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CLASS 12 PHYSICS · NCERT CHAPTER 12 · IMU CET PRACTICE

Atoms

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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 In Rutherford's alpha-particle scattering experiment, most alpha particles passed undeflected. This shows that
 - (A) electrons are heavy
 - (B) the nucleus is negatively charged
 - (C) most of the atom is empty space
 - (D) the atom is a uniform sphere of positive charge
- 2 In the alpha scattering experiment, a very small number of alpha particles were deflected by more than 90° . This indicates
 - (A) atoms are mostly filled with matter
 - (B) the presence of a small, dense, positively charged nucleus
 - (C) the nucleus is neutral
 - (D) electrons repel alpha particles strongly
- 3 Rutherford's model failed to explain
 - (A) the presence of a nucleus
 - (B) the stability of the atom and the line spectrum
 - (C) large-angle scattering
 - (D) the size of the nucleus
- 4 The distance of closest approach of an alpha particle to a nucleus is the point where
 - (A) the force on it is zero
 - (B) it captures an electron
 - (C) its speed is maximum
 - (D) its kinetic energy is fully converted into electrostatic potential energy
- 5 The impact parameter is
 - (A) the scattering angle
 - (B) the radius of the nucleus
 - (C) the distance of closest approach
 - (D) the perpendicular distance of the initial velocity vector from the centre of the nucleus
- 6 According to Bohr's postulate, the angular momentum of an electron in a stationary orbit is
 - (A) $2\pi n h$
 - (B) $h/2\pi n$
 - (C) $nh/2\pi$
 - (D) nh

- 7 The radius of the n th Bohr orbit in a hydrogen atom is proportional to
 (A) $1/n^2$ (B) n^2
 (C) $1/n$ (D) n
-
- 8 The radius of the first Bohr orbit of hydrogen is
 (A) $1.06 \text{ \AA}$ (B) $0.529 \text{ \AA}$
 (C) $5.29 \text{ \AA}$ (D) $0.0529 \text{ \AA}$
-
- 9 The radius of the second Bohr orbit of hydrogen is
 (A) $1.06 \text{ \AA}$ (B) $0.529 \text{ \AA}$
 (C) $4.24 \text{ \AA}$ (D) $2.12 \text{ \AA}$
-
- 10 The energy of the electron in the n th orbit of hydrogen is
 (A) $-13.6/n \text{ eV}$ (B) $+13.6/n^2 \text{ eV}$
 (C) $-13.6 n^2 \text{ eV}$ (D) $-13.6/n^2 \text{ eV}$
-
- 11 The ionisation energy of a hydrogen atom in its ground state is
 (A) 3.4 eV (B) 10.2 eV
 (C) 13.6 eV (D) 1.51 eV
-
- 12 The energy of the electron in the second orbit of hydrogen is
 (A) -3.4 eV (B) -6.8 eV
 (C) -1.51 eV (D) -13.6 eV
-
- 13 The energy required to excite a hydrogen atom from $n = 1$ to $n = 2$ is
 (A) 12.09 eV (B) 13.6 eV
 (C) 10.2 eV (D) 3.4 eV
-
- 14 The speed of the electron in the n th Bohr orbit of hydrogen is proportional to
 (A) $1/n$ (B) n
 (C) $1/n^2$ (D) n^2
-
- 15 The speed of the electron in the first Bohr orbit of hydrogen is about
 (A) $3 \times 10^8 \text{ m/s}$ (B) $2.18 \times 10^6 \text{ m/s}$
 (C) $2.18 \times 10^8 \text{ m/s}$ (D) $1.09 \times 10^6 \text{ m/s}$
-
- 16 The kinetic energy of the electron in the ground state of hydrogen is
 (A) 13.6 eV (B) -27.2 eV
 (C) -13.6 eV (D) 27.2 eV
-
- 17 The potential energy of the electron in the ground state of hydrogen is
 (A) 27.2 eV (B) -13.6 eV
 (C) 13.6 eV (D) -27.2 eV
-
- 18 The ratio of kinetic energy to total energy of an electron in a Bohr orbit is
 (A) 1 (B) -2
 (C) 2 (D) -1
-

