



## ATOMIC STRUCTURE

### JEE Main 2025 : PYQs (21)

*“These are not just assignments. These are questions that once decided someone’s rank. Solve them seriously... they might decide yours.”*

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## Topic–1 : Early Atomic Models

*(Dalton atomic theory, Thomson model, Rutherford model)*

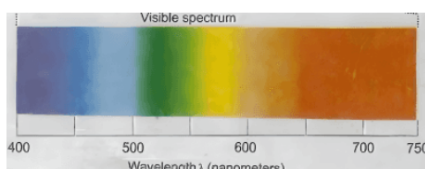
No JEE Main 2025 questions were asked from this topic.

## Topic–2 : Discoveries Before Bohr Model

*(EM waves, Blackbody radiation, Planck theory, Photoelectric effect, Spectrum)*

1. **Which of the following statements are correct, if the threshold frequency of caesium is  $5.16 \times 10^{14}$  Hz?**

**[JEE Main 2025]**



- (A) When Cs is placed inside a vacuum chamber with an ammeter connected to it and yellow light is focused on Cs, the ammeter shows the presence of current.
- (B) When the brightness of the yellow light is dimmed, the value of the current in the ammeter is reduced.
- (C) When a red light is used instead of the yellow light, the current produced is higher with respect to the yellow light.
- (D) When a blue light is used, the ammeter shows the formation of current.
- (E) When a white light is used, the ammeter shows formation of current.

Choose the correct answer from the options given below:

- (a) B, C and D only
- (b) A, C, D and E only
- (c) A, B, D and E only
- (d) A, D and E only

2. Given below are two statements about X-ray spectra of elements :

Statement (I) : A plot of  $\sqrt{\nu}$  (frequency of X-rays emitted) vs atomic mass is a straight line.

Statement (II) : A plot of frequency of X-rays emitted vs atomic number is a straight line.

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

[JEE Main 2025 (Online) 23rd January Evening Shift]

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

### Topic-3 : Bohr's Model of Atom

(Postulates, radius, velocity, energy, ionisation energy, H-spectrum, limitations)

1. Which of the following postulate of Bohr's model of hydrogen atom is not in agreement with quantum mechanical model of an atom? [JEE Main 2025 (Online) 3rd April Morning Shift]

- (a) The electron in a H atom's stationary state moves in a circle around the nucleus.
- (b) An atom can take only certain distinct energies  $E_1, E_2, E_3$ , etc. These allowed states of constant energy are called the stationary states of atom.
- (c) An atom in a stationary state does not emit electromagnetic radiation as long as it stays in the same state.
- (d) When an electron makes a transition from a higher energy stationary state to a lower energy stationary state, then it emits a photon of light.

2. Radius of the first excited state of Helium ion is given as:  $a_0$  \_\_\_\_\_ radius of first stationary state of hydrogen atom. [JEE Main 2025 (Online) 22nd January Morning Shift]

- (a)  $r = \frac{a_0}{4}$
- (b)  $r = 2a_0$
- (c)  $r = 4a_0$
- (d)  $r = \frac{a_0}{2}$

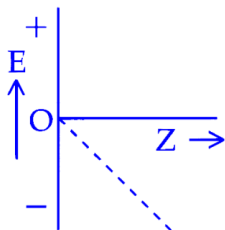
3. According to Bohr's model of hydrogen atom, which of the following statement is incorrect? [JEE Main 2025 (Online) 2nd April Morning Shift]

- (a) Radius of 4th orbit is four times larger than that of 2nd orbit
- (b) Radius of 8th orbit is four times larger than that of 4th orbit
- (c) Radius of 6th orbit is three times larger than that of 4th orbit
- (d) Radius of 3rd orbit is nine times larger than that of 1st orbit

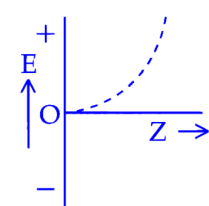
4. The energy of an electron in the first Bohr orbit of the H-atom is  $-13.6\text{ eV}$ . The

magnitude of energy value of an electron in the first excited state of  $\text{Be}^{3+}$  is \_\_\_\_\_ eV (nearest integer value). [JEE Main 2025 (Online) 8th April Evening Shift]

