

# PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

## Bohar Model and h-atom model - CSIR NET Physics PYQs

Atomic and Molecular Physics . All PYQs (2015-2025) with answer key

**9 questions . Answer key included**

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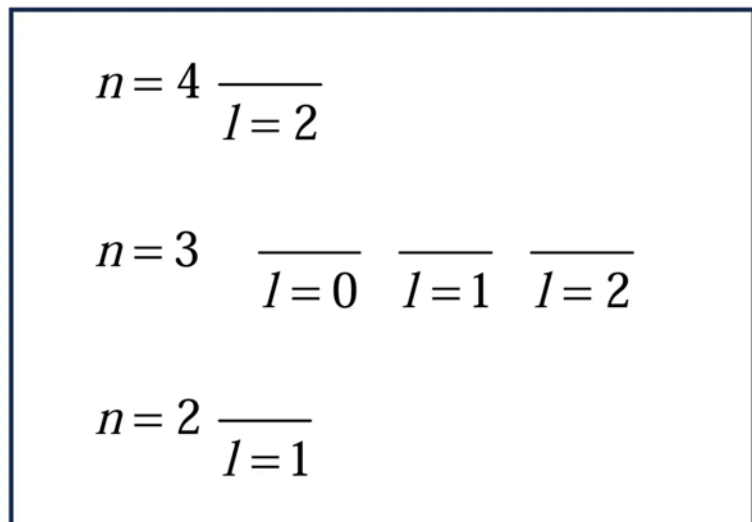
## Q1. [Dec 2018] . 5.0 marks

Atomic and Molecular Physics &gt; Bohar Model and h-atom model

CSIR NET	2018 Dec	5M
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The excited state ( $n = 4, l = 2$ ) of an electron in an atom may decay to one or more of the lower energy levels shown in the diagram below. Of the total emitted light, a fraction  $\frac{1}{4}$  comes from the decay to the state ( $n = 2, l = 1$ ). Based on selection rules, the fractional intensity of the emission line due to the decay to the state ( $n = 3, l = 1$ )

1.  $\frac{3}{4}$
2.  $\frac{1}{2}$
3.  $\frac{1}{4}$
4. 0



**Q2. [Dec 2019] . 5.0 marks**

Atomic and Molecular Physics &gt; Bohar Model and h-atom model

CSIR NET	2019 Dec	5M
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A negative muon, which has a mass nearly 200 times that of an electron, replaces an electron in a *Li* atom. The lowest ionization energy for the muonic *Li* atom is approximately

1. the same as that of He
2. the same as that of normal Li
3. 200 times larger than that of normal Li
4. the same as that of normal *Be*

**Q3. [June 2020] . 3.5 marks**

Atomic and Molecular Physics &gt; Bohar Model and h-atom model

CSIR NET	2020 June	3.5M
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The wavelength of the first Balmer line of hydrogen is 656 nm. The wavelength of the corresponding line for a hydrogenic atom with  $Z = 6$  and nuclear mass of  $19.92 \times 10^{-27}$  kg is

1. 18.2 nm
2. 109.3 nm
3. 143.5 nm
4. 393.6 nm

**Q4. [June 2021] . 5.0 marks**

Atomic and Molecular Physics &gt; Bohar Model and h-atom model

CSIR NET	2021 June	5M
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The  $|3,0,0\rangle$  state in the standard notation  $|n,l,m\rangle$  of the H-atom in the non-relativistic theory decays to the state  $|1,0,0\rangle$  via two dipole transition. The transition route and the corresponding probability are

1.  $|3,0,0\rangle \rightarrow |2,1,-1\rangle \rightarrow |1,0,0\rangle$  and  $1/4$
2.  $|3,0,0\rangle \rightarrow |2,1,1\rangle \rightarrow |1,0,0\rangle$  and  $1/4$
3.  $|3,0,0\rangle \rightarrow |2,1,0\rangle \rightarrow |1,0,0\rangle$  and  $1/3$
4.  $|3,0,0\rangle \rightarrow |2,1,0\rangle \rightarrow |1,0,0\rangle$  and  $2/3$

