CHAPTER

25

Atomic Structure

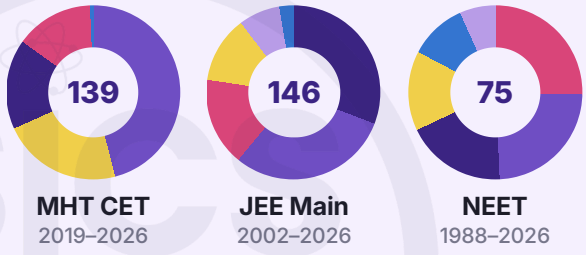
MHT CET · JEE · NEET Physics

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EXAM WEIGHTAGE



MHT CET 2019–2026 | **JEE Main** 2002–2026 | **NEET** 1988–2026

	CET	JEE	NEET
Bohr Model: Orbits, Speed & Angular Momentum	64 46%	44 30%	18 24%
Transitions, Photon Emission & Excitation	23 17%	45 31%	14 19%
Energy of the Electron & Energy Levels	20 14%	24 16%	19 25%
Hydrogen Spectrum & Spectral Series	31 22%	18 12%	11 15%
Atomic Models & Alpha-Particle Scattering	0 0%	11 8%	5 7%
Quantum Numbers, X-rays & Other Questions	1 1%	4 3%	8 11%

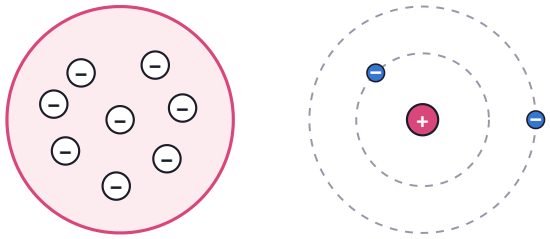
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01 CONCEPT Atomic Models & Alpha-Particle Scattering

IN ONE LINE

Thomson spread the positive charge over the whole atom; Rutherford's α-scattering showed it sits in a **tiny, heavy nucleus**.

25.1.1 Thomson and Rutherford

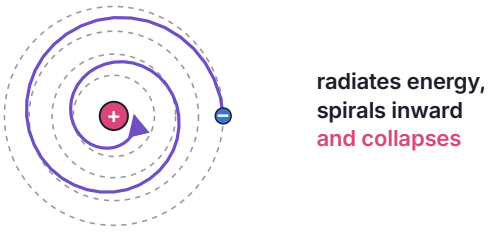


Thomson: positive sphere | Rutherford: tiny nucleus

Plum pudding (left) and nuclear atom (right)

- Thomson: a positive sphere with electrons embedded like seeds in a watermelon.
- It could not explain large-angle α-scattering or the line spectrum of hydrogen.
- Rutherford: all the positive charge and almost all the mass (99.95%) are in a tiny nucleus.
- Nucleus ≈ 10^{-15} m (1 fermi); atom ≈ 10^{-10} m (1 Å). The atom is mostly empty space.
- Electrons revolve round the nucleus like planets round the sun.

25.1.2 Why the atom should collapse

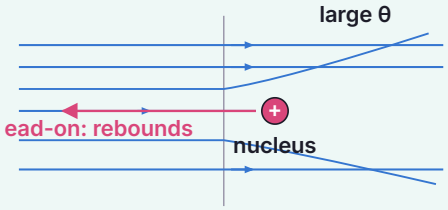


A revolving charge radiates and spirals in

- A revolving electron is accelerated, so by classical theory it must radiate energy.
- Its orbit would shrink and it would fall into the nucleus: atom not stable.
- The emitted spectrum would be continuous, but hydrogen gives a line spectrum.

JEE · NEET Corner

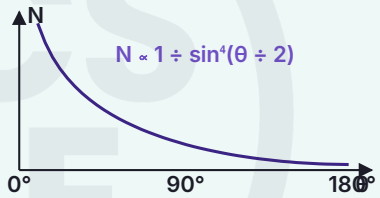
α-scattering experiment (Geiger and Marsden)



Most α pass straight; a few turn back

- Most α-particles pass undeflected; some turn through small angles.
- About 1 in 8000 turns by more than 90°; very few return (180°).

Number scattered against angle



N falls very steeply as θ grows

- For a foil of thickness t: $\frac{N}{t}$ = constant.

Distance of closest approach

$$r_0 = \frac{4kZe^2}{mv^2} = \frac{2kZe^2}{K}$$

- $r_0 \propto Z$, $r_0 \propto \frac{1}{K}$, $r_0 \propto \frac{1}{m}$, $r_0 \propto \frac{1}{v^2}$.
- r_0 is an upper limit of nuclear size (about 10^{-14} m for gold).

Impact parameter b

$$b = \frac{kZe^2}{K} \cot\left(\frac{\theta}{2}\right)$$

- Large b: small deflection. b = 0: head-on, θ = 180°.

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Solved Examples 01 Atomic Models & Alpha-Particle Scattering

SOLVED 1 NEET 2024

Given below are two statements:
Statement I: Atoms are electrically neutral as they contain equal number of positive and negative charges.
Statement II: Atoms of each element are stable and emit their characteristic spectrum.
In the light of the above statements, choose the most appropriate answer.

(a) Both Statement I and Statement II are correct
(b) Both Statement I and Statement II are incorrect
(c) Statement I is correct but Statement II is incorrect
(d) Statement I is incorrect but Statement II is correct

STEP 1 Equal positive and negative charge: atom is neutral. I is correct
STEP 2 A stable atom in its ground state does not emit; it emits only when excited
STEP 3 **I correct, II incorrect**

Answer: **(c)**

SOLVED 2 JEE Main 2024 · 29 Jan · Shift 2

Given below are two statements:
Statement I: Most of the mass of the atom and all its positive charge are concentrated in a tiny nucleus and the electrons revolve around it, is Rutherford's model.
Statement II: An atom is a spherical cloud of positive charges with electrons embedded in it, is a special case of Rutherford's model.
Choose the most appropriate answer.

(a) Both Statement I and Statement II are true
(b) Statement I is true but Statement II is false
(c) Statement I is false but Statement II is true
(d) Both Statement I and Statement II are false

STEP 1 Statement I describes Rutherford's nuclear model: true
STEP 2 Statement II is Thomson's plum pudding model, not a case of Rutherford's model
STEP 3 **I true, II false**

Answer: **(b)**

SOLVED 3 JEE Main 2022 · 24 Jun · Shift 1

Choose the correct option from the following:

(a) In the ground state of Rutherford's model electrons are in stable equilibrium, while in Thomson's model electrons always experience a net force.
(b) An atom has a nearly continuous mass distribution in Rutherford's model but a highly non-uniform mass distribution in Thomson's model.
(c) A classical atom based on Rutherford's model is doomed to collapse.
(d) The positively charged part of the atom possesses most of the mass in Rutherford's model but not in Thomson's model.

STEP 1 An electron going round the nucleus is accelerated
STEP 2 Classically it radiates energy and spirals into the nucleus
STEP 3 So **Rutherford's atom is doomed to collapse**

Answer: **(c)**

SOLVED 4 NEET 2016 · Phase 1

When an α-particle of mass m moving with velocity v bombards on a heavy nucleus of charge Ze, its distance of closest approach from the nucleus depends on m as

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

STEP 1 At closest approach: $\frac{1}{2}mv^2 = \frac{k(2e)(Ze)}{r_0}$
STEP 2 $r_0 = \frac{4kZe^2}{mv^2}$
STEP 3 $r_0 \propto \frac{1}{m}$

Answer: **(c)**

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Solved Examples 01 Atomic Models & Alpha-Particle Scattering (contd.)

SOLVED 5 JEE Main 2026 · 4 Apr · Shift 2

In Rutherford's alpha-particle scattering experiment, only a few alpha particles rebound back because

A. The size of gold nucleus is very small as compared to the size of gold atom.

B. Alpha particle and gold nucleus have equal charge.

C. The impact parameter is minimum for a few alpha particles.

D. A few alpha particles have very high kinetic energy.

E. Only a few alpha particles undergo head-on collision with the nuclei.

(a) A, B only (b) B, E only

(c) C, D only (d) A, C, E only

STEP 1 Tiny nucleus: very few α come close to it (A true)

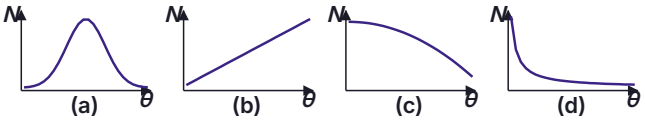
STEP 2 Rebound needs $b \approx 0$, a head-on approach (C, E true)

STEP 3 Charges are 2e and 79e (B false): **A, C, E only**

Answer: **(d)**

SOLVED 6 RE-NEET 2026

In Geiger–Marsden experiment, the number of scattered α-particles N(θ) is plotted as a function of scattering angle θ. Which of the following graphs represents the correct plot?