- 19** The Lyman series of the hydrogen spectrum lies in the
(A) infrared region **(B)** microwave region
(C) ultraviolet region **(D)** visible region
-
- 20** The Balmer series of hydrogen lies in the
(A) ultraviolet region **(B)** X-ray region
(C) visible region **(D)** far infrared region
-
- 21** The Paschen series corresponds to transitions ending at
(A) $n = 4$ **(B)** $n = 2$
(C) $n = 1$ **(D)** $n = 3$
-
- 22** The wavelength of a spectral line is given by $1/\lambda = R(1/n_1^2 - 1/n_2^2)$. The value of the Rydberg constant R is about
(A) $6.6 \times 10^{-34} \text{ m}^{-1}$ **(B)** $9.1 \times 10^7 \text{ m}^{-1}$
(C) $1.097 \times 10^{-7} \text{ m}^{-1}$ **(D)** $1.097 \times 10^7 \text{ m}^{-1}$
-
- 23** The shortest wavelength of the Lyman series is about
(A) 121.6 nm **(B)** 91.2 nm
(C) 365 nm **(D)** 656 nm
-
- 24** The longest wavelength of the Lyman series corresponds to the transition
(A) $n = 2 \rightarrow n = 1$ **(B)** $n = 3 \rightarrow n = 1$
(C) $n = \infty \rightarrow n = 1$ **(D)** $n = 3 \rightarrow n = 2$
-
- 25** The first line ($H\alpha$) of the Balmer series has a wavelength of about
(A) 486 nm **(B)** 656 nm
(C) 365 nm **(D)** 434 nm
-
- 26** The ratio of the longest wavelengths of Lyman and Balmer series is
(A) 1 : 4 **(B)** 27 : 5
(C) 4 : 9 **(D)** 5 : 27
-
- 27** The number of spectral lines possible when an electron jumps from $n = 4$ to the ground state (all routes) is
(A) 4 **(B)** 3
(C) 6 **(D)** 10
-
- 28** A hydrogen atom in its ground state absorbs 12.09 eV. It is excited to
(A) $n = \infty$ **(B)** $n = 4$
(C) $n = 3$ **(D)** $n = 2$
-
- 29** The frequency of a photon emitted when an electron jumps from E_2 to E_1 is
(A) $h(E_2 - E_1)$ **(B)** E_2/h
(C) $(E_2 + E_1)/h$ **(D)** $(E_2 - E_1)/h$
-



- 30** Bohr's model is applicable to
(A) all multi-electron atoms
(B) only helium
(C) hydrogen and hydrogen-like ions (single electron)
(D) molecules
-
- 31** The radius of the first Bohr orbit of He^+ ($Z = 2$) compared to hydrogen is
(A) half
(B) same
(C) double
(D) four times
-
- 32** The ground-state energy of Li^{2+} ($Z = 3$) is
(A) -40.8 eV
(B) -13.6 eV
(C) -122.4 eV
(D) -54.4 eV
-
- 33** The de Broglie explanation of Bohr's quantisation condition is that
(A) the orbit circumference is an integral multiple of the electron's de Broglie wavelength
(B) electrons are particles only
(C) the nucleus emits waves
(D) orbits are elliptical
-
- 34** Emission line spectra are produced by
(A) atoms in a hot, low-density gas
(B) liquids at room temperature
(C) cold dense gases
(D) hot solids
-
- 35** The orbital frequency of the electron in the n th Bohr orbit is proportional to
(A) n
(B) $1/n^3$
(C) $1/n^2$
(D) n^3
-
- 36** When an electron in hydrogen jumps from $n = 3$ to $n = 2$, the energy emitted is
(A) 12.09 eV
(B) 3.4 eV
(C) 1.89 eV
(D) 10.2 eV
-
- 37** The Thomson model of the atom is also called the
(A) quantum model
(B) plum pudding model
(C) nuclear model
(D) planetary model
-
- 38** The size of an atom is of the order of
(A) 10^{-10} m
(B) 10^{-6} m
(C) 10^{-15} m
(D) 10^{-20} m
-
- 39** In Rutherford's experiment, a thin gold foil was used because
(A) gold is radioactive
(B) gold is a good conductor
(C) gold is cheap
(D) gold is malleable and a thin foil reduces multiple scattering
-
- 40** The total energy of an electron in an orbit is negative. This means
(A) the electron is bound to the nucleus
(B) the electron moves backwards
(C) the electron has negative mass
(D) the electron is free
-



- 41 The energy levels of hydrogen get closer together as n
- (A) becomes zero (B) increases
(C) decreases (D) stays at 1
-
- 42 The wavelength of radiation emitted when an electron in hydrogen jumps from $n = \infty$ to $n = 2$ (Balmer limit) is about
- (A) 365 nm (B) 820 nm
(C) 91 nm (D) 656 nm
-
- 43 The angular momentum of an electron in the 3rd Bohr orbit is
- (A) $3h$ (B) $3h/2\pi$
(C) $2h/3\pi$ (D) $h/2\pi$
-
- 44 The excitation energy from $n = 2$ to $n = 3$ in hydrogen corresponds to a photon in the
- (A) visible region (B) ultraviolet region
(C) X-ray region (D) radio region
-
- 45 The binding energy of the electron in the $n = 3$ state of hydrogen is
- (A) 1.51 eV (B) 12.09 eV
(C) 3.4 eV (D) 13.6 eV
-

Answer Key

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

Hints & Solutions

1. (C) Only a tiny fraction were deflected, showing mass and positive charge are concentrated in a small nucleus.

