $(M_0 - 12M_n)C^2$

53. The mass of proton, neutron and helium nucleus are respectively $1.0073\,u, 1.0087\,u$ and $4.0015\,u$. The binding energy of helium nucleus is:
JEE MAIN 2023 · 1 FEB · SHIFT 1
(a) 28.4 MeV (b) 56.8 MeV
(c) 7.1 MeV (d) 14.2 MeV

54. Find the Binding energy per nucleon for ${}^{120}_{50}Sn$. Mass of proton mp = 1.00783 U, mass of neutron mn = 1.00867 U and mass of tin nucleus mSn = 119.902199 U. (take 1U = 931 MeV)
JEE MAIN 2020 · 4 SEP · SHIFT 2
(a) 9.0 MeV (b) 8.5 MeV (c) 8.0 MeV (d) 7.5 MeV

55. If M_O is the mass of an oxygen isotope ${}_{8}O^{17}$, M_p and M_N are the masses of a proton and neutron respectively, the nuclear binding energy of the isotope is
AIEEE 2007
(a) $(M_O - 17M_N)C^2$
(b) $(M_O - 8M_P)C^2$
(c) $(M_O - 8M_P - 9M_N)C^2$
(d) M_Oc^2

◆ Binding energy curve & stability 7 Qs

56. How does the Binding Energy per nucleon vary with the increase in the number of nucleons?
NEET 2013
(a) Decrease continuously with mass number.
(b) First decreases and then increases with increase in mass number.
(c) First increases and then decreases with increase in mass number.
(d) increases continuously with mass number.

57. The binding energy per nucleon is maximum in case of
AIPMT 1993
(a) ${}^{4}_{2}He$ (b) ${}^{56}_{26}Fe$ (c) ${}^{141}_{56}Ba$ (d) ${}^{235}_{92}U$

58. The average binding energy of a nucleon inside an atomic nucleus is about
AIPMT 1989
(a) 8 MeV (b) 8 eV (c) 8 J (d) 8 erg

59. 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
JEE MAIN 2026 · 24 JAN · SHIFT 1
(a) Statement I is false but Statement II is true
(b) Both Statement I and Statement II are true
(c) Both Statement I and Statement II are false
(d) Statement I is true but Statement II is false

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60. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): The binding energy per nucleon is found to be practically independent of the atomic number A, for nuclei with mass numbers between 30 and 170.

Reason (R): Nuclear force is long range. In the light of the above statements, choose the correct answer from the options given below:

JEE MAIN 2025 · 23 JAN · SHIFT 2

(a) (A) is true but (R) is false
(b) Both (A) and (R) are true and (R) is the correct explanation of (A)
(c) (A) is false but (R) is true
(d) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

---

61. This question contains Statement- 1 and Statement- 2. Of the four choices given after the statements, choose the one that best describes the two statements:

Statement- 1:

Energy is released when heavy nuclei undergo fission or light nuclei undergo fusion. Statement- 2:

For heavy nuclei, binding energy per nucleon increases with increasing Z while for light nuclei it decreases with increasing Z.

AIEEE 2008

(a) Statement - 1 is false, Statement - 2 is true
(b) Statement - 1 is true, Statement - 2 is true; Statement - 2 is a correct explanation for Statement - 1
(c) Statement - 1 is true, Statement - 2 is true; Statement - 2 is not a correct explanation for Statement - 1
(d) Statement - 1 is true, Statement - 2 is false

---

62. Given below are two statements: one is labelled as Assertion $\mathbf{A}$ and the other is labelled as Reason $\mathbf{R}$

Assertion A: The binding energy per nucleon is practically independent of the atomic number for nuclei of mass number in the range 30 to 170.

Reason R: Nuclear force is short ranged.

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

JEE MAIN 2023 · 13 APR · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) A is false but $\mathbf{R}$ is true
(b) A is true but $\mathbf{R}$ is false
(c) Both $\mathbf{A}$ and $\mathbf{R}$ are true and $\mathbf{R}$ is the correct explanation of $\mathbf{A}$
(d) Both $\mathbf{A}$ and $\mathbf{R}$ are true but $\mathbf{R}$ is NOT the correct explanation of $\mathbf{A}$

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TOPIC 03

Nuclear Reactions & Q-value

12 PYQs · Easy 12 · Medium 0 · Difficult 0 | MHT CET 2 · NEET 5 · JEE 5

Concepts covered: Balancing nuclear reactions (8) · Q-value from binding energies (1) · Recoil & sharing of energy (3)

LEVEL 1 · EASY 12 questions

◆ Balancing nuclear reactions 8 Qs

63. Which one of the following is possible nuclear reaction?

MHT CET 2026 · 20 MAY · SHIFT 1

(a) ${}_5B^{10} + {}_2He^4 \rightarrow {}_7N^{13} + {}_1H^1$

(b) ${}_{11}Na^{23} + {}_1H^1 \rightarrow {}_{10}N^{20} + {}_2He^4$

(c) ${}_{93}Np^{239} \rightarrow {}_{94}Pu^{239} + {}_{-1}e^0$

(d) ${}_7N^{11} + {}_1H^1 \rightarrow {}_6C^{12} + {}_{-1}e^0$

64. For the following reaction, the particle ' X ' is

${}_6C^{11} \longrightarrow {}_5B^{11} + \beta + X$

MHT CET 2025 · 20 APR · SHIFT 1

(a) proton (b) neutrino

(c) anti neutrino (d) neutron

65. A deuteron is bombarded on 8O16 nucleus then α-particle is emitted. The product nucleus is

AIPMT 2002

(a) 7N13 (b) 5B10 (c) 4Be9 (d) 7N14

66. X(n, α) ${}^7_3$Li, then X will be

AIPMT 2001

(a) ${}_5{}^{10}$ B (b) ${}^9{}_5$ B (c) ${}_5{}^{11}$ Be (d) ${}^4{}_2$ He.