(a) graph (a) (b) graph (b)

(c) graph (c) (d) graph (d)

STEP 1 $N \propto \frac{1}{\sin^4(\theta \div 2)}$

STEP 2 Very large at small θ, falls steeply as θ grows

STEP 3 Steep falling curve: **graph (d)**

Answer: **(d)**

SOLVED 7 AIPMT 2010 · Prelims

An alpha nucleus of energy $\frac{1}{2}mv^2$ bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to

(a) $\frac{1}{Ze}$ (b) v^2

(c) $\frac{1}{m}$ (d) $\frac{1}{v^4}$

STEP 1 $r_0 = \frac{k(2e)(Ze)}{K}$ with $K = \frac{1}{2}mv^2$

STEP 2 $r_0 = \frac{4kZe^2}{mv^2}$

STEP 3 $r_0 \propto Ze$, $r_0 \propto \frac{1}{v^2}$, $r_0 \propto \frac{1}{m}$

Answer: **(c)**

SOLVED 8 AIPMT 2009

In a Rutherford scattering experiment when a projectile of charge z_1 and mass M_1 approaches a target nucleus of charge z_2 and mass M_2, the distance of closest approach is r_0. The energy of the projectile is

(a) directly proportional to z_1z_2

(b) inversely proportional to z_1

(c) directly proportional to mass M_1

(d) directly proportional to $M_1 \times M_2$

STEP 1 All kinetic energy turns into potential energy at r_0

STEP 2 $K = \frac{kz_1z_2e^2}{r_0}$

STEP 3 For a given r_0: $K \propto z_1z_2$

Answer: **(a)**

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02 CONCEPT Bohr Model: Postulates, Radius, Speed & de Broglie

IN ONE LINE

Only orbits with angular momentum **nh ÷ 2π** are allowed. From this: $r \propto n^2 \div Z$ and $v \propto Z \div n$.

25.2.1 For H and H-like atoms

- Electrons move only in certain stationary orbits and do not radiate there.
- In these orbits the angular momentum is quantised:

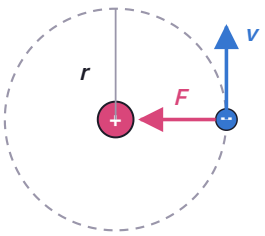
$$L = mvr = n\frac{h}{2\pi} \cdot n = 1, 2, 3, \ldots$$

- Energy is emitted or absorbed only when the electron jumps between orbits:

$$h\nu = E_2 - E_1$$

- Valid only for one-electron systems: H, ^2H, He^+, Li^{2+}, Be^{3+}.
- Change in L between neighbouring orbits = h ÷ 2π ≈ 1.05×10^{-34} J s.

25.2.2 Coulomb force gives centripetal force



mvr = nh ÷ 2π

F = kZe² ÷ r²

gives r and v

Electron in the nth orbit

$$\frac{mv^2}{r} = \frac{kZe^2}{r^2} \text{ and } mvr = n\frac{h}{2\pi}$$

$$r_n = \frac{n^2h^2\varepsilon_0}{\pi mZe^2} = 0.53\,\frac{n^2}{Z}\ \text{Å}$$

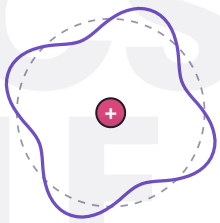
- $r \propto n^2 \div Z$: radii of H orbits are in the ratio 1 : 4 : 9 : 16.
- Bohr radius a_0 = 0.53 Å (n = 1, Z = 1).
- Area of orbit $\propto r^2 \propto n^4$.

25.2.3 Falls as n grows

$$v_n = \frac{Ze^2}{2\varepsilon_0 nh} = \frac{c}{137} \times \frac{Z}{n} = 2.2 \times 10^6 \frac{Z}{n}\ \text{m/s}$$

- $v \propto Z \div n$.
- $\frac{v_1}{c} = \frac{e^2}{2\varepsilon_0 hc} = \frac{1}{137}$ (fine-structure constant).
- Momentum $p = mv \propto Z \div n$.

25.2.4 Why L is quantised



n = 4: four whole waves fit the orbit

2πr = nλ

A stationary orbit holds a whole number of waves

$$2\pi r = n\lambda \Rightarrow \lambda = \frac{2\pi r}{n} = \frac{h}{mv}$$

- $\lambda \propto n \div Z$ (since $r \propto n^2$ and $v \propto 1 \div n$).
- Going up to a higher orbit: λ increases. Coming down to n = 1: λ decreases.
- Example: in n = 3 of H, $\lambda = 2\pi(9a_0) \div 3 = 6\pi a_0$.

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Solved Examples 02 Bohr Model: Postulates, Radius, Speed & de Broglie

SOLVED 1 MHT CET 2026 · 13 May · Shift 2

When an electron in hydrogen atom revolves in a stationary orbit, it

(a) does not radiate light though its velocity changes
(b) does not radiate light and velocity remains unchanged
(c) radiates light but its velocity is unchanged
(d) radiates light with the change of energy

STEP 1 Bohr: no radiation in a stationary orbit
STEP 2 Speed is constant but direction keeps changing
STEP 3 So **no radiation, though velocity changes**

Answer: **(a)**

SOLVED 2 MHT CET 2026 · 20 Apr · Shift 2

Which of the following is an integral multiple of $\frac{h}{2\pi}$ in Bohr's model of an hydrogen atom?

(a) Radius of an atom (b) Kinetic energy
(c) Potential energy (d) Angular momentum

STEP 1 Bohr's second postulate
STEP 2 $mvr = n\frac{h}{2\pi}$
STEP 3 **Angular momentum**

Answer: **(d)**

SOLVED 3 MHT CET 2026 · 18 Apr · Shift 1

The angular momentum of the electron in the third Bohr orbit of a hydrogen atom is 'I', so its angular momentum in the fourth Bohr orbit is

(a) 4I (b) $(\frac{5}{4})$I
(c) $(\frac{4}{3})$I (d) $(\frac{3}{2})$I

STEP 1 $L = n\frac{h}{2\pi} \Rightarrow L \propto n$
STEP 2 $\frac{L_4}{L_3} = \frac{4}{3}$
STEP 3 $L_4 = (\frac{4}{3})$I

Answer: **(c)**

SOLVED 4 MHT CET 2026 · 20 Apr · Shift 1

The angular momentum of an electron in Bohr's hydrogen atom having energy (−0.544) eV is (h = Planck's constant)

(a) $\frac{h}{\pi}$ (b) $\frac{3h}{\pi}$
(c) $\frac{5h}{2\pi}$ (d) $\frac{7h}{2\pi}$

STEP 1 $E = -\frac{13.6}{n^2} = -0.544 \Rightarrow n^2 = 25$
STEP 2 $n = 5$
STEP 3 $L = 5\frac{h}{2\pi} = \mathbf{\frac{5h}{2\pi}}$

Answer: **(c)**

SOLVED 5 MHT CET 2024 · 2 May · Shift 1

The radius of innermost orbit of hydrogen atom is 5.3×10^{-11} m. The radius of fourth allowed orbit of hydrogen atom is

(a) 8.48 Å (b) 2.12 Å
(c) 4.77 Å (d) 0.53 Å

STEP 1 $r = n^2 r_1$
STEP 2 $r_4 = 16 \times 0.53$ Å
STEP 3 $r_4 = \mathbf{8.48}$ **Å**

Answer: **(a)**

SOLVED 6 MHT CET 2026 · 18 Apr · Shift 2

If the difference between (n + 1)th Bohr radius and nth Bohr radius is equal to the (n − 1)th Bohr radius, then the value of n is

(a) 4 (b) 3
(c) 2 (d) 1

STEP 1 $r \propto n^2 \Rightarrow (n+1)^2 - n^2 = (n-1)^2$
STEP 2 $2n + 1 = n^2 - 2n + 1 \Rightarrow n^2 = 4n$
STEP 3 $n = \mathbf{4}$

Answer: **(a)**

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ATOMIC STRUCTURE

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

151	21	6
questions	concepts	topics

CONTENTS

01	Atomic Models & Alpha-Particle Scattering	Q 1–8	8 Qs
02	Bohr Model: Orbits, Speed & Angular Momentum	Q 9–68	60 Qs
03	Energy of the Electron & Energy Levels	Q 69–101	33 Qs
04	Transitions, Photon Emission & Excitation	Q 102–122	21 Qs
05	Hydrogen Spectrum & Spectral Series	Q 123–144	22 Qs
06	Quantum Numbers, X-rays & Other Questions	Q 145–151	7 Qs
	Answer key		

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TOPIC 01

Atomic Models & Alpha-Particle Scattering

8 PYQs · Easy 8 · Medium 0 · Difficult 0 | MHT CET 0 · NEET 5 · JEE 3

Concepts covered: Thomson & Rutherford models (2) · Alpha scattering: N against angle (2) · Distance of closest approach & impact parameter (4)

LEVEL 1 · EASY 8 questions

◆ Thomson & Rutherford models 2 Qs

1. Given below are two statements:

Statement I: Atoms are electrically neutral as they contain equal number of positive and negative charges.

