



LifeX Merchant Navy

IMU CET Coaching & Merchant Navy Sponsorship Training

CLASS 12 PHYSICS · NCERT CHAPTER 13 · IMU CET PRACTICE

Nuclei

Call/WhatsApp: +91 91401 91138

Web: www.lifexmerchantnavy.com

Questions: 45 MCQs

Each question has exactly one correct option. Attempt all questions first, then check the Answer Key and Solutions at the end.

- 1 The nucleus of an atom consists of
(A) only protons
(B) neutrons and electrons
(C) protons and neutrons
(D) protons and electrons
- 2 The number of neutrons in $^{238}_{92}\text{U}$ is
(A) 92
(B) 146
(C) 238
(D) 330
- 3 Isotopes have the same
(A) mass number and atomic number
(B) number of neutrons
(C) mass number but different atomic number
(D) atomic number but different mass number
- 4 Isobars have the same
(A) mass number
(B) chemical properties
(C) number of neutrons
(D) atomic number
- 5 Isotones have the same
(A) number of protons
(B) number of electrons
(C) number of neutrons
(D) mass number
- 6 1 atomic mass unit (u) is equal to
(A) 1/16 of the mass of oxygen atom
(B) mass of a proton
(C) mass of a hydrogen atom
(D) 1/12 of the mass of a ^{12}C atom
- 7 The energy equivalent of 1 u is about
(A) 1 MeV
(B) 0.511 MeV
(C) 9.31 MeV
(D) 931.5 MeV
- 8 The radius of a nucleus of mass number A is
(A) $R_0 A^{(1/3)}$
(B) $R_0 A^2$
(C) $R_0 A^{(1/2)}$
(D) $R_0 A$



- 9 The ratio of radii of nuclei ^{27}Al and ^{64}Cu is
(A) 27 : 64 (B) 9 : 16
(C) 3 : 4 (D) 1 : 1
- 10 The density of nuclear matter is
(A) inversely proportional to A (B) proportional to A^2
(C) nearly the same for all nuclei (D) proportional to A
- 11 The mass defect of a nucleus is
(A) the mass lost in radioactive decay
(B) the difference between the sum of masses of nucleons and the mass of the nucleus
(C) the mass of electrons
(D) the mass of the neutrons only
- 12 Binding energy of a nucleus is
(A) the kinetic energy of nucleons
(B) the electrostatic energy of protons
(C) the energy of electrons
(D) the energy equivalent of its mass defect
- 13 The binding energy per nucleon is maximum for nuclei near
(A) hydrogen (B) iron ($A \approx 56$)
(C) helium (D) uranium
- 14 Nuclear forces are
(A) always repulsive (B) weaker than gravitational force
(C) long-range and electrostatic (D) short-range and charge-independent
- 15 Nuclear force becomes repulsive at separations
(A) less than about 0.8 fm (B) of about 10 fm
(C) more than 3 fm (D) at all distances
- 16 The mass defect of a nucleus is 0.03 u. Its binding energy is about
(A) 27.9 MeV (B) 0.03 MeV
(C) 2.79 MeV (D) 279 MeV
- 17 In nuclear fission,
(A) light nuclei combine
(B) a heavy nucleus splits into lighter nuclei with release of energy
(C) energy is absorbed
(D) no mass is converted
- 18 The energy released per fission of ^{235}U is about
(A) 20 MeV (B) 200 MeV
(C) 2 MeV (D) 2000 MeV