67. In the given nuclear reaction, the element X is

${}^{22}_{11}Na \rightarrow X + e^+ + v$

NEET 2022 · PHASE 1 *(Not in current JEE/NEET syllabus)*

(a) ${}^{23}_{11}Na$ (b) ${}^{23}_{10}Ne$ (c) ${}^{22}_{10}Ne$ (d) ${}^{22}_{12}Mg$

68. For the given reaction, the particle X is

${}_6C^{11} \rightarrow {}_5B^{11} + \beta^+ + X$

AIPMT 2000 *(Not in current JEE/NEET syllabus)*

(a) neutron (b) anti neutrino

(c) neutrino (d) proton

69. When ${}_3Li^7$ nuclei are bombarded by protons, and the resultant nuclei are ${}_4Be^8$, the emitted particles will be

AIEEE 2006

(a) alpha particles (b) beta particles

(c) gamma photons (d) neutrons

70. A nuclear transformation is denoted by $X\,(n, \alpha)^7_3Li$. Which of the following is the nucleus of element X?

AIEEE 2005

(a) ${}^{10}_5B$ (b) ${}^{12}C_6$ (c) ${}^{11}_4Be$ (d) ${}^9_5B$

◆ Q-value from binding energies 1 Q

71. In the reaction ${}^2_1H + {}^3_1H \rightarrow {}^4_2He + {}^1_0n$, if the binding energies of ${}^2_1$ H, ${}^3_1$H and ${}^4_2$He are respectively a, b and c (in MeV),

then the energy (in MeV) released in this reaction is

AIPMT 2005

(a) a + b + c (b) a + b – c

(c) c – a – b (d) c + a – b

◆ Recoil & sharing of energy 3 Qs

72. A nucleus at rest disintegrates into two smaller nuclei with their masses in the ratio of 2 : 1 . After disintegration they will move:

JEE MAIN 2024 · 9 APR · SHIFT 2

(a) in opposite directions with speed in the ratio of 1 : 2 respectively.

(b) in the same direction with same speed.

(c) in opposite directions with speed in the ratio of 2 : 1 respectively.

(d) in opposite directions with the same speed.

73. A nucleus of mass M at rest splits into two parts having masses $\frac{M'}{3}$ and $\frac{2M'}{3}$ $(M' < M)$. The ratio of de Broglie wavelength of two parts will be:

JEE MAIN 2022 · 26 JUL · SHIFT 2

(a) 1: 2 (b) 2: 1 (c) 1: 1 (d) 2: 3

74. When a U^{238} nucleus originally at rest, decays by emitting an alpha particle having a speed $'u'$, the recoil speed of the residual nucleus is

AIEEE 2003 *(Not in current JEE/NEET syllabus)*

(a) $\frac{4\mu}{238}$ (b) $-\frac{4\mu}{234}$ (c) $\frac{4\mu}{234}$ (d) $-\frac{4\mu}{238}$

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TOPIC 04

Nuclear Fission & Fusion

28 PYQs · Easy 28 · Medium 0 · Difficult 0 | MHT CET 0 · NEET 17 · JEE 11

Concepts covered: Fission: reaction & energy released (12) · Nuclear reactor & power output (2) · Nuclear fusion & energy of stars (14)

LEVEL 1 · EASY 28 questions

◆ Fission: reaction & energy released 12 Qs

75. A nucleus with mass number 240 breaks into two fragments each of mass number 120, the binding per nucleon of unfragmented nuclei is 7.6MeV while that of fragments is 8.5MeV. The total gain in the Binding Energy in the process is:
NEET 2021
(a) 216MeV (b) 0.9MeV (c) 9.4MeV (d) 804MeV

76. In any fission process the ratio
mass of fission products
is
mass of parent nucleus
AIPMT 2005
(a) equal to 1
(b) greater than 1
(c) less than 1
(d) depends on the mass of the parent nucleus.

77. Energy released in nuclear fission is due to
AIPMT 2001
(a) some mass is converted into energy
(b) total binding energy of fragments is more than the binding energy of parental element
(c) total binding energy of fragments is less than the binding energy of parental element
(d) total binding energy of fragments is equal to the binding energy of parental element.

78. Nuclear fission is best explained by
AIPMT 2000
(a) liquid droplet theory
(b) Yukawa π-meson theory
(c) independent particle model of the nucleus
(d) proton-proton cycle.

79. Complete the equation for the following fission process:
$_{92}\mathrm{U}^{235} + {}_0n^1 \longrightarrow {}_{38}\mathrm{Sr}^{90} + \ldots\ldots$
AIPMT 1998
(a) $_{54}\mathrm{Xe}^{143} + 3\,{}_0n^1$ (b) $_{54}\mathrm{Xe}^{145}$
(c) $_{57}\mathrm{Xe}^{142}$ (d) $_{54}\mathrm{Xe}^{142} + {}_0n^1$

80. When a uranium isotope $^{235}_{92}U$ is bombarded with a neutron, it generates $^{89}_{36}Kr$, three neutrons and:
NEET 2020 · PHASE 1 *(Not in current JEE/NEET syllabus)*
(a) $^{91}_{40}Zr$ (b) $^{101}_{36}Kr$ (c) $^{103}_{36}Kr$ (d) $^{144}_{56}Ba$

81. In a hypothetical fission reaction
$_{92}X^{236} \rightarrow {}_{56}\mathrm{Y}^{141} + {}_{36}Z^{92} + 3R$
The identity of emitted particles (R) is:
JEE MAIN 2024 · 8 APR · SHIFT 2
(a) Proton (b) Neutron
(c) Electron (d) γ-radiations

82. Which of the following nuclear fragments corresponding to nuclear fission between neutron $\left({}^1_0\mathrm{n}\right)$ and uranium isotope $\left({}^{235}_{92}\mathrm{U}\right)$ is correct:
JEE MAIN 2024 · 4 APR · SHIFT 1
(a) $^{140}_{56}\mathrm{Xe} + {}^{94}_{38}\mathrm{Sr} + 3{}^1_0\mathrm{n}$ (b) $^{153}_{51}\mathrm{Sb} + {}^{99}_{41}\mathrm{Nb} + 3{}^1_0\mathrm{n}$
(c) $^{144}_{56}\mathrm{Ba} + {}^{89}_{36}\mathrm{Kr} + 4{}^1_0\mathrm{n}$ (d) $^{144}_{56}\mathrm{Ba} + {}^{89}_{36}\mathrm{Kr} + 3{}^1_0\mathrm{n}$

83. Nucleus A is having mass number 220 and its binding energy per nucleon is 5.6 MeV. It splits into two fragments 'B' and 'C' of mass numbers 105 and 115. The binding energy of nucleons in 'B' and 'C' is 6.4 MeV per nucleon. The energy Q released per fission will be:
JEE MAIN 2022 · 24 JUN · SHIFT 1
(a) 0.8 MeV (b) 275 MeV (c) 220 MeV (d) 176 MeV