Statement II: Atoms of each element are stable and emit their characteristic spectrum. In the light of the above statements, choose the most appropriate answer from the options given below.

NEET 2024

(a) Both Statement I and Statement II are correct
(b) Both Statement I and Statement II are incorrect
(c) Statement I is correct but Statement II is incorrect
(d) Statement I is incorrect but Statement II is correct

2. Given below are two statements:

Statement I: Most of the mass of the atom and all its positive charge are concentrated in a tiny nucleus and the electrons revolve around it, is Rutherford's model.

Statement II: An atom is a spherical cloud of positive charges with electrons embedded in it, is a special case of Rutherford's model.

In the light of the above statements, choose the most appropriate from the options given below

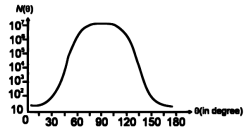
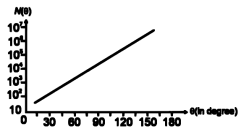
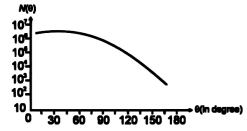
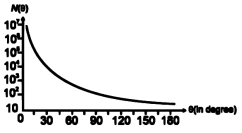
JEE MAIN 2024 · 29 JAN · SHIFT 2

(a) Both Statement I and Statement II are true
(b) Statement I is true but Statement II is false
(c) Statement I is false but Statement II is true
(d) Both statement I and statement II are false

◆ Alpha scattering: N against angle 2 Qs

3. In Geiger-Marsden experiment, the number of scattered α-particles $N(\theta)$ is plotted as a function of scattering angle θ. Which of the following options represents the correct plot?

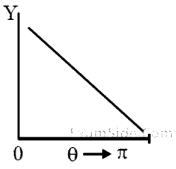
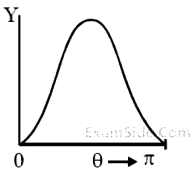
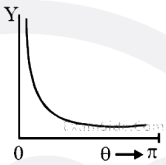
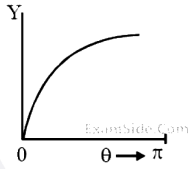
RE-NEET 2026

(a) 
(b) 
(c) 
(d) 

4. The graph which depicts the results of Rutherford gold foil experiment with α-particales is: θ: Scattering angle

Y: Number of scattered α-particles detected (Plots are schematic and not to scale)

JEE MAIN 2020 · 8 JAN · SHIFT 1

(a) 
(b) 
(c) 
(d) 

◆ Distance of closest approach & impact parameter 4 Qs

5. When an α-particle of mass m moving with velocity v bombards on a heavy nucleus of charge Ze, its distance of closest approach from the nucleus depends on m as

NEET 2016 · PHASE 1

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

6. An alpha nucleus of energy $\frac{1}{2}$ mv2 bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to

AIPMT 2010 · PRELIMS

(a) $\frac{1}{Ze}$ (b) v2 (c) $\frac{1}{m}$ (d) $\frac{1}{v^4}$

7. In a Rutherford scattering experiment when a projectile of charge z1 and mass M1 approaches a target nucleus of charge z2 and mass M2, the distance of closest approach is r0. The energy of the projectile is

AIPMT 2009

(a) directly proportional to z1z2
(b) inversely proportional to z1
(c) directly proportional to mass M1
(d) directly proportional to M1 $\times$ M2

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8. An alpha nucleus of energy $\frac{1}{2}mv^2$ bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to

AIEEE 2006

(a) v^2 (b) $\frac{1}{m}$ (c) $\frac{1}{v^4}$ (d) $\frac{1}{Ze}$

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TOPIC 02

Bohr Model: Orbits, Speed & Angular Momentum

60 PYQs · Easy 60 · Medium 0 · Difficult 0 | MHT CET 29 · NEET 12 · JEE 19

Concepts covered: Bohr's postulates & angular momentum (13) · Radius of the orbit (15) · Speed of the electron (9) · de Broglie waves in Bohr orbits (9) · Frequency, time period & current (2) · Magnetic moment & magnetic field at the nucleus (8) · Acceleration & Coulomb force (4)

LEVEL 1 · EASY 60 questions

◆ Bohr's postulates & angular momentum 13 Qs

9. When an electron in hydrogen atom revolves in a stationary orbit, it

MHT CET 2026 · 13 MAY · SHIFT 2

(a) does not radiate light though its velocity changes
(b) does not radiate light and velocity remains unchanged
(c) radiates light but its velocity is unchanged
(d) radiates light with the change of energy

10. Which of the following is an integral multiple of $\frac{h}{2\pi}$ in Bohr's model of an hydrogen atom?

MHT CET 2026 · 20 APR · SHIFT 2

(a) Radius of an atom (b) Kinetic energy
(c) Potential energy (d) Angular momentum

11. The angular momentum of the electron in the third Bohr orbit of a hydrogen atom is 'l' so its angular momentum in the fourth Bohr orbit is

MHT CET 2026 · 18 APR · SHIFT 1

(a) $4l$ (b) $\left(\frac{5}{4}\right)l$ (c) $\left(\frac{4}{3}\right)l$ (d) $\left(\frac{3}{2}\right)l$

12. The angular momentum of the electron in the third Bohr orbit of hydrogen atom is ' l '. Its angular momentum in the fourth Bohr orbit is

MHT CET 2024 · 11 MAY · SHIFT 2

(a) $4l$ (b) $\frac{4}{3}l$ (c) $\frac{5}{4}l$ (d) $\frac{3}{2}l$

13. When an electron is excited from its 4 th orbit to 5 th stationary orbit, the change in the angular momentum of electron is approximately.
(Planck's constant $= h = 6.63 \times 10^{-34}$ J $-$ s)

MHT CET 2023 · 13 MAY · SHIFT 2

(a) 2×10^{-34} J $-$ s (b) 6.63×10^{-34} J $-$ s
(c) 1×10^{-34} J $-$ s (d) 3.14×10^{-34} J $-$ s

14. For which one of the following, Bohr model is not valid?

NEET 2020 · PHASE 1

(a) Singly ionised helium atom (He+)
(b) Deuteron atom
(c) Singly ionised neon atom (Ne+)
(d) Hydrogen atom

15. The Bohr model of atoms

AIPMT 2004

(a) Assumes that the angular momentum of electrons is quantized.
(b) Uses Einstein's photoelectric equation.
(c) Predicts continuous emission spectra fror atoms.
(d) Predicts the same emission spectra for all types of atoms.

16. To explain his theory, Bohr used

AIPMT 1989

(a) conservation of linear momentum
(b) quantisation of angular momentum
(c) conservation of quantum frequency
(d) none of these

17. Given below are two statements:
Statement (I): The dimensions of Planck's constant and angular momentum are same. Statement (II): In Bohr's model electron revolve around the nucleus only in those orbits for which angular momentum is integral multiple of Planck's constant.
In the light of the above statements, choose the most appropriate answer from the options given below:

JEE MAIN 2025 · 4 APR · SHIFT 2

(a) Both Statement I and Statement II are correct
(b) Statement I is correct but Statement II is incorrect
(c) Both Statement I and Statement II are incorrect
(d) Statement I is incorrect but Statement II is correct

18. Given below are two statements: one is labelled as $\mathbf{Assertion A}$ and the other is labelled as Reason $\mathbf{R}$
Assertion A: The Bohr model is applicable to hydrogen and hydrogen-like atoms only. Reason $\mathbf{R}$: The formulation of Bohr model does not include repulsive force between electrons. In the light of the above statements, choose the correct answer from the options given below

JEE MAIN 2025 · 3 APR · SHIFT 2

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

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19. According to Bohr's theory, the moment of momentum of an electron revolving in 4^{th} orbit of hydrogen atom is:

JEE MAIN 2024 · 4 APR · SHIFT 2

(a) $2\frac{h}{\pi}$ (b) $\frac{h}{2\pi}$ (c) $\frac{h}{\pi}$ (d) $8\frac{h}{\pi}$

20. The angular momentum for the electron in Bohr's orbit is L. If the electron is assumed to revolve in second orbit of hydrogen atom, then the change in angular momentum will be

JEE MAIN 2023 · 10 APR · SHIFT 1

(a) L (b) $\frac{L}{2}$ (c) zero (d) 2 L

21. Given below are two statements:

Statement I: In hydrogen atom, the frequency of radiation emitted when an electron jumps from lower energy orbit (E1) to higher energy orbit (E2), is given as hf = E1 – E2

Statement II: The jumping of electron from higher energy orbit (E2) to lower energy orbit (E1) is associated with frequency of radiation given as f = (E2 – E1)/h

This condition is Bohr's frequency condition.