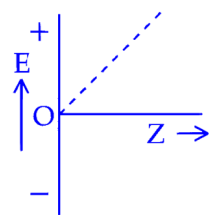
5. For hydrogen like species, which of the following graphs provides the most appropriate representation of  $E$  vs  $Z$  plot for a constant  $n$ ? ( $E$  : Energy of stationary state,  $Z$  : atomic number) [JEE Main 2025 (Online) 29th January Evening Shift]



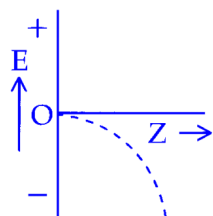
(a)



(b)



(c)



(d)

6. Heat treatment of muscular pain involves radiation of wavelength of about 900 nm. Which spectral line of H atom is suitable for this? [JEE Main 2025 (Online) 23rd January Morning Shift]
- Lyman series ( $\infty \rightarrow 1$ )
  - Balmer series ( $\infty \rightarrow 2$ )
  - Paschen series ( $5 \rightarrow 3$ )
  - Paschen series ( $\infty \rightarrow 3$ )

## Topic-4 : Discoveries Before Quantum Mechanical Model

(de Broglie hypothesis, Heisenberg uncertainty principle)

1. If  $a_0$  is denoted as the Bohr radius of hydrogen atom, then what is the de-Broglie wavelength ( $\lambda$ ) of the electron present in the second orbit of hydrogen atom? ( $n$  : any

integer) [JEE Main 2025 (Online) 29th January Morning Shift]

- (a)  $\frac{8\pi a_0}{n}$
- (b)  $\frac{2\pi a_0}{n}$
- (c)  $\frac{4\pi a_0}{n}$
- (d)  $\frac{\pi a_0}{n}$

2. Given below are two statements :

**Statement (I) :** It is impossible to specify simultaneously with arbitrary precision, both the linear momentum and the position of a particle.

**Statement (II) :** If the uncertainty in the measurement of position and uncertainty in measurement of momentum are equal for an electron, then the uncertainty in the measurement of velocity is  $\geq \sqrt{\frac{h}{\pi} \times \frac{1}{2m}}$ .

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

[JEE Main 2025 (Online) 29th January Evening Shift]

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

## Topic-5 : Quantum Mechanical Model of Atom

(Quantum numbers, orbitals, shapes, nodes, rules, configuration, graphs)

1. Given below are two statements :

**Statement (I) :** For a given shell, the total number of allowed orbitals is given by  $n^2$ .

**Statement (II) :** For any subshell, the spatial orientation of the orbitals is given by  $-\ell$  to  $+\ell$  values including zero.

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

[JEE Main 2025 (Online) 23rd January Evening Shift]

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

2. For electrons in  $2s$  and  $2p$  orbitals, the orbital angular momentum values, respectively are : [JEE Main 2025 (Online) 3rd April Evening Shift]

- (a) 0 and  $\sqrt{6} \frac{h}{2\pi}$
- (b) 0 and  $\sqrt{2} \frac{h}{2\pi}$

- (c)  $\sqrt{2}\frac{h}{2\pi}$  and 0  
(d)  $\sqrt{6}\frac{h}{2\pi}$  and  $\sqrt{2}\frac{h}{2\pi}$

3. In a multielectron atom, which of the following orbitals described by three quantum numbers will have same energy in absence of electric and magnetic fields?

- (A)  $n = 1, \ell = 0, m_\ell = 0$   
(B)  $n = 2, \ell = 0, m_\ell = 0$   
(C)  $n = 2, \ell = 1, m_\ell = 1$   
(D)  $n = 3, \ell = 2, m_\ell = 1$   
(E)  $n = 3, \ell = 2, m_\ell = 0$

Choose the correct answer from the options given below :

[JEE Main 2025 (Online) 28th January Morning Shift]

- (a) B and C only  
(b) C and D only  
(c) A and B only  
(d) D and E only

4. Which of the following is/are not correct with respect to energy of atomic orbitals of hydrogen atom?

- (A)  $1s < 2p < 3d < 4s$   
(B)  $1s < 2s = 2p < 3s = 3p$   
(C)  $1s < 2s < 2p < 3s < 3p$   
(D)  $1s < 2s < 4s < 3d$