84. When Uranium is bombarded with neutrons, it undergoes fission. The fission reaction can be written as:
$_{92}U^{235} + {}_0n^1 \rightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3x + Q$ (energy)
where three particles named x are produced and energy Q is released. What is the name of the particle x?
JEE MAIN 2013 · 9 APR · SHIFT 1
(a) electron (b) α-particle
(c) neutron (d) neutrino

85. A nucleus with mass number 242 and binding energy per nucleon as 7.6 MeV breaks into two fragment each with mass number 121. If each fragment nucleus has binding energy per nucleon as 8.1 MeV, the total gain in binding energy is _____ MeV.
JEE MAIN 2023 · 8 APR · SHIFT 1 *(Numerical)*

86. The energy released per fission of nucleus of ^{240}X is 200 MeV. The energy released if all the atoms in 120g of pure ^{240}X undergo fission is _____ $\times 10^{25}$ MeV.
(Given $\mathrm{N_A} = 6 \times 10^{23}$)
JEE MAIN 2023 · 24 JAN · SHIFT 2 *(Numerical)*

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◆ Nuclear reactor & power output 2 Qs

87. Water is used as a coolant in a nuclear reactor because of its
NEET 2024
(a) high thermal expansion coefficient
(b) high specific heat capacity
(c) low density
(d) low boiling point

88. Which of the following is used as a moderator in nuclear reaction?
AIPMT 1997
(a) cadmium (b) plutonium
(c) uranium (d) heavy water.

◆ Nuclear fusion & energy of stars 14 Qs

89. A certain mass of Hydrogen is changed to Helium by the process of fusion. The mass defect in fusion reaction is 0.02866 u. The energy liberated per u is (given 1 u = 931 MeV)
NEET 2013
(a) 6.675 MeV (b) 13.35 MeV
(c) 2.67 MeV (d) 26.7 MeV

90. Fusion reaction takes place at high temperature because
AIPMT 2011 · PRELIMS
(a) nuclei break up at high temperature
(b) atoms get ionised at high temperature
(c) kinetic energy is high enough to overcome the coulomb repulsion between nuclei
(d) molecules break up at high temperature

91. The binding energy per nucleon in deuterium and helium nuclei are 1.1 MeV and 7.0 MeV, respectively. When two deuterium nuclei fuse to form a helium nucleus the energy released in the fusion is
AIPMT 2010 · MAINS
(a) 23.6 MeV (b) 2.2 MeV (c) 28.0 MeV (d) 30.2 MeV

92. The binding energy of deuteron is 2.2 MeV and that of $^4_2$He is 28 MeV. If two deuterons are fused to form one $^4_2$He then the energy released is
AIPMT 2006
(a) 30.2 MeV (b) 25.8 MeV (c) 23.6 MeV (d) 19.2 MeV

93. If in a nuclear fusion process the masses of the fusing nuclei be m1 and m2 and the mass of the resultant nucleus be m3, then
AIPMT 2004
(a) m3 = m1 + m2 (b) m3 = $|m_1 - m_2|$
(c) m3 < (m1 + m2) (d) m3 > (m1 + m2)

94. Solar energy is mainly caused due to
AIPMT 2003
(a) burning of hydrogen in the oxygen
(b) fission of uranium present in the Sun
(c) fusion of protons during synthesis of heavier elements
(d) gravitational contraction

95. Which of the following are suitable for the fusion process?
AIPMT 2002
(a) light nuclei
(b) heavy nuclei
(c) element lying in the middle of the periodic table
(d) middle elements, which are lying on binding energy curve.

96. The binding energies per nucleon for a deuteron and an α-particle are x_1 and x_2 respectively. The energy Q released in the reaction
$^2H_1 + {}^2H_1 \rightarrow {}^4He_2 + Q$,
is
AIPMT 1995
(a) $4(x_1 + x_2)$ (b) $4(x_2 - x_1)$
(c) $2(x_2 - x_1)$ (d) $2(x_1 + x_2)$

97. Solar energy is due to
AIPMT 1992
(a) fusion reaction (b) fission reaction
(c) combustion reaction (d) chemical reaction

98. The energy released if hydrogen atoms are combined to form $^4_2$He is ____ MeV. (Take binding energies per nucleon of $^2_1$H and $^4_2$He as 1.1 MeV and 7.2 MeV, respectively)
JEE MAIN 2026 · 6 APR · SHIFT 2
(a) 6.1 (b) 24.4 (c) 26.6 (d) 5

99. Energy released when two deuterons $(_1H^2)$ fuse to form a helium nucleus $(_2He^4)$ is: (Given: Binding energy per nucleon of $_1H^2 = 1.1$MeV and binding energy per nucleon of $_2He^4 = 7.0$MeV)
JEE MAIN 2025 · 2 APR · SHIFT 2
(a) 26.8 MeV (b) 8.1 MeV (c) 23.6 MeV (d) 5.9 MeV

100. Two deuterons undergo nuclear fusion to form a Helium nucleus. Energy released in this process is: (given binding energy per nucleon for deuteron = 1.1 MeV and for helium = 7.0 MeV)
JEE MAIN 2017 · 8 APR · SHIFT 1
(a) 30.2 MeV (b) 32.4 MeV (c) 23.6 MeV (d) 25.8 MeV

101. The binding energy per nucleon of deuteron $\left(^2_1H\right)$ and helium nucleus $\left(^4_2He\right)$ is 1.1 MeV and 7 MeV respectively. If two deuteron nuclei react to form a single helium nucleus, then the energy released is
AIEEE 2004
(a) 23.6 MeV (b) 26.9 MeV
(c) 13.9 MeV (d) 19.2 MeV

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102. Two lighter nuclei combine to form a comparatively heavier nucleus by the relation given below: ${}_1^2X + {}_1^2X = {}_2^4Y$

The binding energies per nucleon for ${}_1^2X$ and ${}_2^4Y$ are $1.1\,\text{MeV}$ and $7.6\,\text{MeV}$ respectively. The energy released in this process is _____ MeV.