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

JEE MAIN 2022 · 27 JUN · SHIFT 2

(a) Both Statement I and Statement II are true.
(b) Both Statement I and Statement II are false.
(c) Statement I is correct but Statement II is false.
(d) Statement I is incorrect but Statement II is true.

◆ Radius of the orbit 15 Qs

22. In the hydrogen atom, radii of the first four Bohr orbits are related as

MHT CET 2026 · 15 APR · SHIFT 2

(a) 1 : 2 : 3 : 4 (b) $\frac{1}{2} : \frac{1}{3} : \frac{1}{4}$
(c) 1 : 4 : 9 : 16 (d) $\frac{1}{4} : \frac{1}{9} : \frac{1}{16}$

23. The ratio of the radius of the first Bohr orbit to that of the second Bohr orbit of the orbital electron is

MHT CET 2024 · 3 MAY · SHIFT 2

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

24. The radius of innermost orbit of hydrogen atom is 5.3×10^{-11} m. The radius of fourth allowed orbit of hydrogen atom is

MHT CET 2024 · 2 MAY · SHIFT 1

(a) 8.48 A^o (b) 2.12 A^o (c) 4.77 A^o (d) 0.53 A^o

25. The radius of inner most orbit of hydrogen atom is 5.3×10^{-11} m. What is the radius of third allowed orbit of hydrogen atom?

NEET 2023

(a) 1.06 A^o (b) 1.59 A^o (c) 4.77 A^o (d) 0.53 A^o

26. Let R1 be the radius of the second stationary orbit and R2 be the radius of the fourth stationary orbit of an electron in Bohr's model. The ratio $\frac{R_1}{R_2}$ is:

NEET 2022 · PHASE 2

(a) 4 (b) 0.25 (c) 0.5 (d) 2

27. In which of the following systems will the radius of the first orbit (n = 1) be minimum?

AIPMT 2003

(a) doubly ionized lithium
(b) singly ionized helium
(c) deuterium atom
(d) hydrogen atom

28. When hydrogen atom is in its first excited level, its radius is ..... of the Bohr radius.

AIPMT 1997

(a) twice (b) 4 times (c) same (d) half.

29. According to Bohr's principle, the relation between principal quantum number (n) and radius of orbit (r) is

AIPMT 1996

(a) $r \propto \frac{1}{n}$ (b) $r \propto \frac{1}{n^2}$ (c) $r \propto n$ (d) $r \propto n^2$

30. In terms of Bohr radius a_0, the radius of the second Bohr orbit of a hydrogen atom is given by

AIPMT 1992

(a) $4a_0$ (b) $8a_0$ (c) $\sqrt{2}\,a_0$ (d) $2a_0$

31. Considering the Bohr model of hydrogen like atoms, the ratio of the radius of 5^{th} orbit of the electron in Li^{2+} and $He^{+}$is

JEE MAIN 2025 · 4 APR · SHIFT 1

(a) $\frac{3}{2}$ (b) $\frac{2}{3}$ (c) $\frac{4}{9}$ (d) $\frac{9}{4}$

32. 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.)

JEE MAIN 2025 · 2 APR · SHIFT 2

(a) 2 (b) 9 (c) 1 (d) 3

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

JEE MAIN 2024 · 27 JAN · SHIFT 1

(a) $\frac{4}{3}$R (b) $\frac{16}{9}R$ (c) $\frac{3}{4}R$ (d) $\frac{9}{16}$R

34. The radius of electron's second stationary orbit in Bohr's atom is R. The radius of 3rd orbit will be

JEE MAIN 2023 · 31 JAN · SHIFT 2

(a) 2.25R (b) 3R (c) $\frac{R}{3}$ (d) 9R

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35. Using Boh'r model of quantization of angular momentum the relation between the radius 'r' of the n^{th} allowed orbit of quantum number 'n' for an electron in hydrogen atom is:

JEE MAIN 2022 · 30 JUL · SHIFT 2

(a) $r \propto n^{\frac{1}{2}}$ (b) $r \propto n^2$

(c) $r \propto \left(\frac{1}{n}\right)^2$ (d) $r \propto \left(\frac{1}{n}\right)^{\frac{1}{2}}$

36. The radius of fifth orbit of the Li^{++} is _____ $\times 10^{-12}$ m.

Take: radius of hydrogen atom $= 0.51\,\mathring{A}$

JEE MAIN 2023 · 6 APR · SHIFT 1 *(Numerical)*

◆ Speed of the electron 9 Qs

37. In Bohr's theory of hydrogen atom, 'r' is the radius of the orbit, 'V' is the speed of electron and E is the total energy of the electron. Out of the following which physical quantity is inversely proportional to principal quantum number?

MHT CET 2026 · 11 APR · SHIFT 2

(a) $\frac{1}{Vr}$ (b) Vr (c) V^2r (d) Vr^2

38. In the Bohr model of hydrogen atom, the centripetal force is furnished by the coulomb attraction between the proton and the electron. If ' r_0 ' is the radius of the ground state orbit, ' m ' is the mass, ' e ' is the charge on the electron and ' ε_0 ' is the permittivity of vacuum, the speed of the electron is

MHT CET 2024 · 10 MAY · SHIFT 2

(a) zero (b) $\frac{e}{\sqrt{\varepsilon_0 r_0 m}}$

(c) $\frac{e}{\sqrt{4\pi\varepsilon_0 r_0 m}}$ (d) $\frac{\sqrt{4\pi\varepsilon_0 r_0 m}}{e}$

39. In hydrogen atom, if V_n and V_p are orbital velocities in n^{th} and p^{th} orbit respectively, then the ratio $V_p : V_n$ is

MHT CET 2024 · 9 MAY · SHIFT 2

(a) p : n (b) n : p (c) $p^2 : n^2$ (d) $n^2 : p^2$

40. The ratio of the velocity of the electron in the first Bohr orbit to that in the second Bohr orbit of hydrogen atom is

MHT CET 2023 · 10 MAY · SHIFT 2

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

41. If the speed of an electron of hydrogen atom in the ground state is 2.2×10^6 m/s, then its speed in the third excited state will be

MHT CET 2019 · 3 MAY · SHIFT 1

(a) 5.5×10^6 m/s (b) 5.5×10^5 m/s

(c) 8.8×10^5 m/s (d) 6.8×10^6 m/s

42. In the Bohr's model of a hydrogen atom, the centripetal force is furnished by the Coulomb attraction between the proton and the electron. If a_0 is the radius of the ground state orbit, m is the mass and e is the charge on the electron, ε_0 is the vacuum permittivity, the speed of the electron is

AIPMT 1998

(a) zero (b) $\frac{e}{\sqrt{\varepsilon_0 a_0 m}}$

(c) $\frac{e}{\sqrt{4\pi\varepsilon_0 a_0 m}}$ (d) $\frac{\sqrt{4\pi\varepsilon_0 a_0 m}}{e}$

43. Speed of an electron in Bohr's 7^{th} orbit for Hydrogen atom is 3.6×10^6 m/s. The corresponding speed of the electron in 3^{rd} orbit, in m/s is:

JEE MAIN 2023 · 30 JAN · SHIFT 1

(a) (1.8×10^6) (b) (7.5×10^6)

(c) (8.4×10^6) (d) (3.6×10^6)

44. The ratio for the speed of the electron in the 3rd orbit of He+ to the speed of the electron in the 3rd orbit of hydrogen atom will be:

JEE MAIN 2022 · 25 JUN · SHIFT 1

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

45. If an electron is moving in the nth orbit of the hydrogen atom, then its velocity (vn) for the nth orbit is given as:

JEE MAIN 2021 · 17 MAR · SHIFT 1

(a) $v_n \propto \frac{1}{n}$ (b) vn $\propto$ n2

(c) vn $\propto$ n (d) $v_n \propto \frac{1}{n^2}$

◆ de Broglie waves in Bohr orbits 9 Qs

46. The de Broglie wavelength of an electron moving in the n^{th} Bohr orbit of radius 'r' is

MHT CET 2026 · 19 MAY · SHIFT 1

(a) $n\pi r$ (b) $\frac{nr}{}$ (c) $\frac{2\pi r}{n}$ (d) $\frac{nr}{2\pi}\,\pi$

47. The de-Broglie wavelength of an electron moving in the n^{th} Bohr orbit of radius 'r' is

MHT CET 2026 · 19 APR · SHIFT 2

(a) $n\pi r$ (b) $\frac{nr}{}$ (c) $\frac{2\pi r}{n}$ (d) $\frac{nr}{2\pi}\,\pi$

48. The de Broglie wavelength of the electron in the ground state is λ_1 and that in the $n = 3$ level is λ_3 then λ_3 is given by

MHT CET 2026 · 18 APR · SHIFT 2

(a) $\frac{\lambda_1}{3}$ (b) $\frac{\lambda_1}{2}$ (c) $2\lambda_1$ (d) $3\lambda_1$

49. When the electron orbiting in hydrogen atom in its ground state moves to the third excited state, the de-Broglie wavelength associated with it

MHT CET 2026 · 15 APR · SHIFT 1

(a) will decrease (b) will increase

(c) will remain same (d) will be zero

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50. When an electron orbiting in hydrogen atom in its ground state jumps to higher excited state, the de-Broglie wavelength associated with it
MHT CET 2024 · 16 MAY · SHIFT 1
(a) will become zero. (b) will remain same.
(c) will decrease. (d) will increase.