- 19 In nuclear fusion,
- (A) light nuclei combine to form a heavier nucleus
 - (B) no energy is released
 - (C) heavy nuclei split
 - (D) electrons combine with protons
-
- 20 Fusion reactions require very high temperatures because
- (A) nuclei must be cooled
 - (B) nuclei must overcome Coulomb repulsion
 - (C) nuclear forces are long range
 - (D) neutrons are charged
-
- 21 The source of energy of the Sun is
- (A) chemical burning
 - (B) nuclear fission
 - (C) nuclear fusion
 - (D) radioactive decay of uranium
-
- 22 In a nuclear reactor, the moderator is used to
- (A) cool the reactor
 - (B) absorb all neutrons
 - (C) speed up neutrons
 - (D) slow down fast neutrons
-
- 23 Control rods in a nuclear reactor are made of
- (A) uranium
 - (B) graphite
 - (C) cadmium or boron
 - (D) heavy water
-
- 24 In alpha decay, the mass number and atomic number change by
- (A) -4 and -2
 - (B) -2 and -4
 - (C) 0 and +1
 - (D) -4 and +2
-
- 25 In β^- decay,
- (A) a proton changes into a neutron
 - (B) mass number decreases by 1
 - (C) a neutron changes into a proton, emitting an electron and an antineutrino
 - (D) atomic number decreases by 1
-
- 26 Gamma emission changes
- (A) both by 1
 - (B) neither the mass number nor the atomic number
 - (C) the mass number by 4
 - (D) the atomic number by 1
-
- 27 $^{238}_{92}\text{U}$ decays to $^{206}_{82}\text{Pb}$. The number of α and β^- particles emitted are
- (A) 8 α and 6 β
 - (B) 8 α and 8 β
 - (C) 4 α and 6 β
 - (D) 6 α and 8 β
-
- 28 The law of radioactive decay is
- (A) $N = N_0(1 - e^{(-\lambda t)})$
 - (B) $N = N_0 e^{(-\lambda t)}$
 - (C) $N = N_0 \lambda t$
 - (D) $N = N_0 e^{(\lambda t)}$
-
- 29 The half-life $T_{1/2}$ and decay constant λ are related by
- (A) $T_{1/2} = \lambda/0.693$
 - (B) $T_{1/2} = 0.693\lambda$
 - (C) $T_{1/2} = 1/\lambda$
 - (D) $T_{1/2} = 0.693/\lambda$
-



- 30 The mean life τ and decay constant λ are related by
(A) $\tau = 0.693/\lambda$ (B) $\tau = \lambda^2$
(C) $\tau = \lambda$ (D) $\tau = 1/\lambda$
- 31 A radioactive sample has a half-life of 10 days. The fraction remaining after 30 days is
(A) $1/8$ (B) $1/16$
(C) $1/6$ (D) $1/3$
- 32 75% of a radioactive sample decays in 20 minutes. Its half-life is
(A) 20 min (B) 15 min
(C) 10 min (D) 5 min
- 33 The activity of a radioactive sample is measured in
(A) tesla (B) becquerel
(C) joule (D) coulomb
- 34 The activity of a sample decreases from 800 Bq to 100 Bq in 6 hours. Its half-life is
(A) 2 h (B) 3 h
(C) 6 h (D) 1.5 h
- 35 Which radiation has the highest penetrating power?
(A) Alpha particles (B) Beta particles
(C) Gamma rays (D) All equal
- 36 Which radiation has the highest ionising power?
(A) Alpha particles (B) Neutrinos
(C) Gamma rays (D) Beta particles
- 37 In the fusion reaction ${}^2\text{H} + {}^2\text{H} \rightarrow {}^3\text{He} + \text{n}$, the energy is released because
(A) neutrons carry negative energy
(B) the products have greater total mass
(C) charge is created
(D) the products have a higher binding energy per nucleon
- 38 A nuclear chain reaction is controlled when the multiplication factor k is
(A) less than 1 (B) greater than 1
(C) equal to 1 (D) zero
- 39 The decay constant of a radioactive substance depends on
(A) chemical state (B) temperature
(C) the nature of the nucleus only (D) pressure
- 40 Neutrinos are emitted in β -decay to conserve
(A) charge only (B) atomic number
(C) mass number (D) energy and angular momentum
- 41 The binding energy per nucleon of deuteron (${}^2\text{H}$) is about 1.1 MeV. Its total binding energy is
(A) 1.1 MeV (B) 0.55 MeV
(C) 4.4 MeV (D) 2.2 MeV

- 42 The equivalent energy of 1 g of matter is
(A) 9×10^{13} J (B) 3×10^8 J
(C) 9×10^{16} J (D) 9×10^{10} J
-
- 43 After two half-lives, the fraction of a radioactive sample that has decayed is
(A) $1/2$ (B) $3/4$
(C) $1/8$ (D) $1/4$
-
- 44 Heavy water used as a moderator is
(A) H_2O_2 (B) D_2O
(C) H_2O at 4°C (D) T_2O only
-
- 45 The nucleus ^{16}O has radius about ($R_0 = 1.2$ fm)
(A) 3 fm (B) 1.2 fm
(C) 4.8 fm (D) 19.2 fm
-

Answer Key

1	2	3	4	5	6	7	8	9	10
C	B	D	A	C	D	D	A	C	C
11	12	13	14	15	16	17	18	19	20
B	D	B	D	A	A	B	B	A	B
21	22	23	24	25	26	27	28	29	30
C	D	C	A	C	B	A	B	D	D
31	32	33	34	35	36	37	38	39	40
A	C	B	A	C	A	D	C	C	D
41	42	43	44	45					
D	A	B	B	A					