JEE MAIN 2022 · 26 JUL · SHIFT 2 *(Numerical)*

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TOPIC 05

Radioactive Decays: Alpha, Beta, Gamma

35 PYQs · Easy 35 · Medium 0 · Difficult 0 | MHT CET 4 · NEET 19 · JEE 12

Concepts covered: Properties of alpha, beta & gamma (9) · Displacement laws: change in A and Z (17) · Counting alpha and beta particles (5) · Beta decay, neutrino & gamma energy (4)

LEVEL 1 · EASY 35 questions

◆ Properties of alpha, beta & gamma 9 Qs

103. Select the correct statements among the following:

A. Slow neutrons can cause fission in $^{235}_{92}U$ than fast neutrons.

B. α-rays are Helium nuclei.

C. β-rays are fast moving electrons or positrons.

D. γ -rays are electromagnetic radiations of wavelengths larger than X-rays.

Choose the most appropriate answer from the options given below:

NEET 2024

(a) A, B and C only (b) A, B and D only
(c) A and B only (d) C and D only

104. α-particle consists of:

NEET 2019

(a) 2 electrons, 2 protons and 2 neutrons
(b) 2 electrons and 4 protons only
(c) 2 protons only
(d) 2 protons and 2 neutrons only

105. Alpha particles are

AIPMT 1999

(a) 2 free protons
(b) helium atoms
(c) singly ionised helium atoms
(d) doubly ionised helium atoms

106. The most penetrating radiation out of the following are

AIPMT 1997

(a) β-rays (b) γ-rays (c) X-rays (d) α-rays.

107. α-particles, β-particles and γ-rays are all having same energy. Their penetrating power in a given medium in increasing order will be

NEET 2013 *(Not in current JEE/NEET syllabus)*

(a) γ, α, β (b) α, β, γ
(c) β, α, γ (d) β, γ, α

108. Which rays contain (positive) charged particles?

AIPMT 2001 *(Not in current JEE/NEET syllabus)*

(a) α-rays (b) β-rays (c) γ-rays (d) X-rays

109. In gamma ray emission from a nucleus

AIEEE 2007 *(Not in current JEE/NEET syllabus)*

(a) only the proton number changes
(b) both the neutron number and the proton number change
(c) there is no change in the proton number and the neutron number
(d) only the neutron number changes

110. Which of the following radiations has the least wavelength?

AIEEE 2003 *(Not in current JEE/NEET syllabus)*

(a) γ - rays (b) β - rays (c) α - rays (d) X - rays

111. Which of the following cannot be emitted by radioactive substances during their decay?

AIEEE 2003 *(Not in current JEE/NEET syllabus)*

(a) Protons (b) Neutrinoes
(c) Helium nuclei (d) Electrons

◆ Displacement laws: change in A and Z 17 Qs

112. A radioactive element $^{242}_{92}X$ emits two α particles, one electron and two positrons. The product nucleus is represented by $^{234}_{P}Y$. The value of P is

MHT CET 2025 · 23 APR · SHIFT 2

(a) 87 (b) 85 (c) 92 (d) 96

113. A radioactive element A decays into radioactive element C by the following processes in succession. $A \rightarrow B + {}_2H_e^4; B \rightarrow C + 2e^-$ Then elements

MHT CET 2025 · 22 APR · SHIFT 2

(a) A and B are isobars. (b) A and C are isobars.
(c) A and C are isotopes. (d) A and B are isotopes.

114. $^{290}_{82}X \xrightarrow{\alpha} Y \xrightarrow{e^+} Z \xrightarrow{\beta^-} P \xrightarrow{e^-} Q$

In the nuclear emission stated above, the mass number and atomic number of the product Q respectively, are

NEET 2024

(a) 280, 81 (b) 286, 80 (c) 288, 82 (d) 286, 81

115. What happens to the mass number and atomic number of an element when it emits γ-radiation?

NEET 2020 · PHASE 2

(a) Mass number increases by four and atomic number increases by two.
(b) Mass number decreases by four and atomic number decreases by two.
(c) Mass number and atomic number remain unchanged.
(d) Mass number remains unchanged while atomic

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number decreases by one.

116. In one α and 2β-emissions
AIPMT 1999
(a) mass number reduces by 2
(b) mass number reduces by 6
(c) atomic number reduces by 2
(d) atomic number remains unchanged

117. A nucleus ${}_nX^m$ emits one α and two β particles. The resulting nucleus is
AIPMT 1998
(a) ${}_nX^{m-4}$ (b) ${}_{n-2}Y^{m-4}$
(c) ${}_{n-4}Z^{m-4}$ (d) none of these

118. In the nuclear decay given below
${}^A_ZX \to {}^A_{Z+1}Y \to {}^{A-4}_{Z-1}B^* \to {}^{A-4}_{Z-1}B,$
the particles emitted in the sequence are
AIPMT 1993
(a) γ, β, α (b) β, γ, α (c) α, β, γ (d) β, α, γ

119. The nucleus ${}_6C^{12}$ absorbs an energetic neutron and emits a beta particle (β). The resulting nucleus is
AIPMT 1990
(a) ${}_7N^{14}$ (b) ${}_7N^{13}$ (c) ${}_5B^{13}$ (d) ${}_6C^{13}$

120. An element A decays into element C by a two step process
$A \to B + {}_2He^4$; $B \to C + 2e^-$
Then
AIPMT 1989
(a) A and C are isotopes (b) A and C are isobars
(c) A and B are isotopes (d) A and B are isobars

121. The nucleus ${}^{115}_{48}Cd$, after two successive β-decay will give
AIPMT 1988
(a) ${}^{115}_{46}Pa$ (b) ${}^{114}_{49}In$ (c) ${}^{113}_{50}Sn$ (d) ${}^{115}_{50}Sn$

122. A nucleus ${}^m_nX$ emits one α particle and two β particles. The resulting nucleus is
AIPMT 2011 · PRELIMS *(Not in current JEE/NEET syllabus)*
(a) ${}^{m-6}_{n-4}Z$ (b) ${}^{m-6}_{n}Z$ (c) ${}^{m-4}_{n}X$ (d) ${}^{m-4}_{n-2}Y$

123. In the nuclear decay given below
${}^A_ZX \to {}^A_{Z+1}Y \to {}^{A-4}_{Z-1}B^* \to {}^{A-4}_{Z-1}B,$
the particles emitted in the sequence are
AIPMT 2009 *(Not in current JEE/NEET syllabus)*
(a) γ, β, α (b) β, γ, α
(c) α, β, γ (d) β, α, γ

124. A nuclear reaction given by
ZXA $\to$ z+1YA + _1e0 + $\bar{}v$ represents
AIPMT 2003 *(Not in current JEE/NEET syllabus)*
(a) β-decay (b) γ-decay (c) fusion (d) fission

125. Consider the following radioactive decay process
${}^{218}_{84}A \xrightarrow{\alpha} A_1 \xrightarrow{\beta^-} A_2 \xrightarrow{\gamma} A_3 \xrightarrow{\alpha} A_4 \xrightarrow{\beta^+} A_5 \xrightarrow{\gamma} A_6$
The mass number and the atomic number of A_6 are given by:
JEE MAIN 2023 · 24 JAN · SHIFT 1 *(Not in current JEE/NEET syllabus)*
(a) 210 and 84 (b) 210 and 80
(c) 211 and 80 (d) 210 and 82