51. For an electron moving in the n^{th} Bohr orbit the deBroglie wavelength of an electron is
MHT CET 2023 · 9 MAY · SHIFT 1
(a) $n\pi r$ (b) $\frac{\pi r}{n}$ (c) $\frac{nr}{2\pi}$ (d) $\frac{2\pi r}{n}$

52. Consider an electron in the n^{th} orbit of a hydrogen atom in the Bohr model. The circumference of the orbit can be expressed in terms of de Broglie wavelength λ of that electron as
AIPMT 1990
(a) $(0.529)n\lambda$ (b) $\sqrt{n}\,\lambda$
(c) $(13.6)\lambda$ (d) $n\lambda$

53. The momentum of an electron revolving in n^{th} orbit is given by:
(Symbols have their usual meanings)
JEE MAIN 2022 · 25 JUL · SHIFT 1
(a) $\frac{nh}{2\pi r}$ (b) $\frac{nh}{2r}$ (c) $\frac{nh}{2\pi}$ (d) $\frac{2\pi r}{nh}$

54. The de - Broglie wavelength associated with the electron in the n = 4 level is:
JEE MAIN 2015 · 11 APR · SHIFT 1
(a) two times the de-Broglie wavelength of the electron in the ground state
(b) four times the de -Broglie wavelength of the electron in the ground state
(c) half of the de-Broglie wavelength of the electron in the ground state
(d) 1/4th of the de-Broglie wavelength of the electron in the ground state

◆ Frequency, time period & current 2 Qs

55. The frequency of revolution of an electron in the n^{th} orbit of hydrogen atom is
MHT CET 2025 · 19 APR · SHIFT 2
(a) directly proportional to n^2
(b) inversely proportional to n^2
(c) directly proportional to n^3
(d) inversely proportional to n^3

56. The frequency of revolution of the electron in Bohr's orbit varies with n, the principal quantum number as:
JEE MAIN 2025 · 28 JAN · SHIFT 2
(a) $\frac{1}{n^4}$ (b) $\frac{1}{n^2}$ (c) $\frac{1}{n^3}$ (d) $\frac{1}{n}$

◆ Magnetic moment & magnetic field at the nucleus 8 Qs

57. The magnetic moment of electron due to orbital motion is proportional to
(n = principal quantum number)
MHT CET 2026 · 19 APR · SHIFT 2
(a) n (b) n^2 (c) $\frac{1}{n}$ (d) $\frac{1}{n^2}$

58. The orbital magnetic moment (m_{orb}) of a revolving electron around the nucleus varies with the principal quantum number (n) as
MHT CET 2026 · 17 APR · SHIFT 1
(a) $m_{orb} \propto n^2$ (b) $m_{orb} \propto n$
(c) $m_{orb} \propto \frac{1}{n^2}$ (d) $m_{orb} \propto \frac{1}{n}$

59. The magnetic moment of electron due to orbital motion is proportional to (n = principal quantum number)
MHT CET 2025 · 26 APR · SHIFT 2
(a) n (b) n^2 (c) $\frac{1}{n}$ (d) $\frac{1}{n^2}$

60. Magnetic field at the centre of the hydrogen atom due to motion of electron in n^{th} orbit is proportional to
MHT CET 2023 · 14 MAY · SHIFT 1
(a) n^4 (b) n^{-3} (c) n^3 (d) n^{-5}

61. The orbital magnetic moment associated with orbiting electron of charge 'e' is
MHT CET 2023 · 11 MAY · SHIFT 2
(a) inversely proportional to angular momentum
(b) directly proportional to mass of electron
(c) directly proportional to angular momentum
(d) inversely proportional to charge on electron

62. The angle made by orbital angular momentum of electron with the direction of the orbital magnetic moment is
MHT CET 2019 · 2 MAY · SHIFT 1
(a) 120° (b) 60° (c) 180° (d) 90°

63. The magnetic moment of an electron (e) revolving in an orbit around nucleus with an orbital angular momentum is given by:
JEE MAIN 2022 · 25 JUL · SHIFT 1
(a) $\vec{\mu}_L = \frac{\vec{eL}}{2m}$ (b) $\vec{\mu}_L = -\frac{\vec{eL}}{2m}$
(c) $\vec{\mu}_l = -\frac{\vec{eL}}{m}$ (d) $\vec{\mu}_l = \frac{\vec{2eL}}{m}$

64. According to Bohr's theory, the time averaged magnetic field at the centre (i.e. nucleus) of a hydrogen atom due to the motion of electrons in the nth orbit is proportional to: (n = principal quantum number)
JEE MAIN 2017 · 8 APR · SHIFT 1
(a) n^{-4} (b) n^{-5} (c) n^{-3} (d) n^{-2}

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◆ Acceleration & Coulomb force 4 Qs

65. The force acting on the electron in hydrogen atom (Bohr's theory) is related to the principal quantum number n as

MHT CET 2026 · 16 APR · SHIFT 1

(a) n^4 (b) n^{-4} (c) n^2 (d) n^{-2}

66. The force acting on the electron in hydrogen atom (Bohr' theory) is related to the principle quantum number 'n' as

MHT CET 2023 · 9 MAY · SHIFT 2

(a) n^4 (b) n^{-4} (c) n^2 (d) n^{-2}

67. The force acting on the electrons in hydrogen atom (Bohr's theory) is related to the principle quantum number n as

MHT CET 2020 · 16 OCT · SHIFT 1

(a) n^{-4} (b) n^4 (c) n^{-2} (d) n^2

68. An electron is moving round the nucleus of a hydrogen atom in a circular orbit of radius r. The Coulomb force $\vec{F}$ between the two is

AIPMT 2003

(a) $K\frac{e^2}{r^2}\hat{r}$ (b) $-K\frac{e^2}{r^3}\hat{r}$ (c) $K\frac{e^2}{r^3}\hat{r}$ (d) $-K\frac{e^2}{r^2}\hat{r}$

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TOPIC 03

Energy of the Electron & Energy Levels

33 PYQs · Easy 33 · Medium 0 · Difficult 0 | MHT CET 11 · NEET 14 · JEE 8

Concepts covered: Kinetic, potential & total energy (18) · Energy levels of H & H-like ions (6) · Ionisation & excitation energy (7) · Energy level diagrams (2)

LEVEL 1 · EASY 33 questions

◆ Kinetic, potential & total energy 18 Qs

69. The kinetic energy of the electron in an orbit of radius r in hydrogen atom is proportional to (e = electronic charge)

MHT CET 2026 · 20 APR · SHIFT 2

(a) $\frac{e^2}{2r^2}$ (b) $\frac{e^2}{r^2}$ (c) $\frac{e^2}{2r}$ (d) $\frac{e^2}{4r}$

70. An electron makes a transition from an excited state to the ground state of a hydrogen like atom. Out of the following statements which one is correct?

(A) K.E, P. E. and T.E. decreases

(B) K.E. increases but P. E. and T.E. decreases

(C) K.E. and T.E. decreases but P.E. increases

(D) K.E. decreases, P.E. increases but T.E. remains the same

MHT CET 2026 · 16 APR · SHIFT 2

(a) A (b) B (c) C (d) D

71. The kinetic energy of the electron in an orbit of radius r in hydrogen atom is proportional to (e = electronic charge)

MHT CET 2026 · 11 APR · SHIFT 1

(a) $\frac{e^2}{2r^2}$ (b) $\frac{e^2}{r}$ (c) $\frac{e^2}{2r}$ (d) $\frac{e^2}{r^2}$

72. When a hydrogen atom is raised from the ground state to the excited state

MHT CET 2024 · 9 MAY · SHIFT 1

(a) potential energy increases and K.E. decreases.

(b) potential energy decreases and K.E. increases.

(c) both K.E. and potential energy will increase.

(d) both K.E. and potential energy decreases.