Hints & Solutions

- (C) Nucleons = protons + neutrons.
- (B) $N = A - Z = 238 - 92 = 146$.
- (D) Example: ^1H , ^2H , ^3H .
- (A) Example: ^3H and ^3He .
- (C) Example: $^{198}_{80}\text{Hg}$ and $^{197}_{79}\text{Au}$ (118 neutrons each).
- (D) $1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$.
- (D) $E = mc^2$ for $1 \text{ u} \approx 931.5 \text{ MeV}$.
- (A) $R = R_0 A^{1/3}$, $R_0 \approx 1.2 \text{ fm}$.
- (C) $R \propto A^{1/3} \rightarrow 3 : 4$.
- (C) Volume $\propto A$ and mass $\propto A$, so density ($\sim 2.3 \times 10^{17} \text{ kg/m}^3$) is independent of A .
- (B) $\Delta m = [Zm_p + (A - Z)m_n] - M_{\text{nucleus}}$.
- (D) $BE = \Delta m c^2$.
- (B) Fe-56 has about 8.8 MeV per nucleon, the highest.
- (D) Strong nuclear force acts over $\sim \text{fm}$, is nearly the same for p-p, n-n and n-p.
- (A) At very short distances the nuclear force becomes strongly repulsive, keeping nucleons apart.
- (A) $BE = 0.03 \times 931.5 \approx 27.9 \text{ MeV}$.
- (B) Example: $^{235}\text{U} + n \rightarrow ^{141}\text{Ba} + ^{92}\text{Kr} + 3n + \sim 200 \text{ MeV}$.
- (B) Typical fission releases $\approx 200 \text{ MeV}$.
- (A) Fusion powers the Sun, e.g., $4 ^1\text{H} \rightarrow ^4\text{He}$.
- (B) High kinetic energy lets positively charged nuclei come close enough for the strong force.
- (C) Proton-proton chain converts hydrogen to helium.
- (D) Slow (thermal) neutrons cause fission of ^{235}U more efficiently; e.g., heavy water, graphite.
- (C) Cd and B absorb neutrons and control the chain reaction rate.

24. (A) An alpha particle (${}^4_2\text{He}$) is emitted.
25. (C) $n \rightarrow p + e^- + \bar{\nu}$; A unchanged, Z increases by 1.
26. (B) Gamma rays are photons from nuclear de-excitation.
27. (A) $\Delta A = 32 \rightarrow 8 \alpha$. Z: $92 - 16 = 76$; to reach 82 need 6 β^- .
28. (B) The number of undecayed nuclei decreases exponentially.
29. (D) $T_{1/2} = \ln 2/\lambda$.
30. (D) Mean life $= 1/\lambda = 1.44 T_{1/2}$.
31. (A) 3 half-lives $\rightarrow (\frac{1}{2})^3 = 1/8$.
32. (C) 25% left $= (\frac{1}{2})^2 \rightarrow 2$ half-lives $= 20 \text{ min} \rightarrow T_{1/2} = 10 \text{ min}$.
33. (B) 1 Bq = 1 decay per second; 1 Ci $= 3.7 \times 10^{10}$ Bq.
34. (A) $800 \rightarrow 100$ is $1/8 = 3$ half-lives in 6 h $\rightarrow T_{1/2} = 2 \text{ h}$.
35. (C) Gamma rays (uncharged photons) penetrate the most; alpha the least.
36. (A) Alpha particles are heavy and doubly charged, so they ionise strongly.
37. (D) Increase in binding energy (mass defect) appears as released energy.
38. (C) $k = 1$ (critical) keeps the reaction steady; $k > 1$ leads to an explosion.
39. (C) Radioactivity is a nuclear property, unaffected by physical or chemical conditions.
40. (D) The continuous β spectrum and spin conservation required a third particle (Pauli's neutrino).
41. (D) $BE = 1.1 \times 2 = 2.2 \text{ MeV}$.
42. (A) $E = mc^2 = 10^{-3} \times 9 \times 10^{16} = 9 \times 10^{13} \text{ J}$.
43. (B) Remaining $= 1/4$, so decayed $= 3/4$.
44. (B) Deuterium oxide slows neutrons effectively with low absorption.
45. (A) $R = 1.2 \times 16^{(1/3)} = 1.2 \times 2.52 \approx 3 \text{ fm}$.

Preparing for IMU CET & Merchant Navy Sponsorship?

Join LifeX Merchant Navy — IPP (offline), AIM (online), Interview Intensive, PSP/ASP sponsorship guidance & Test Series.

Call/WhatsApp: +91 91401 91138 | www.lifexmerchantnavy.com