126. In the following nuclear reaction,
$D \xrightarrow{\alpha} D_1 \xrightarrow{\beta^-} D_2 \xrightarrow{\alpha} D_3 \xrightarrow{\gamma} D_4$
Mass number of D is 182 and atomic number is 74. Mass number and atomic number of D4 respectively will be _____.
JEE MAIN 2022 · 29 JUN · SHIFT 2 *(Not in current JEE/NEET syllabus)*
(a) 174 and 71 (b) 174 and 69
(c) 172 and 69 (d) 172 and 71

127. A nucleus with $Z = 92$ emits the following in a sequence:
$\alpha, \beta^-, \beta^-, \alpha, \alpha, \alpha, \alpha, \alpha, \beta^-, \beta^-, \alpha, \beta^+, \beta^+, \alpha$
Then Z of the resulting nucleus is
AIEEE 2003 *(Not in current JEE/NEET syllabus)*
(a) 76 (b) 78 (c) 82 (d) 74

128. A radioactive element ${}^{242}_{92}X$ emits two α-particles, one electron and two positrons. The product nucleus is represented by ${}^{234}_{P}Y$. The value of P is _____.
JEE MAIN 2023 · 29 JAN · SHIFT 1 *(Numerical)* *(Not in current JEE/NEET syllabus)*

◆ Counting alpha and beta particles 5 Qs

129. ${}_{88}R_a^{226}$ is converted into ${}_{82}P_b^{206}$ by emission of alpha (α) and beta (β) particles. The number of alpha and beta particles emitted are respectively
MHT CET 2025 · 22 APR · SHIFT 1
(a) 5, 4 (b) 4, 5 (c) 6, 4 (d) 4, 6

130. In the uranium radioactive series, the initial nucleus is ${}^{238}_{92}U$ and that the final nucleus is ${}^{206}_{82}Pb$. When uranium nucleus decays into lead, the number of α-particles and β-particles emitted are
MHT CET 2024 · 3 MAY · SHIFT 1
(a) $4\alpha, 5\beta$ (b) $5\alpha, 3\beta$ (c) $6\alpha, 7\beta$ (d) $8\alpha, 6\beta$

131. What is the respective number of α and β particles emitted in the following radioactive decay? ${}^{200}X_{90} \to {}^{168}Y_{80}$
AIPMT 1995
(a) 8 and 8 (b) 8 and 6 (c) 6 and 8 (d) 6 and 6

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132. How many alpha and beta particles are emitted when Uranium 92U238 decays to lead 82Pb206?

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(a) 3 alpha particles and 5 beta particles
(b) 6 alpha particles and 4 beta particles
(c) 4 alpha particles and 5 beta particles
(d) 8 alpha particles and 6 beta particles

133. In a radioactive decay chain, the initial nucleus is $^{232}_{90}$Th. At the end there are 6 α-particles and 4 β-particles which are emitted. If the end nucleus is $^{A}_{Z}$X, A and Z are given by:

JEE MAIN 2019 · 12 JAN · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) A = 208; Z = 80 (b) A = 208; Z = 82
(c) A = 200; Z = 81 (d) A = 202; Z = 80

◆ Beta decay, neutrino & gamma energy 4 Qs

134. In a radioactive decay process, the negatively charged emitted β-particles are

AIPMT 2007 *(Not in current JEE/NEET syllabus)*

(a) the electrons produced as a result of the decay of neutrons inside the nucleus
(b) the electrons produced as a result of collisions between atoms
(c) the electrons orbitting around the nucleus
(d) the electrons present inside the nucleus

135. A free neutron decays into a proton but a free proton does not decay into neutron. This is because

JEE MAIN 2023 · 31 JAN · SHIFT 1 *(Not in current JEE/NEET syllabus)*

(a) neutron is an uncharged particle
(b) neutron has larger rest mass than proton
(c) neutron is a composite particle made of a proton and an electron
(d) proton is a charged particle

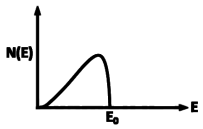
136. The decay of a proton to neutron is:

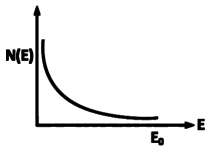
JEE MAIN 2021 · 18 MAR · SHIFT 2 *(Not in current JEE/NEET syllabus)*

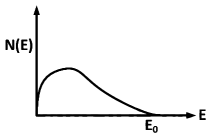
(a) always possible as it is associated only with β^+ decay
(b) possible only inside the nucleus
(c) not possible as proton mass is less than the neutron mass
(d) not possible but neutron to proton conversation is possible

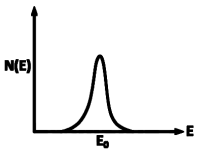
137. The energy spectrum of β-particles [number $N(E)$ as a function of β-energy E] emitted from a radioactive source is

AIEEE 2006 *(Not in current JEE/NEET syllabus)*

(a) 

(b) 

(c) 

(d) 

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TOPIC 06

Law of Radioactive Decay

50 PYQs · Easy 50 · Medium 0 · Difficult 0 | MHT CET 13 · NEET 18 · JEE 19

Concepts covered: Decay law & half-life (27) · Mean life (1) · Activity & rate of disintegration (14) · Comparing two radioactive samples (2) · Parallel & successive decay (3) · Radioactive dating & tracers (3)

LEVEL 1 · EASY 50 questions

◆ Decay law & half-life 27 Qs

138. A radioactive sample has half-life of 5 years. The percentage of fraction decayed in 10 years will be
MHT CET 2026 · 19 APR · SHIFT 1
(a) 25% (b) 50% (c) 75% (d) 90%

139. A radioactive element having half-life 30 min. is undergoing beta decay. The fraction of radioactive element remains undecayed after 90 min. will be
MHT CET 2025 · 5 MAY · SHIFT 2
(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{8}$ (d) $\frac{1}{16}$

140. A radioactive substance has half-life of 60 minutes. During 3 hours, the amount of substance decayed would be
MHT CET 2024 · 15 MAY · SHIFT 1
(a) 8.5% (b) 25% (c) 12.5% (d) 87.5%