73. According to Bohr's theory of hydrogen atom, the total energy of the electron in the n^{th} stationary orbit is

MHT CET 2023 · 11 MAY · SHIFT 2

(a) directly proportional to n

(b) inversely proportional to n

(c) directly proportional to n^2

(d) inversely proportional to n^2

74. An electron makes a transition from an excited state to the ground state of a hydrogen like atom. Out of the following statements which one is correct?

MHT CET 2021 · 24 SEP · SHIFT 1

(a) Kinetic energy, potential energy and total energy decreases

(b) Kinetic energy and total energy decreased but potential energy increases

(c) Kinetic energy increases but potential energy and total energy decreases

(d) Kinetic energy decreases, potential energy increases but total energy remains the same.

75. In n^{th} Bohr orbit, the ratio of the kinetic energy of an electron to the total energy of it, is

MHT CET 2021 · 22 SEP · SHIFT 2

(a) 2 : 1 (b) 1 : −1 (c) +1 : 1 (d) −1 : 2

76. If the electron in a hydrogen atom moves from ground state orbit to 5th orbit, then the potential energy of the electron

MHT CET 2021 · 20 SEP · SHIFT 1

(a) is increased (b) is zero

(c) is decreased (d) remains unchanged

77. The total energy of an electron in the n^{th} stationary orbit of the hydrogen atom can be obtained by

NEET 2020 · PHASE 2

(a) $E_n = -13.6 \times n^2$ eV (b) $E_n = \frac{13.6}{n^2}$ eV

(c) $E_n = -\frac{13.6}{n^2}$ eV (d) $E_n = -\frac{1.36}{n^2}$ eV

78. The total energy of an electron in an atom in an orbit is –3.4 eV. Its kinetic and potential energies are, respectively.

NEET 2019

(a) 3.4 eV, – 6.8 eV (b) 3.4 eV, 3.4 eV

(c) – 3.4 eV, – 3.4 eV (d) – 3.4 eV, – 6.8 eV

79. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, is

NEET 2018

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

80. The total energy of electron in the ground state of hydrogen atom is – 13.6 eV. The kinetic energy of an electron in the first excited state is

AIPMT 2007

(a) 6.8 eV (b) 13.6 eV (c) 1.7 eV (d) 3.4 eV.

81. The total energy of an electron in the first excited state of hydrogen atom is about – 3.4 eV. Its kinetic energy in this state is

AIPMT 2005

(a) 3.4 eV (b) 6.8 eV (c) − 3.4 eV (d) − 6.8 eV

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82. When a hydrogen atom is raised from the ground state to an excited state,
AIPMT 1995
(a) both K.E. and P.E. increase
(b) both K.E. and P.E. decrease
(c) the P.E. decreases and K.E. increases
(d) the P.E. increases and K.E. decreases.

83. 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:
JEE MAIN 2024 · 5 APR · SHIFT 1
(a) $2E = 3U$ (b) $E = U$
(c) $2E = U$ (d) $E = 2U$

84. The ratio of the magnitude of the kinetic energy to the potential energy of an electron in the 5th excited state of a hydrogen atom is:
JEE MAIN 2024 · 30 JAN · SHIFT 1
(a) 4 (b) 1 (c) $\frac{1}{2}$ (d) $\frac{1}{4}$

85. In Bohr's atomic model of hydrogen, let K, P and E are the kinetic energy, potential energy and total energy of the electron respectively. Choose the correct option when the electron undergoes transitions to a higher level:
JEE MAIN 2022 · 24 JUN · SHIFT 2
(a) All K, P and E increase.
(b) K decreases, P and E increase.
(c) P decreases, K and E increase.
(d) K increases, P and E decrease.

86. As an electron makes a transition from an excited state to the ground state of a hydrogen - like atom/ion:
JEE MAIN 2015
(a) kinetic energy decreases, potential energy increases but total energy remains same
(b) kinetic energy and total energy decrease but potential energy increases
(c) its kinetic energy increases but potential energy and total energy decrease
(d) kinetic energy, potential energy and total energy decrease

◆ Energy levels of H & H-like ions 6 Qs

87. In hydrogen atom, the energy of electron in first and third orbit is ' E_1 ' and' E_3 ' respectively. If $E_3 = xE_1$ then the value of x will be
MHT CET 2025 · 23 APR · SHIFT 1
(a) $\frac{1}{9}$ (b) $\frac{1}{64}$ (c) $\frac{1}{27}$ (d) $\frac{1}{8}$

88. Let T1 and T2 be the energy of an electron in the first and second excited states of hydrogen atoms, respectively. According to the Bohr's model of an atom, the ratio T1: T2 is
NEET 2022 · PHASE 1
(a) 1: 4 (b) 4: 1 (c) 4: 9 (d) 9: 4

89. The energy of a hydrogen atom in the ground state is – 13.6 eV. The energy of a He+ ion in the first excited state will be
AIPMT 2010 · PRELIMS
(a) – 13.6 eV (b) – 27.2 eV
(c) – 54.4 eV (d) – 6.8 eV

90. The energy of the ground electronic state of hydrogen atom is −13.6 eV. The energy of the first excited state will be
AIPMT 1997
(a) −27.2 eV (b) −52.4 eV
(c) −3.4 eV (d) −6.8 eV.

91. The energy of a hydrogen atom in its ground state is −13.6 eV. The energy of the level corresponding to the quantum number $n = 2$ in the hydrogen atom is
AIPMT 1996
(a) −0.54 eV (b) −3.4 eV (c) −2.72 eV (d) −0.85 eV

92. The energy of He^+ ion in its first excited state is, (The ground state energy for the Hydrogen atom is −13.6 eV):
JEE MAIN 2023 · 11 APR · SHIFT 2
(a) −13.6 eV (b) −27.2 eV
(c) −3.4 eV (d) −54.4 eV

◆ Ionisation & excitation energy 7 Qs

93. If the ionisation energy for the hydrogen atom is 13.6 eV, then the energy required to excite it from the ground state to the next higher state is nearly
MHT CET 2026 · 19 APR · SHIFT 2
(a) $-10.2\,eV$ (b) $-3.4\,eV$
(c) $10.2\,eV$ (d) $13.6\,eV$

94. If the ionisation energy for the hydrogen atom is 13.6 eV, then the energy required to excite it from the ground state to the next higher state is nearly
MHT CET 2024 · 10 MAY · SHIFT 1
(a) 10.2 eV (b) 13.6 eV
(c) −10.2 eV (d) −3.4 eV

95. The ground state energy of hydrogen atom is −13.6 eV. The energy needed to ionize hydrogen atom from its second excited state will be:
NEET 2023
(a) 13.6 eV (b) 6.8 eV (c) 1.51 eV (d) 3.4 eV

96. The ground state energy of hydrogen atom is – 13.6 eV. When its electron is in the first excited state, its excitation energy is
AIPMT 2008
(a) 10.2 eV (b) 0 (c) 3.4 eV (d) 6.8 eV

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97. The ground state energy of H-atom is 13.6 eV. The energy needed to ionize H-atom from its second excited state

AIPMT 1991

(a) 1.51 eV (b) 3.4 eV
(c) 13.6 eV (d) none of these

98. The ionisation energy of hydrogen atom is 13.6 eV, the ionisation energy of a singly ionised helium atom would be

AIPMT 1988

(a) 13.6 eV (b) 27.2 eV (c) 6.8 eV (d) 54.4 eV

99. Which of the following atoms has the lowest ionization potential?

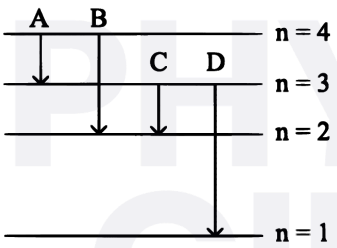
AIEEE 2003

(a) $^{14}_{7}N$ (b) $^{133}_{55}Cs$ (c) $^{40}_{18}Ar$ (d) $^{16}_{8}O$

◆ Energy level diagrams 2 Qs

100. The energy levels of an hydrogen atom are shown below. The transition corresponding to emission of shortest wavelength is:

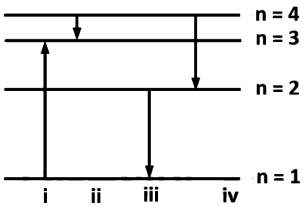
JEE MAIN 2023 · 6 APR · SHIFT 1



(a) A (b) C (c) B (d) D

101. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy?

