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de Broglie Waves · JEE Main 2023 · Shift-I — View Solution on Crucible ↗

1. An α particle, a proton and an electron have the same kinetic energy. Which one of the following is correct in case of their de-Broglie wavelength:

(A) $\lambda_\alpha > \lambda_p > \lambda_e$

(B) $\lambda_\alpha < \lambda_p < \lambda_e$

(C) $\lambda_\alpha = \lambda_p = \lambda_e$

(D) $\lambda_\alpha > \lambda_p < \lambda_e$

Radius of Nth Bohr orbit · JEE Main 2025 · Shift-II — View Solution on Crucible ↗

2. Assuming the validity of Bohr's atomic model for hydrogen like ions the radius of Li^{++} ion in its ground state is given by $\frac{1}{X}a_0$, where $X =$ _____. (Where a_0 is the first Bohr's radius.)

(A) 2

(B) 1

(C) 3

(D) 9

Kinematics of nuclear reactions · JEE Main 2024 · Shift-II — View Solution on Crucible ↗

3. In a nuclear fission reaction of an isotope of mass M, three similar daughter nuclei of same mass are formed. The speed of a daughter nuclei in terms of mass defect ΔM will be :

(A) $\sqrt{\frac{2c\Delta M}{M}}$

(B) $\frac{\Delta Mc^2}{3}$

(C) $c\sqrt{\frac{2\Delta M}{M}}$

(D) $c\sqrt{\frac{3\Delta M}{M}}$

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4. The ratio of the de-Broglie wavelengths of proton and electron having same kinetic energy: (Assume $m_p = m_e \times 1849$)

(A) $1:43$

(B) $1:30$

(C) $1:62$

(D) $2:43$

Energy of electron in nth orbit · JEE Main 2025 · Shift-I — View Solution on Crucible ↗

5. In a hydrogen like ion, the energy difference between the 2^{nd} excitation energy state and ground is 108.8 eV. The atomic number of the ion is

(A) 4

(B) 2

(C) 1

(D) 3

Nuclear binding energy · JEE Main 2024 · Shift-I View Solution on Crucible ↗

6. 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:

(A) $10\,\mu g$
(B) $20\,\mu g$
(C) $0.2\,\mu g$
(D) $2\,\mu g$

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7. The ratio of de-Broglie wavelength of an α-particle and a proton accelerated from rest by the same potential is $\frac{1}{\sqrt{m}}$, the value of m is:

(A) 4
(B) 16
(C) 8
(D) 2

Angular Momentum of Electron in Bohr Orbit · JEE Main 2022 · Shift-I View Solution on Crucible ↗

8. The momentum of an electron revolving in n^{th} orbit is given by : (Symbols have their usual meanings)

(A) $\frac{nh}{2\pi r}$
(B) $\frac{nh}{2r}$
(C) $\frac{nh}{2\pi}$
(D) $\frac{2\pi r}{nh}$

Nuclear fission · JEE Main 2024 · Shift-I View Solution on Crucible ↗

9. Which of the following nuclear fragments corresponding to nuclear fission between neutron $\left({}_0^1n\right)$ and uranium isotope $\left({}_{92}^{235}U\right)$ is correct :

(A) ${}_{56}^{144}\text{Ba} + {}_{36}^{89}\text{Kr} + 4{}_0^1n$
(B) ${}_{56}^{144}\text{Ba} + {}_{36}^{89}\text{Kr} + 3{}_0^1n$
(C) ${}_{56}^{140}\text{Xe} + {}_{38}^{94}\text{Sr} + 3{}_0^1n$
(D) ${}_{51}^{153}\text{Sb} + {}_{41}^{99}\text{Nb} + 3{}_0^1n$

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10. A proton and an α-particle are accelerated from rest by 2 V and 4 V potentials, respectively. The ratio of their de-Broglie wavelength is :

(A) $8 : 1$
(B) $2 : 1$
(C) $4 : 1$
(D) $16 : 1$

Hydrogen Spectrum and Spectral Lines · JEE Main 2024 · Shift-II View Solution on Crucible ↗

11. The longest wavelength associated with Paschen series is : (Given $R_H = 1.097 \times 10^7$ SI unit)

(A) 3.646×10^{-6} m
(B) 1.876×10^{-6} m
(C) 2.973×10^{-6} m
(D) 1.094×10^{-6} m

Beta decay · JEE Main 2025 · Shift-I View Solution on Crucible ↗

12. Choose the correct nuclear process from the below options [p: proton, n : neutron, e^-: electron, e^+: positron, v : neutrino, $\bar{v}$: antineutrino]