141. Half life of radio-active element is 1600 years. The fraction of sample remains undecayed after 6400 years will be
MHT CET 2023 · 14 MAY · SHIFT 2
(a) $\frac{1}{16}$ (b) $\frac{1}{4}$ (c) $\frac{1}{8}$ (d) $\frac{1}{24}$

142. A radioactive sample has half-life of 5 years. The percentage of fraction decayed in 10 years will be
MHT CET 2023 · 13 MAY · SHIFT 1
(a) 25% (b) 50% (c) 75% (d) 100%

143. A sample of radioactive element contains 8×10^{16} active nuclei. The halt-life of the element is 15 days. The number of nuclei decayed after 60 days is
MHT CET 2021 · 20 SEP · SHIFT 2
(a) 7.5×10^{16} (b) 2.0×10^{16}
(c) 0.5×10^{16} (d) 4.0×10^{16}

144. The half-life of a radioactive material is 3 h. If the initial amount is 300 g, then after 18 h, it will remain
AIPMT 2000
(a) 4.68 g (b) 46.8 g (c) 9.375 g (d) 93.75 g

145. The count rate of a Geiger Muller counter for the radiation of a radioactive material of half-life of 30 minutes decreases to 5 second^{-1} after 2 hours. The initial count rate was
AIPMT 1995
(a) 80 second^{-1} (b) 625 second^{-1}
(c) 20 second^{-1} (d) 25 second^{-1}

146. The half life of radium is 1600 years. The fraction of a sample of radium that would remain after 6400 years
AIPMT 1991
(a) 1/4 (b) 1/2 (c) 1/8 (d) 1/16

147. A radioactive element has half life period 800 years. After 6400 years what amount will remain?
AIPMT 1989
(a) 1/2 (b) 1/16 (c) 1/8 (d) 1/256

148. The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drops to $\left(\frac{1}{16}\right)^{\text{th}}$ of its initial value?
NEET 2023 *(Not in current JEE/NEET syllabus)*
(a) 40 minutes (b) 60 minutes
(c) 80 minutes (d) 20 minutes

149. Given below are two statements
Statement I: The law of radioactive decay states that the number of nuclei undergoing the decay per unit time is inversely proportional to the total number of nuclei in the sample. Statement II: The half-life of a radionuclide is the sum of the life time of all nuclei, divided by the initial concentration of the nuclei at time t = 0.
In the light of the above statements, choose the most appropriate answer from the options given below:
NEET 2022 · PHASE 2 *(Not in current JEE/NEET syllabus)*
(a) Statement I is incorrect but statement II is correct
(b) Both statement I and statement II are correct
(c) Both statement I and statement II are incorrect
(d) Statement I is correct but statement II is incorrect

150. For a radioactive material, half-life is 10 minutes. If initially there are 600 number of nuclei, the time taken (in minutes) for the disintegration of 450 nuclei is
NEET 2018 *(Not in current JEE/NEET syllabus)*
(a) 20 (b) 10 (c) 30 (d) 15

151. The half life of radian is about 1600 years. Of 100 g of radium existing now, 25 g will remain unchanged after
AIPMT 2004 *(Not in current JEE/NEET syllabus)*
(a) 4800 years (b) 6400 years
(c) 2400 years (d) 3200 years

152. A sample of radioactive element containing 4×1016 active nuclei. Half life of element is 10 days, then number of decayed nuclei after 30 days
AIPMT 2002 *(Not in current JEE/NEET syllabus)*
(a) 0.5×1016 (b) 2×1016
(c) 3.5×1016 (d) 1×1016

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153. Half life of a radioactive element is 12.5 hour and its quantity is 256 g. After how much time its quantity will remain 1 g?

AIPMT 2001 *(Not in current JEE/NEET syllabus)*

(a) 50 hrs (b) 100 hrs (c) 150 hrs (d) 200 hrs

154. The relation between λ and T1/2 as (T1/2 $\rightarrow$ half life)

AIPMT 2000 *(Not in current JEE/NEET syllabus)*

(a) $T1/2 = \frac{\ln 2}{\lambda}$ (b) $T1/2 \ln 2 = \lambda$

(c) $T1/2 = \frac{1}{\lambda}$ (d) $(\lambda + T1/2) = \ln 2$

155. The half-life of a radioactive nucleus is 5 years. The fraction of the original sample that would decay in 15 years is:

JEE MAIN 2023 · 15 APR · SHIFT 1 *(Not in current JEE/NEET syllabus)*

(a) $\frac{1}{8}$ (b) $\frac{3}{4}$ (c) $\frac{7}{8}$ (d) $\frac{1}{4}$

156. The half life of a radioactive substance is T. The time taken, for disintegrating $\frac{7}{8}$ th part of its original mass will be:

JEE MAIN 2023 · 10 APR · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) 8T (b) 3T (c) T (d) 2T

157. A radio active material is reduced to $1/8$ of its original amount in 3 days. If 8×10^{-3} kg of the material is left after 5 days the initial amount of the material is

JEE MAIN 2023 · 8 APR · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) 64 g (b) 256 g (c) 32 g (d) 40 g

158. If a radioactive element having half-life of 30 min is undergoing beta decay, the fraction of radioactive element remains undecayed after 90 min. will be

JEE MAIN 2023 · 29 JAN · SHIFT 1 *(Not in current JEE/NEET syllabus)*

(a) $\frac{1}{16}$ (b) $\frac{1}{4}$ (c) $\frac{1}{8}$ (d) $\frac{1}{2}$

159. A radioactive sample decays $\frac{7}{8}$ times its original quantity in 15 minutes. The half-life of the sample is

JEE MAIN 2022 · 28 JUL · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) 5 min (b) 7.5 min (c) 15 min (d) 30 min

160. The half life period of a radioactive substance is 60 days. The time taken for $\frac{7}{8}$ th of its original mass to disintegrate will be:

JEE MAIN 2022 · 28 JUL · SHIFT 1 *(Not in current JEE/NEET syllabus)*

(a) 120 days (b) 130 days (c) 180 days (d) 20 days

161. Following statements related to radioactivity are given below:

(A) Radioactivity is a random and spontaneous process and is dependent on physical and chemical conditions.

(B) The number of un-decayed nuclei in the radioactive sample decays exponentially with time.

(C) Slope of the graph of loge (no. of undecayed nuclei) Vs. time represents the reciprocal of mean life time (τ).

(D) Product of decay constant (λ) and half-life time (T1/2) is not constant.