AIEEE 2005



(a) *iv* (b) *iii* (c) *ii* (d) *i*

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TOPIC 04

Transitions, Photon Emission & Excitation

21 PYQs · Easy 21 · Medium 0 · Difficult 0 | MHT CET 7 · NEET 5 · JEE 9

Concepts covered: Photon energy & wavelength in a transition (15) · Number of spectral lines (6)

LEVEL 1 · EASY 21 questions

◆ Photon energy & wavelength in a transition 15 Qs

102. Which of the following transition in hydrogen atom emits photon of highest frequency?
MHT CET 2026 · 12 MAY · SHIFT 1
(a) $n = 5$ to $n = 2$ (b) $n = 2$ to $n = 5$
(c) $n = 2$ to $n = 3$ (d) $n = 3$ to $n = 2$

103. Out of the following transitions in hydrogen atom, identify the transition which emits photons of highest frequency.
MHT CET 2025 · 22 APR · SHIFT 1
(a) n = 1 to n = 2 (b) n = 2 to n = 1
(c) $n = 2$ to $n = 6$ (d) $n = 6$ to $n = 2$

104. Which of the following transitions in hydrogen atom emit photons of highest frequency? (n = principle quantum number)
MHT CET 2025 · 21 APR · SHIFT 1
(a) n = 1 to n = 3 (b) n = 2 to n = 4
(c) n = 5 to n = 3 (d) n = 2 to n = 1

105. The wavelength of light for the least energetic photons emitted in the Lyman series of the hydrogen spectrum is nearly [Take hc = 1240 eV - nm, change in energy of the levels = 10.2 eV]
MHT CET 2023 · 9 MAY · SHIFT 2
(a) 150 nm (b) 122 nm (c) 102 nm (d) 82 nm

106. If an electron in a hydrogen atom jumps from an orbit of level $n = 3$ to orbit of level $n = 2$, then the emitted radiation frequency is (where R = Rydberg's constant, C = Velocity of light)
MHT CET 2023 · 9 MAY · SHIFT 1
(a) $\frac{3RC}{27}$ (b) $\frac{RC}{25}$ (c) $\frac{8RC}{9}$ (d) $\frac{5RC}{36}$

107. Energy E of a hydrogen atom with principal quantum number n is given by $E = \frac{-13.6}{n^2}$ eV. The energy of a photon ejected when the electron jumps from $n = 3$ state to $n = 2$ state of hydrogen, is approximately
AIPMT 2004
(a) 1.5 eV (b) 0.85 eV (c) 3.4 eV (d) 1.9 eV

108. Maximum frequency of emission is obtained for the transition
AIPMT 2000
(a) n = 2 to n = 1 (b) n = 6 to n = 2
(c) n = 1 to n = 2 (d) n = 2 to n = 6.

109. An electron makes a transition from orbit $n = 4$ to the orbit $n = 2$ of a hydrogen atom. What is the wavelength of the emitted radiations? (R = Rydberg's constant)
AIPMT 1995
(a) $\frac{16}{4R}$ (b) $\frac{16}{5R}$ (c) $\frac{16}{2R}$ (d) $\frac{16}{3R}$

110. The ionization energy of hydrogen atom is 13.6 eV. Following Bohr's theory, the energy corresponding to a transition between 3rd and 4th orbit is
AIPMT 1992
(a) 3.40 eV (b) 1.51 eV (c) 0.85 eV (d) 0.66 eV

111. 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 = 4×10^{-15} eVs):
JEE MAIN 2023 · 24 JAN · SHIFT 2
(a) 99.3 nm (b) 94.1 nm (c) 974 nm (d) 941 nm

112. Find the ratio of energies of photons produced due to transition of an electron 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.
JEE MAIN 2022 · 29 JUL · SHIFT 1
(a) 3: 4 (b) 4: 3 (c) 1: 4 (d) 4: 1

113. The wavelength of the photon emitted by a hydrogen atom when an electron makes a transition from n = 2 to n = 1 state is:
JEE MAIN 2021 · 25 FEB · SHIFT 2
(a) 194.8 nm (b) 490.7 nm (c) 913.3 nm (d) 121.8 nm

114. According to Bohr atomic model, in which of the following transitions will the frequency be maximum?
JEE MAIN 2021 · 24 FEB · SHIFT 2
(a) n = 2 to n = 1 (b) n = 3 to n = 2
(c) n = 4 to n = 3 (d) n = 5 to n = 4

115. Which of the following transitions in hydrogen atoms emit photons of highest frequency?
AIEEE 2007
(a) $n = 1$ to $n = 2$ (b) $n = 2$ to $n = 6$
(c) $n = 6$ to $n = 2$ (d) $n = 2$ to $n = 1$

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116. The wavelengths involved in the spectrum of deuterium $\left({}_1^2D\right)$ are slightly different from that of hydrogen spectrum, because
AIEEE 2003
(a) the size of the two nuclei are different
(b) the nuclear forces are different in the two cases
(c) the masses of the two nuclei are different
(d) the attraction between the electron and the nucleus is different in the two cases

◆ Number of spectral lines 6 Qs

117. The electron in hydrogen atom is initially in the second excited state. When it finally moves to ground state, the maximum number of spectral lines emitted are
MHT CET 2026 · 15 APR · SHIFT 2
(a) 2 (b) 3 (c) 4 (d) 5

118. The electron in hydrogen atom is initially in the third excited state. When it finally moves to ground state, the maximum number of spectral lines emitted are
MHT CET 2021 · 20 SEP · SHIFT 1
(a) 3 (b) 4 (c) 5 (d) 6

119. Hydrogen atoms are excited from ground state of the principle quantum number 4. Then the number of spectral lines observed will be
AIPMT 1993
(a) 3 (b) 6 (c) 5 (d) 2

120. The number of spectral lines emitted by atomic hydrogen that is in the 4th energy level, is
JEE MAIN 2025 · 29 JAN · SHIFT 2
(a) 3 (b) 6 (c) 1 (d) 0

121. Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4. Then the number of spectral lines in the emission spectra will be:
AIEEE 2012
(a) 2 (b) 3 (c) 5 (d) 6

122. X different wavelengths may be observed in the spectrum from a hydrogen sample if the atoms are excited to states with principal quantum number n = 6? The value of X is _____.
JEE MAIN 2021 · 27 AUG · SHIFT 2 *(Numerical)*

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TOPIC 05

Hydrogen Spectrum & Spectral Series

22 PYQs · Easy 22 · Medium 0 · Difficult 0 | MHT CET 12 · NEET 6 · JEE 4

Concepts covered: Spectral series & their regions (8) · Series limit, first line & wavelength ratios (14)

LEVEL 1 · EASY 22 questions

◆ Spectral series & their regions 8 Qs

123. Which one of the following spectral series of hydrogen atom lies in ultraviolet region?
MHT CET 2026 · 20 MAY · SHIFT 1
(a) Lyman (b) Paschen (c) Brackett (d) Pfund

124. The spectral series observed for hydrogen atom found in visible region is
MHT CET 2024 · 9 MAY · SHIFT 2
(a) Lyman (b) Balmer (c) Paschen (d) Brackett

125. When the electron in hydrogen atom jumps from fourth Bohr orbit to second Bohr orbit, one gets the
MHT CET 2019 · 2 MAY · SHIFT 2
(a) second line of Balmer series
(b) first line of Balmer series
(c) first line of Pfund series
(d) second line of Paschen series

126. The spectral series which corresponds to the electronic transition from the levels $n_2 = 5, 6, \ldots$ to the level $n_1 = 4$ is
NEET 2024
(a) Pfund series (b) Brackett series
(c) Lyman series (d) Balmer series

127. The wavelength of Lyman series of hydrogen atom appears in:
NEET 2023
(a) visible region (b) far infrared region
(c) ultraviolet region (d) infrared region

128. When an electron does transition from n = 4 to n = 2, then emitted line spectrum will be
AIPMT 2000
(a) first line of Lyman series
(b) second line of Balmer series
(c) first line of Balmer series
(d) second line of Paschen series.

129. Which source is associated with a line emission spectrum?
AIPMT 1993
(a) Electric fire (b) Neon street sign
(c) Red traffic light (d) Sun

130. The atomic hydrogen emits a line spectrum consisting of various series. Which series of hydrogen atomic spectra is lying in the visible region?
JEE MAIN 2021 · 17 MAR · SHIFT 2
(a) Brackett series (b) Balmer series
(c) Paschen series (d) Lyman series

◆ Series limit, first line & wavelength ratios 14 Qs

131. The ratio of minimum wavelengths of Lyman and Balmer series will be
MHT CET 2026 · 13 MAY · SHIFT 1
(a) 1.25 (b) 0.25 (c) 5 (d) 10

132. In Bohr's theory of hydrogen atom, in any series of spectral lines, wavelength of first line and corresponding series limit is respectively
MHT CET 2026 · 12 MAY · SHIFT 2
(a) longest and shortest (b) shortest and shortest
(c) longest and longest (d) shortest and longest

133. In hydrogen spectrum, the ratio of wavelengths of the last line of Lyman series and that of the last line of Balmer series is
MHT CET 2025 · 20 APR · SHIFT 1
(a) 1 (b) 0.5 (c) 0.25 (d) 0.2

134. The ratio of the wavelength of the last line of Paschen series to that of Balmer series is
MHT CET 2025 · 19 APR · SHIFT 1
(a) $\frac{9}{4}$ (b) $\frac{3}{2}$ (c) $\frac{2}{3}$ (d) $\frac{4}{9}$