(A) $n \to p + e^+ + \bar{v}$
(B) $n \to p + e^+ + v$
(C) $n \to p + e^- + v$
(D) $n \to p + e^- + \bar{v}$

Photon count emitted per second · JEE Main 2024 · Shift-II View Solution on Crucible ↗

13. Two sources of light emit with a power of 200 W. The ratio of number of photons of visible light emitted by each source having wavelengths 300 nm and 500 nm respectively, will be :

(A) $1:5$
(B) $1:3$
(C) $5:3$
(D) $3:5$

Radius of Nth Bohr orbit · JEE Main 2024 · Shift-I View Solution on Crucible ↗

14. The radius of third stationary orbit of electron for Bohr's atom is R. The radius of fourth stationary orbit will be:

(A) $\frac{4}{3}R$
(B) $\frac{16}{9}R$
(C) $\frac{3}{4}R$
(D) $\frac{9}{16}R$

Nuclear fission · JEE Main 2019 · Shift-II View Solution on Crucible ↗

15. Consider the nuclear fission $Ne^{20} \to 2He^4 + C^{12}$ Given that the binding energy/nucleon of Ne^{20}, He^4 and C^{12} are respectively, 8.03 MeV, 7.07 MeV and 7.86 MeV, identify the correct statement.

(A) Energy of 12.4 MeV will be supplied.
(B) Energy of 9.72 MeV has to be supplied.
(C) Energy of 3.6 MeV will be released.
(D) 8.3 MeV energy will be released.

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16. A sub-atomic particle of mass 10^{-30} kg is moving with a velocity 2.21×10^{6} m/s. Under the matter wave consideration, the particle will behave closely like _____ ($h = 6.63 \times 10^{-34}$ J.s)

(A) Visible radiation
(B) Gamma rays
(C) Infra-red radiation
(D) X-rays

Energy of electron in nth orbit · JEE Main 2024 · Shift-I View Solution on Crucible ↗

17. An electron rotates in a circle around a nucleus having positive charge Ze. Correct relation between total energy (E) of electron to its potential energy (U) is :

(A) $E = U$
(B) $2E = U$
(C) $2E = 3U$
(D) $E = 2U$

Nuclear binding energy · JEE Main 2024 · Shift-II View Solution on Crucible ↗

18. The atomic mass of ${}_6C^{12}$ is 12.000000 u and that of ${}_6C^{13}$ is 13.003354 u. The required energy to remove a neutron from ${}_6C^{13}$, if mass of neutron is 1.008665 u, will be:

(A) 62.5 MeV
(B) 6.25 MeV
(C) 4.95 MeV
(D) 49.5 MeV

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19. The de Broglie wavelengths for an electron and a photon are λ_e and λ_p respectively. For the same kinetic energy of electron and photon, which of the following presents the correct relation between the de Broglie wavelengths of two?

(A) $\lambda_p \propto \lambda_e^2$
(B) $\lambda_p \propto \lambda_e$
(C) $\lambda_p \propto \sqrt{\lambda_e}$
(D) $\lambda_p \propto \sqrt{\frac{1}{\lambda_e}}$

Orbital frequency of electron · JEE Main 2025 · Shift-II View Solution on Crucible ↗

20. The frequency of revolution of the electron in Bohr's orbit varies with n, the principal quantum number as

(A) $\frac{1}{n^4}$
(B) $\frac{1}{n^2}$
(C) $\frac{1}{n}$
(D) $\frac{1}{n^3}$

Nuclear binding energy · JEE Main 2024 · Shift-I View Solution on Crucible ↗

21. If M_o 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 :

(A) $(M_o - 5M_p)C^2$
(B) $(5M_p + 7M_n - M_o)C^2$
(C) $(M_0 - 12M_n)C^2$
(D) $(M_o - 5M_p - 7M_n)C^2$

Radiation pressure and force · JEE Main 2024 · Shift-II View Solution on Crucible ↗

22. If the total energy transferred to a surface in time t is 6.48×10^5 J, then the magnitude of the total momentum delivered to this surface for complete absorption will be :

(A) 2.46×10^{-3} kg m s^{-1}
(B) 2.16×10^{-3} kg m s^{-1}
(C) 1.58×10^{-3} kg m s^{-1}
(D) 4.32×10^{-3} kg m s^{-1}

Frequency of Emitted Radiation · JEE Main 2022 · Shift-I View Solution on Crucible ↗

23. Find the ratio of energies of photons produced due to transition of an election of hydrogen atom from its (i) second permitted energy level to the first level, and (ii) the highest permitted energy level to the first permitted level.