Choose the most appropriate answer from the options given below:

JEE MAIN 2022 · 28 JUN · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) (A) and (B) only (b) (B) and (D) only

(c) (B) and (C) only (d) (C) and (D) only

162. Starting with a sample of pure ^{66}Cu, $\frac{7}{8}$ of it decays into Zn in 15 minutes. The corresponding half life is

AIEEE 2005 *(Not in current JEE/NEET syllabus)*

(a) 15 minutes (b) 10 minutes

(c) $7\frac{1}{2}$ minutes (d) 5 minutes

163. If N_0 is the original mass of the substance of half-life period $t_{1/2} = 5$ years, then the amount of substance left after 15 years is

AIEEE 2002 *(Not in current JEE/NEET syllabus)*

(a) $N_0/8$ (b) $N_0/16$ (c) $N_0/2$ (d) $N_0/4$

164. The half life of a radioactive substance is 5 years. After x years a given sample of the radioactive substance gets reduced to 6.25% of its initial value. The value of x is _____.

JEE MAIN 2022 · 29 JUN · SHIFT 2 *(Numerical)* *(Not in current JEE/NEET syllabus)*

◆ Mean life 1 Q

165. In a radioactive disintegration, the ratio of initial number of atoms to the number of atoms present at time $t = \frac{1}{2\lambda}$ is [λ = decay constant]

MHT CET 2023 · 11 MAY · SHIFT 1

(a) $\frac{1}{e}$ (b) $\sqrt{e}$ (c) e (d) 2e

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◆ Activity & rate of disintegration 14 Qs

166. Activity of a radioactive sample decreases to $\left(\frac{1}{3}\right)^{rd}$ of its original value in 3 days. Then in 9 days its activity will become

MHT CET 2026 · 14 MAY · SHIFT 1

(a) $\left(\frac{1}{27}\right)$ of the original value
(b) $\left(\frac{1}{9}\right)$ of the original value
(c) $\left(\frac{1}{18}\right)$ of the original value
(d) $\left(\frac{1}{3}\right)$ of the original value

167. Activity of a radioactive sample decreases to $\left(\frac{1}{4}\right)^{th}$ of its original value in 4 days. Then in 16 days its activity will become x times the original value. The value of x is

MHT CET 2026 · 20 APR · SHIFT 2

(a) $\frac{1}{16}$ (b) $\frac{1}{32}$ (c) $\frac{1}{256}$ (d) $\frac{1}{128}$

168. A radioactive element has rate of disintegration 16,000 disintegrations per minute at a particular instant. After four minutes, it becomes 2000 disintegrations per minute. The decay constant per minute is

MHT CET 2026 · 19 APR · SHIFT 2

(a) $0.25 \log_e 2$ (b) $0.50 \log_e 3$
(c) $0.75 \log_e 2$ (d) $0.8 \log_e 3$

169. A radio active element has rate of disintegration 8000 disintegrations per minute at a particular instant. After four minutes it becomes 2000 disintegrations per minute. The decay constant per minute is

MHT CET 2025 · 26 APR · SHIFT 2

(a) $0.8 \log_e 2$ (b) $0.6 \log_e 2$
(c) $0.5 \log_e 2$ (d) $0.2 \log_e 2$

170. Half-life period of a radioactive substance is 6 h. After 24 h activity is 0.01 μC, what was the initial activity?

AIPMT 2001

(a) 0.04 μC (b) 0.08 μC (c) 0.24 μC (d) 0.16 μC

171. Curie is a unit of

AIPMT 1989

(a) energy of gamma rays
(b) half-life
(c) radioactivity
(d) intensity of gamma rays

172. A radioactive sample with a half life of 1 month has the label: 'Activity = 2 micro curies on 1 - 8 - 1991'. What would be its activity two months earlier?

AIPMT 1988

(a) 1.0 micro curie (b) 0.5 micro curie
(c) 4 micro curie (d) 8 micro curie

173. In a radioactive material the activity at time t1 is R1 and at a later time t2, it is R2. If the decay constant of the material is λ, then

AIPMT 2006 *(Not in current JEE/NEET syllabus)*

(a) R1 = R2 (b) $R1 = R2e^{-\lambda}(t1-t2)$
(c) $R1 = R2e^{\lambda}(t1-t2)$ (d) R1 = R2(t2/t1).

174. The activity of a radioactive material is 6.4×10^{-4} curie. Its half life is 5 days. The activity will become 5×10^{-6} curie after:

JEE MAIN 2022 · 27 JUL · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) 7 days (b) 15 days (c) 25 days (d) 35 days

175. What is the half-life period of a radioactive material if its activity drops to $1/16^{th}$ of its initial value in 30 years?

JEE MAIN 2022 · 27 JUL · SHIFT 1 *(Not in current JEE/NEET syllabus)*

(a) 9.5 years (b) 8.5 years
(c) 7.5 years (d) 10.5 years

176. The activity of a radioactive material is 2.56×10^{-3} Ci. If the half life of the material is 5 days, after how many days the activity will become 2×10^{-5} Ci?

JEE MAIN 2022 · 29 JUN · SHIFT 1 *(Not in current JEE/NEET syllabus)*

(a) 30 days (b) 35 days (c) 40 days (d) 25 days

177. The $'rad'$ is the correct unit used to report the measurement of

AIEEE 2006 *(Not in current JEE/NEET syllabus)*

(a) the ability of a beam of gamma ray photons to produce ions in a target
(b) the energy delivered by radiation to a target
(c) the biological effect of radiation
(d) the rate of decay of radioactive source

178. The nuclear activity of a radioactive element becomes $\left(\frac{1}{8}\right)^{th}$ of its initial value in 30 years. The half- life of radioactive element is _____ years.

JEE MAIN 2021 · 25 JUL · SHIFT 2 *(Numerical)* *(Not in current JEE/NEET syllabus)*

179. A radioactive substance decays to $\left(\frac{1}{16}\right)^{th}$ of its initial activity in 80 days. The half life of the radioactive substance expressed in days is _____.