**Q5. [June 2022] . 5.0 marks**

Atomic and Molecular Physics &gt; Bohar Model and h-atom model

CSIR NET	2022 June	5M
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In the absorption spectrum of H-atom, the frequency of transition from the ground state to the first excited state is  $\nu_H$ . The corresponding frequency for a bound state of a positively charged muon ( $\mu^+$ ) and an electron is  $\nu_\mu$ . Using  $m_\mu = 10^{-28}$  kg,  $m_e = 10^{-30}$  kg and  $m_p \gg m_e, m_\mu$ , the value of  $(\nu_\mu - \nu_H)/\nu_H$  is

1. 0.001
2. -0.001
3. -0.01
4. 0.01

**Q6. [Dec 2023] . 5.0 marks**

Atomic and Molecular Physics &gt; Bohar Model and h-atom model

CSIR NET	2023 Dec	5 M
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The ionization potential of hydrogen atom is 13.6 eV and  $\lambda_H$  and  $\lambda_D$  denote longest wavelengths in Balmer spectrum of hydrogen and deuterium atoms, respectively. Ignoring the fine and hyperfine structures, the percentage

difference  $y = \frac{\lambda_H - \lambda_D}{\lambda_H} \times 100$ , is closest to

1. 1.0003%
2. -0.03%
3. 0.03%
4. -1.0003%

**Q7. [June 2023] . 5.0 marks**

Atomic and Molecular Physics &gt; Bohar Model and h-atom model

CSIR NET	2023 June	5M
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The electron cloud (of the outermost electrons) of an ensemble of atoms of atomic number  $Z$  is described by a continuous charge density  $\rho(r)$  that adjusts itself so that the electrons at the Fermi level have zero energy. If  $V(r)$  is the local electrostatic potential, then  $\rho(r)$  is

1.  $\frac{e}{3\pi^2 \hbar^3} [2m_e eV(\mathbf{r})]^{3/2}$

2.  $\frac{Ze}{3\pi^2 \hbar^3} [2m_e eV(\mathbf{r})]^{3/2}$

3.  $\frac{e}{3\pi^2 \hbar^3} [Zm_e eV(\mathbf{r})]^{3/2}$

4.  $\frac{e}{3\pi^2 \hbar^3} [m_e eV(\mathbf{r})]^{3/2}$

**Q8. [Dec 2024] . 5.0 marks**

Atomic and Molecular Physics &gt; Bohar Model and h-atom model

CSIR NET	2024 Dec	5M
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A hydrogen atom, excited to electronic configuration  $3S_{1/2}$  ( $nL_j$  notation), relaxes to the ground state via electric dipole transitions. Considering only fine structure and ignoring hyperfine structure, the maximum number of emitted spectral lines is

1. 3
2. 6
3. 1
4. 4

**Q9. [June 2024] . 5.0 marks**

Atomic and Molecular Physics &gt; Bohar Model and h-atom model

CSIR NET	2024 June	5M
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An atom of mass  $m$ , initially at rest, resonantly absorbs a photon. It makes a transition from the ground state to an excited state and also gets a momentum kick. If the difference between the energies of the ground state and the excited state is  $\hbar\Delta$ , the angular frequency of the absorbed photon is closest to

1.  $\Delta \left( 1 + \frac{3}{2} \frac{\hbar\Delta}{2mc^2} \right)$

2.  $\Delta \left( 1 + \frac{1}{2} \frac{\hbar\Delta}{mc^2} \right)$

3.  $\Delta \left( 1 + \frac{\hbar\Delta}{mc^2} \right)$

4.  $\Delta \left( 1 + 2 \frac{\hbar\Delta}{mc^2} \right)$

## Answer Key

9 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Atomic and Molecular Physics	Bohar Model and h-atom model	1
Q2	Atomic and Molecular Physics	Bohar Model and h-atom model	1
Q3	Atomic and Molecular Physics	Bohar Model and h-atom model	1
Q4	Atomic and Molecular Physics	Bohar Model and h-atom model	3
Q5	Atomic and Molecular Physics	Bohar Model and h-atom model	3
Q6	Atomic and Molecular Physics	Bohar Model and h-atom model	3
Q7	Atomic and Molecular Physics	Bohar Model and h-atom model	1
Q8	Atomic and Molecular Physics	Bohar Model and h-atom model	4
Q9	Atomic and Molecular Physics	Bohar Model and h-atom model	2

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