Choose the correct answer from the options given below :

[JEE Main 2025 (Online) 28th January Evening Shift]

- (a) (A) and (B) only  
(b) (A) and (C) only  
(c) (B) and (D) only  
(d) (C) and (D) only

5. For hydrogen atom, the orbital/s with lowest energy is/are :

- (A)  $4s$  (B)  $3p_x$  (C)  $3d_{x^2-y^2}$  (D)  $3d_{z^2}$  (E)  $4p_z$

Choose the correct answer from the options given below :

[JEE Main 2025 (Online) 24th January Evening Shift]

- (a) (A) only  
(b) (B) only  
(c) (B), (C) and (D) only  
(d) (A) and (E) only

6. Given below are two statements :

**Statement (I) :** A spectral line will be observed for a  $2p_x \rightarrow 2p_y$  transition.

**Statement (II) :**  $2p_x$  and  $2p_y$  are degenerate orbitals.

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

[JEE Main 2025 (Online) 22nd January Evening Shift]

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

7. Consider the ground state of chromium atom ( $Z = 24$ ). How many electrons are with azimuthal quantum number  $\ell = 1$  and  $\ell = 2$  respectively? [JEE Main 2025 (Online) 4th April Evening Shift]

- (a) 16 and 5
- (b) 12 and 5
- (c) 12 and 4
- (d) 16 and 4

8. Correct statements for an element with atomic number 9 are :

- (A) There can be 5 electrons for which  $m_s = +\frac{1}{2}$  and 4 electrons for which  $m_s = -\frac{1}{2}$
- (B) There is only one electron in  $p_z$  orbital
- (C) The last electron goes to orbital with  $n = 2$  and  $\ell = 1$
- (D) The sum of angular nodes of all the atomic orbitals is 1

Choose the correct answer from the options given below :

[JEE Main 2025 (Online) 8th April Evening Shift]

- (a) A and B only
- (b) A, C and D only
- (c) A and C only
- (d) C and D only

9. The extra stability of half-filled subshell is due to :

- (A) Symmetrical distribution of electrons
- (B) Smaller coulombic repulsion energy
- (C) Presence of electrons with same spin in non-degenerate orbitals
- (D) Larger exchange energy
- (E) Relatively smaller shielding of electrons by one another

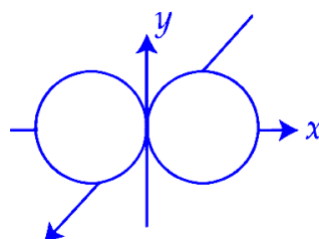
Identify the correct statements :

[JEE Main 2025 (Online) 7th April Evening Shift]

- (a) (B), (D) and (E) only
- (b) (A), (B), (D) and (E) only
- (c) (B), (C) and (D) only
- (d) (A), (B) and (D) only

10. Which of the following statements are true? [JEE Main 2025 (Online) 2nd April Evening Shift]

(A) The subsidiary quantum number describes the shape of the orbital occupied by the electron.

(B)  is the boundary surface diagram of the  $2p_x$  orbital.

(C) The + and - signs in the wave function of the orbital refer to charge.

(D) The wave function of orbital is zero everywhere in the xy-plane.

(a) (A) and (B) only

(b) (B) and (D) only

(c) (C) and (D) only

(d) (A), (B) and (C) only

11. Which one of the following about an electron occupying the  $1s$  orbital in a hydrogen atom is incorrect? (Bohr's radius is represented by  $a_0$ ) [JEE Main 2025 (Online) 4th April Morning Shift]

(a) The probability density of finding the electron is maximum at the nucleus.

(b) The total energy of the electron is maximum when it is at a distance  $a_0$  from the nucleus.

(c) The electron can be found at a distance  $2a_0$  from the nucleus.

(d) The  $1s$  orbital is spherically symmetrical.

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*“Don't measure your preparation by Marks or Confidence. Measure it by the number of questions you've solved honestly.”*

— End of Assignment —