JEE MAIN 2021 · 20 JUL · SHIFT 2 *(Numerical)* *(Not in current JEE/NEET syllabus)*

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◆ Comparing two radioactive samples 2 Qs

180. Two different radioactive elements with half lives T_1 and T_2 have undecayed atoms N_1 and N_2 respectively, present at a given instant. The ratio of their activities at this instant is

MHT CET 2026 · 15 APR · SHIFT 1

(a) $\frac{N_1T_1}{N_2T_2}$ (b) $\frac{N_1T_2}{N_2T_1}$ (c) $\frac{N_1T_2}{T_1T_2}$ (d) $\frac{T_1T_2}{N_1N_2}$

181. Two different radioactive elements with half lives 'T_1' and 'T_2' have undecayed atoms 'N_1' and 'N_2' respectively present at a given instant. The ratio of their activities at that instant is

MHT CET 2023 · 12 MAY · SHIFT 2

(a) $\frac{N_1 T_1}{N_2 T_2}$ (b) $\frac{N_2 T_2}{N_1 T_1}$ (c) $\frac{N_1 T_2}{N_2 T_1}$ (d) $\frac{N_1 N_2}{T_1 T_2}$

◆ Parallel & successive decay 3 Qs

182. A radioactive nucleus can decay by two different processes. Half-life for the first process is 3.0 hours while it is 4.5 hours for the second process. The effective half-life of the nucleus will be:

JEE MAIN 2022 · 26 JUN · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) 3.75 hours (b) 0.56 hours
(c) 0.26 hours (d) 1.80 hours

183. A radioactive sample disintegrates via two independent decay processes having half lives $T_{1/2}^{(1)}$ and $T_{1/2}^{(2)}$ respectively. The effective half-life T1/2 of the nuclei is:

JEE MAIN 2021 · 18 MAR · SHIFT 1 *(Not in current JEE/NEET syllabus)*

(a) None of the above (b) $T_{1/2} = T_{1/2}^{(1)} + T_{1/2}^{(2)}$

(c) $T_{1/2} = \frac{T_{1/2}^{(1)} T_{1/2}^{(2)}}{T_{1/2}^{(1)} + T_{1/2}^{(2)}}$ (d) $T_{1/2} = \frac{T_{1/2}^{(1)} + T_{1/2}^{(2)}}{T_{1/2}^{(1)} - T_{1/2}^{(2)}}$

184. A radioactive nucleus decays by two different processes. The half life for the first process is 10 s and that for the second is 100 s. The effective half life of the nucleus is close to:

JEE MAIN 2020 · 5 SEP · SHIFT 2 *(Not in current JEE/NEET syllabus)*

(a) 12 sec (b) 9 sec (c) 55 sec (d) 6 sec

◆ Radioactive dating & tracers 3 Qs

185. A radioactive X with a half life 1.4×109 years decays to Y which is stable. A sample of the rock from a cave was found to contain X and Y in the ratio 1: 7. The age of the rock is

AIPMT 2014 *(Not in current JEE/NEET syllabus)*

(a) 1.96×109 years (b) 3.92×109 years
(c) 4.20×109 years (d) 8.40×109 years

186. The half life of a radioactive isotope 'X' is 20 years. It decays to another element 'Y' which is stable. The two elements 'X' and 'Y' were found to be in the ratio 1: 7 in a sample of a given rock. The age of the rock is estimated to be

NEET 2013 *(Not in current JEE/NEET syllabus)*

(a) 80 years (b) 100 years
(c) 40 years (d) 60 years

187. The half life of a radioactive isotope X is 50 years. It decays to another element Y which is stable. The two elements X and Y were found to be in the ratio of 1: 15 in a sample of a given rock. The age of the rock was estimated to be

AIPMT 2011 · PRELIMS *(Not in current JEE/NEET syllabus)*

(a) 150 years (b) 200 years
(c) 250 years (d) 100 years

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ANSWER KEY

Shaded by level: **Easy**

01 Nucleus: Composition, Size & Nuclear Force

1. (a)	2. (a)	3. (b)	4. (c)	5. (a)	6. (a)	7. (a)	8. (d)	9. (c)	10. (d)
11. (b)	12. (a)	13. (d)	14. (c)	15. (d)	16. (a)	17. (d)	18. (b)	19. (b)	20. (b)
21. 27	22. 4	23. (a)	24. (c)	25. (b)	26. (b)	27. (c)	28. (b)	29. (a)	30. (c)
31. (b)	32. (c)	33. (b)	34. (c)	35. (c)	36. (c)				

02 Mass Defect & Binding Energy

37. (a)	38. (c)	39. (a)	40. (a)	41. (c)	42. (c)	43. 1	44. (a)	45. (a)	46. (d)
47. (b)	48. (c)	49. (a)	50. (c)	51. (b)	52. (a)	53. (a)	54. (b)	55. (c)	56. (c)
57. (b)	58. (a)	59. (a)	60. (a)	61. (d)	62. (c)				

03 Nuclear Reactions & Q-value

63. (c)	64. (b)	65. (d)	66. (a)	67. (c)	68. (c)	69. (c)	70. (a)	71. (c)	72. (a)
73. (c)	74. (c)								

04 Nuclear Fission & Fusion

75. (a)	76. (c)	77. (a)	78. (a)	79. (a)	80. (d)	81. (b)	82. (d)	83. (d)	84. (c)
85. 121	86. 6	87. (b)	88. (d)	89. (a)	90. (c)	91. (a)	92. (c)	93. (c)	94. (c)
95. (a)	96. (b)	97. (a)	98. (b)	99. (c)	100. (c)	101. (a)	102. 26		

05 Radioactive Decays: Alpha, Beta, Gamma

103. (a)	104. (d)	105. (d)	106. (b)	107. (b)	108. (a)	109. (c)	110. (a)	111. (a)	112. (a)
113. (c)	114. (d)	115. (c)	116. (d)	117. (a)	118. (d)	119. (b)	120. (a)	121. (d)	122. (c)
123. (d)	124. (a)	125. (b)	126. (a)	127. (b)	128. 87	129. (a)	130. (d)	131. (b)	132. (d)
133. (b)	134. (a)	135. (b)	136. (b)	137. (c)					

06 Law of Radioactive Decay

138. (c)	139. (c)	140. (d)	141. (a)	142. (c)	143. (a)	144. (a)	145. (a)	146. (d)	147. (d)
148. (c)	149. (c)	150. (a)	151. (d)	152. (c)	153. (b)	154. (a)	155. (c)	156. (b)	157. (b)
158. (c)	159. (a)	160. (c)	161. (c)	162. (d)	163. (a)	164. 20	165. (b)	166. (a)	167. (c)
168. (c)	169. (c)	170. (d)	171. (c)	172. (d)	173. (b)	174. (d)	175. (c)	176. (b)	177. (c)
178. 10	179. 20	180. (b)	181. (c)	182. (d)	183. (c)	184. (b)	185. (c)	186. (d)	187. (b)

Note: *"Bonus" = no option is correct as the question is printed (dropped in the official key). Numerical questions show the numerical answer.*

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