135. Frequency of the series limit of Balmer series of hydrogen atom of Rydberg's constant ' R ' and velocity of light ' C ' is
MHT CET 2024 · 16 MAY · SHIFT 1
(a) $\frac{RC}{4}$ (b) RC (c) $\frac{4}{RC}$ (d) 4 RC

136. In hydrogen atom, ratio of the shortest wavelength in the Balmer series to that in the Paschen series is
MHT CET 2024 · 9 MAY · SHIFT 1
(a) 9 : 4 (b) 3 : 1 (c) 4 : 9 (d) 1 : 3

137. The ratio of minimum wavelengths of Lyman and Balmer series will be
MHT CET 2024 · 4 MAY · SHIFT 2
(a) 1.25 (b) 0.25 (c) 5 (d) 10

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138. Frequency of the series limit of Balmer series of hydrogen atom in terms of Rydberg's constant (R) and velocity of light (c) is

MHT CET 2023 · 14 MAY · SHIFT 1

(a) $4\mathrm{Rc}$ (b) $\frac{4}{\mathrm{Rc}}$ (c) Rc (d) $\frac{\mathrm{Rc}}{4}$

139. The wave number of the last line of the Balmer series in hydrogen spectrum will be (Rydberg's constant $= 10^7\ \mathrm{m}^{-1}$)

MHT CET 2022 · 11 AUG · SHIFT 2

(a) $250\ \mathrm{m}^{-1}$ (b) $2.5 \times 10^6\ \mathrm{m}^{-1}$
(c) $0.25 \times 10^9\ \mathrm{m}^{-1}$ (d) $2.5 \times 10^5\ \mathrm{m}^{-1}$

140. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is

NEET 2017

(a) 1 (b) 4 (c) 0.5 (d) 2

141. Given the value of Rydberg constant is 107 m^{-}1, the wave number of the last line of the Balmer series in hydrogen spectrum will be

NEET 2016 · PHASE 1

(a) $0.25 \times 107\ \mathrm{m}^{-1}$ (b) $2.5 \times 107\ \mathrm{m}^{-1}$
(c) $0.025 \times 104\ \mathrm{m}^{-1}$ (d) $0.5 \times 107\ \mathrm{m}^{-1}$

142. For a hydrogen atom, the ratio of the largest wavelength of Lyman series to that of the Balmer series is

JEE MAIN 2025 · 7 APR · SHIFT 1

(a) 5 : 27 (b) 27 : 5 (c) 3 : 4 (d) 5 : 36

143. The ratio of the shortest wavelength of Balmer series to the shortest wavelength of Lyman series for hydrogen atom is:

JEE MAIN 2024 · 6 APR · SHIFT 1

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

144. If the series limit frequency of the Lyman series is ν_L, then the series limit frequency of the Pfund series is:

JEE MAIN 2018

(a) $\nu_L/25$ (b) $25\nu_L$ (c) $16\nu_L$ (d) $\nu_L/16$

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TOPIC 06

Quantum Numbers, X-rays & Other Questions

7 PYQs · Easy 7 · Medium 0 · Difficult 0 | MHT CET 0 · NEET 5 · JEE 2

Concepts covered: Quantum numbers & electronic configuration (3) · X-rays (2) · Other questions (2)

LEVEL 1 · EASY 7 questions

◆ Quantum numbers & electronic configuration 3 Qs

145. Of the following pairs of species which one will have the same electronic configuration for both members?

AIPMT 1992

(a) Li^+ and Na^+ (b) He and Ne^+
(c) H and Li (d) C and N^+

146. The valence electron in alkali metal is a

AIPMT 1990

(a) f-electron (b) p-electron
(c) s-electron (d) d-electron

147. The atomic number of silicon is 14. Its ground state electron configuration is

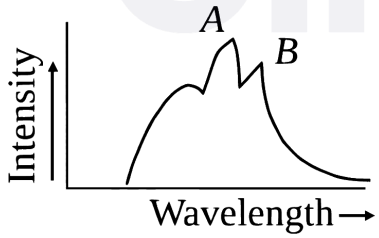
AIPMT 1989

(a) $1s^2\ 2s^2\ 2p^2\ 2s^4$ (b) $1s^2\ 2s^2\ 2p^6\ 3s^1\ 3p^3$
(c) $1s^2\ 2s^2\ 2p^8\ 3s^2$ (d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

◆ X-rays 2 Qs

148. The figure represents the observed intensity of X-rays emitted by an X-ray tube, as a function of wavelength. The sharp peaks A and B denote

AIPMT 1995 *(Not in current JEE/NEET syllabus)*



(a) white radiations
(b) characteristic radiations
(c) band spectrum
(d) continuous spectrum

149. The waves emitted when a metal target is bombarded with high energy electrons are

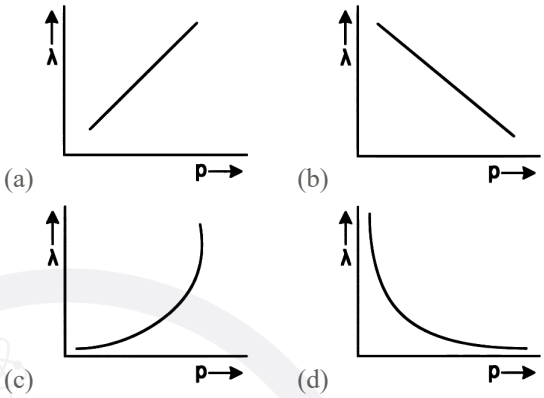
JEE MAIN 2023 · 8 APR · SHIFT 2

(a) Infrared rays (b) Radio Waves
(c) Microwaves (d) X-rays

◆ Other questions 2 Qs

150. The graph which shows the variation of the de Broglie wavelength (λ) of a particle and its associated momentum (p) is

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



151. 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

JEE MAIN 2025 · 24 JAN · SHIFT 2

(a) $E^2 = pc^2 + m^2c^4$ (b) $E^2 = pc^2 + m^2c^2$
(c) $E^2 = p^2c^2 + m^2c^4$ (d) $E^2 = p^2c^2 + m^2c^2$

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ANSWER KEY

Shaded by level: **Easy**

01 Atomic Models & Alpha-Particle Scattering

1. (c)	2. (b)	3. (d)	4. (c)	5. (c)	6. (c)	7. (a)	8. (b)		

02 Bohr Model: Orbits, Speed & Angular Momentum

9. (a)	10. (d)	11. (c)	12. (b)	13. (c)	14. (c)	15. (a)	16. (b)	17. (b)	18. (b)
19. (a)	20. (a)	21. (d)	22. (c)	23. (c)	24. (a)	25. (c)	26. (b)	27. (a)	28. (b)
29. (d)	30. (a)	31. (b)	32. (d)	33. (b)	34. (a)	35. (b)	36. 425	37. (a)	38. (c)
39. (b)	40. (b)	41. (b)	42. (c)	43. (c)	44. (d)	45. (a)	46. (c)	47. (c)	48. (d)
49. (b)	50. (d)	51. (d)	52. (d)	53. (a)	54. (b)	55. (d)	56. (c)	57. (a)	58. (b)
59. (a)	60. (d)	61. (c)	62. (c)	63. (b)	64. (b)	65. (b)	66. (b)	67. (a)	68. (d)

03 Energy of the Electron & Energy Levels

69. (c)	70. (b)	71. (c)	72. (a)	73. (d)	74. (c)	75. (b)	76. (a)	77. (c)	78. (a)
79. (b)	80. (d)	81. (a)	82. (d)	83. (c)	84. (c)	85. (b)	86. (c)	87. (a)	88. (d)
89. (a)	90. (c)	91. (b)	92. (a)	93. (c)	94. (a)	95. (c)	96. (a)	97. (a)	98. (d)
99. (b)	100. (d)	101. (b)							

04 Transitions, Photon Emission & Excitation

102. (a)	103. (b)	104. (d)	105. (b)	106. (d)	107. (d)	108. (a)	109. (d)	110. (d)	111. (b)
112. (a)	113. (d)	114. (a)	115. (d)	116. (c)	117. (b)	118. (d)	119. (b)	120. (b)	121. (d)
122. 15									

05 Hydrogen Spectrum & Spectral Series

123. (a)	124. (b)	125. (a)	126. (b)	127. (c)	128. (b)	129. (b)	130. (b)	131. (b)	132. (a)
133. (c)	134. (a)	135. (a)	136. (c)	137. (b)	138. (d)	139. (b)	140. (b)	141. (a)	142. (a)
143. (d)	144. (a)								

06 Quantum Numbers, X-rays & Other Questions

145. (d)	146. (c)	147. (d)	148. (b)	149. (d)	150. (d)	151. (c)			

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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