(A) $3 : 4$
(B) $4 : 3$
(C) $1 : 4$
(D) $4 : 1$

Nuclear fission · JEE Main 2024 · Shift-II View Solution on Crucible ↗

24. In a hypothetical fission reaction $_{92}X^{236} \rightarrow_{56} Y^{141} +_{36} Z^{92} + 3R$. The identity of emitted particles (R) is :

(A) Electron
(B) Neutron
(C) γ-radiations
(D) Proton

Einstein photoelectric equation · JEE Main 2024 · Shift-I View Solution on Crucible ↗

25. In photoelectric experiment energy of 2.48eV irradiates a photo sensitive material. The stopping potential was measured to be 0.5 V. Work function of the photo sensitive material is :

(A) 1.68 eV
(B) 2.48 eV
(C) 1.98 eV
(D) 0.5 eV

Orbital frequency of electron · JEE Main 2024 · Shift-II View Solution on Crucible ↗

26. An electron revolving in n^{th} Bohr orbit has magnetic moment μ_n. If $\mu_n \propto n^x$, the value of x is:

(A) 2
(B) 1
(C) 3
(D) 0

Mass energy equivalence · JEE Main 2024 · Shift-I View Solution on Crucible ↗

27. The energy equivalent of 1 g of substance is :

(A) 5.6×10^{12} MeV
(B) 5.6×10^{26} MeV
(C) 11.2×10^{24} MeV
(D) 5.6 eV

Energy of Photon · JEE Main 2025 · Shift-II View Solution on Crucible ↗

28. The energy E and momentum p of a moving body of mass m are related by some equation. Given that c represents the speed of light, identify the correct equation.

(A) $E^2 = pc^2 + m^2c^2$
(B) $E^2 = p^2c^2 + m^2c^2$
(C) $E^2 = pc^2 + m^2c^4$
(D) $E^2 = p^2c^2 + m^2c^4$

Frequency of Emitted Radiation · JEE Main 2023 · Shift-II View Solution on Crucible ↗

29. A photon is emitted in transition from $n = 4$ to $n = 1$ level in hydrogen atom. The corresponding wavelength for this transition is (given, $h = 4 \times 10^{-15}$ eV s)

(A) 941 nm
(B) 974 nm
(C) 99.3 nm
(D) 94.1 nm

Size of nuclei · JEE Main 2025 · Shift-II View Solution on Crucible ↗

30. For a nucleus of mass number A and radius R, the mass density of nucleus can be represented as

(A) A^3
(B) $A^{\frac{1}{3}}$
(C) $A^{\frac{2}{3}}$
(D) Independent of A

Answer Key (Q1 to Q30)

Click any question number below to open its exact step-by-step solution on The Crucible ↗

1: (B)	2: (C)	3: (C)	4: (A)	5: (D)	6: (B)	7: (C)	8: (A)	9: (B)	10: (C)
11: (B)	12: (D)	13: (D)	14: (B)	15: (B)	16: (D)	17: (B)	18: (C)	19: (A)	20: (D)
21: (B)	22: (B)	23: (A)	24: (B)	25: (C)	26: (B)	27: (B)	28: (D)	29: (D)	30: (D)

Sample Solution — Question 1 (Correct Option: B)

Open Full Solution on Crucible ↗

Q1. An α particle, a proton and an electron have the same kinetic energy. Which one of the following is correct in case of their de-Broglie wavelength:

Same kinetic energy, so use $p = \sqrt{2mK}$.

$\lambda = \frac{h}{\sqrt{2mK}}$, so $\lambda \propto \frac{1}{\sqrt{m}}$

$m_\alpha \approx 4m_p$ and $m_p \approx 1836\, m_e$, so $m_\alpha > m_p > m_e$.

The heaviest has the shortest wavelength: $\lambda_\alpha < \lambda_p < \lambda_e$

So the answer is (b).

• **Watch out:** Many students choose (a), the reverse order, because they think a bigger particle must have a bigger wavelength. At the same energy, a heavier particle carries more momentum, so its wavelength is shorter.

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