2. (B) Large-angle scattering requires a strong repulsive force from concentrated positive charge.

3. (B) Classically, an orbiting electron radiates energy and spirals into the nucleus, giving a continuous spectrum.

4. (D) $\frac{1}{2}mv^2 = k(2e)(Ze)/r_0$.

5. (D) Small impact parameter $\rightarrow$ large scattering angle.

6. (C) $L = mvr = n\hbar$.

7. (B) $r_n = 0.529 n^2 \text{ \AA}$.

8. (B) Bohr radius $a_0 \approx 0.529 \times 10^{-10} \text{ m}$.

9. (D) $r_2 = 4 \times 0.529 = 2.116 \text{ \AA}$.

10. (D) $E_n = -13.6/n^2 \text{ eV}$.

11. (C) Energy needed to take the electron from $n = 1$ (-13.6 eV) to ∞ (0).

12. (A) $E_2 = -13.6/4 = -3.4 \text{ eV}$.

13. (C) $\Delta E = -3.4 - (-13.6) = 10.2 \text{ eV}$.

14. (A) $v_n = (2.18 \times 10^6/n) \text{ m/s}$.

15. (B) $v_1 = c/137 \approx 2.18 \times 10^6 \text{ m/s}$.

16. (A) $K = -E = 13.6 \text{ eV}$; $PE = -27.2 \text{ eV}$.

17. (D) $U = 2E = -27.2 \text{ eV}$.

18. (D) $K = -E \rightarrow K/E = -1$.

19. (C) Transitions ending at $n = 1$ involve large energies $\rightarrow$ UV.

20. (C) Transitions ending at $n = 2$ give visible lines ($H\alpha$ 656 nm, $H\beta$ 486 nm, ...).

21. (D) Lyman $\rightarrow$ 1, Balmer $\rightarrow$ 2, Paschen $\rightarrow$ 3, Brackett $\rightarrow$ 4, Pfund $\rightarrow$ 5.

22. (D) $R \approx 1.097 \times 10^7 \text{ m}^{-1}$.

23. (B) $n_2 = \infty \rightarrow 1/\lambda = R \rightarrow \lambda = 91.2 \text{ nm}$.
24. (A) Smallest energy gap in the Lyman series gives the longest wavelength.
25. (B) $n = 3 \rightarrow 2$ transition: $\lambda \approx 656.3 \text{ nm}$ (red).
26. (D) Lyman: $1/\lambda = R(3/4)$; Balmer: $1/\lambda = R(5/36)$. $\lambda_L/\lambda_B = (5/36)/(3/4) = 5/27$.
27. (C) $n(n-1)/2 = 4 \times 3/2 = 6$.
28. (C) $E_3 = -1.51 \text{ eV}$; $-1.51 - (-13.6) = 12.09 \text{ eV}$.
29. (D) Bohr's frequency condition $h\nu = E_2 - E_1$.
30. (C) Bohr's model handles one-electron systems like H, He^+ , Li^{2+} .
31. (A) $r \propto n^2/Z$.
32. (C) $E = -13.6 Z^2 = -13.6 \times 9 = -122.4 \text{ eV}$.
33. (A) $2\pi r = n\lambda = nh/(mv) \rightarrow mvr = nh/2\pi$.
34. (A) Isolated excited atoms emit discrete wavelengths.
35. (B) $f = v/(2\pi r) \propto (1/n)/(n^2) = 1/n^3$.
36. (C) $E = -1.51 - (-3.4) = 1.89 \text{ eV}$.
37. (B) Electrons embedded in a uniform sphere of positive charge, like plums in a pudding.
38. (A) Atomic radius $\sim 1 \text{ \AA}$; nuclear radius $\sim 1 \text{ fm}$ (10^{-15} m).
39. (D) Very thin foils ensure each alpha particle is scattered by at most one nucleus.
40. (A) Negative total energy means work must be done to remove the electron — a bound state.
41. (B) $E_n \propto -1/n^2$, so the gaps ($\propto 1/n^2 - 1/(n+1)^2$) shrink with increasing n .
42. (A) $1/\lambda = R/4 \rightarrow \lambda = 4/R = 364.6 \text{ nm}$.
43. (B) $L = nh/2\pi$ with $n = 3$.
44. (A) This is the $\text{H}\alpha$ transition ($\approx 1.89 \text{ eV}$, 656 nm).
45. (A) $|E_3| = 13.6/9 = 1.51 \text{ eV}$.

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