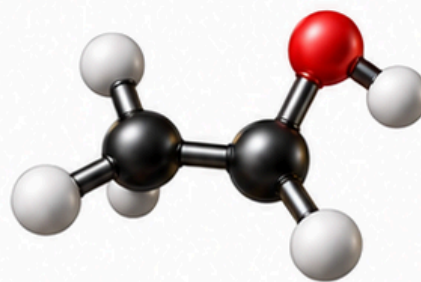


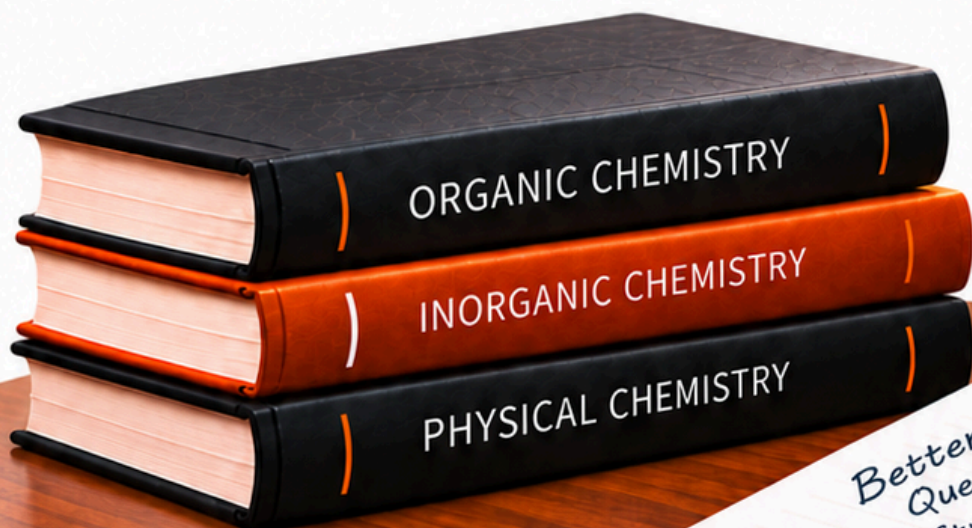
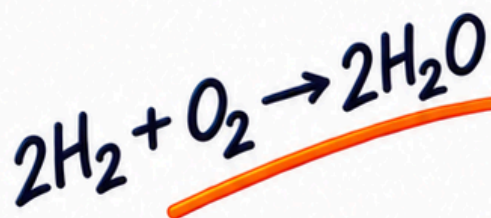
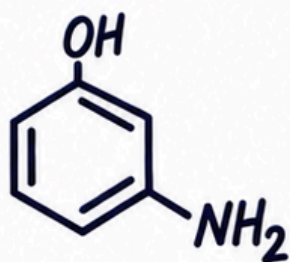


REACTIONS
CONCEPTS
QUESTIONS
HIGHER GOALS



JEE Main Chemistry

Quantum mechanical model of the atom and atomic orbitals PYQ



PRACTICE
TODAY
A BRIGHTER
TOMORROW

Better
Questions
Stronger
Concepts
Brighter Future

Subject: Chemistry

Years: 2026-2003

Total Questions: 33

About this PYQ collection

What is inside

A complete topic-wise set of **33 previous year questions** on **Quantum mechanical model of the atom and atomic orbitals** from **JEE Main (2026-2017)** and its predecessor **AIEEE (2008-2003)**, across **15 exam years**. **25 questions** are from 2019 onwards, so most of the set reflects the recent NTA pattern.

Questions are arranged to reduce unused page space, with newest-first priority and continuous numbering from 1. Each carries an exam date and shift tag to trace the original paper.

Topic-wise questions

TOPIC	QS	%
Quantum mechanical model of the atom and atomic orbitals	33	100%

Question types

TYPE	QS	%
Single-correct MCQ	30	91%
Numerical value	3	9%

Numerical-value questions have no options; all 3 are from 2021 onwards.

How these questions help you

- **Know where the marks are:** quantum mechanical model of the atom and atomic orbitals make up **33 of 33 questions (about 100%)**.
- **Build speed and accuracy:** practice the concepts and question styles used in previous papers.
- **Learn the patterns:** the same question styles return year after year.
- **Strengthen other chapters:** these concepts support further study in Chemistry.

Questions – Quantum mechanical model of the atom and atomic orbitals

1. Match the LIST – I with LIST – II

List-I Orbital		List-II Radial nodes and nodal plane	
A.	2s	I.	1 Radial node + two nodal planes
B.	3s	II.	1 Radial node + one nodal plane
C.	3p	III.	2 Radial nodes + No nodal plane
D.	4d	IV.	1 Radial node + No nodal plane

Choose the correct answer from the options given below:

(6 Apr 2026 | Shift 1)

(A) A-IV, B-I, C-III, D-II

(B) A-IV, B-II, C-III, D-I

(C) A-III, B-I, C-IV, D-II

(D) A-IV, B-III, C-II, D-I

2. Identify the correct statements from the following :

A. Heisenberg uncertainty principle is applicable to electrons.

B. The size of $2p_x$ orbital is less than the size of $3p_x$ orbital.

C. The energy of 2 s orbital of H atom is equal to the energy of 2 s orbital of Li .

D. The electronic configuration of Cr is $[\text{Ar}]3d^5 4s^1$

Choose the correct answer from the options given below:

(5 Apr 2026 | Shift 1)

(A) A, B and C Only

(B) A, B and D Only

(C) B, C and D Only

(D) A, C and D Only

3. The number of radial node/s for $3p$ orbital is :

(1 Feb 2024 | Shift 2)

(A) 3

(B) 2

(C) 1

(D) 4

4. The total number of isoelectronic species from the given set is _____.

O^{2-} , F^- , Al , Mg^{2+} , Na^+ , O^+ , Mg , Al^{3+} , F

(15 Apr 2023 | Shift 1)

5.

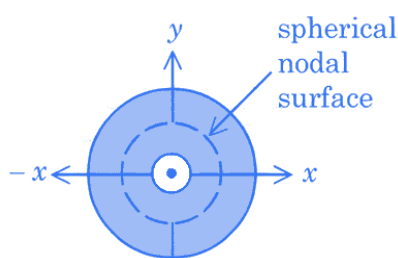


Figure 1. electron probability density for 2 s orbital

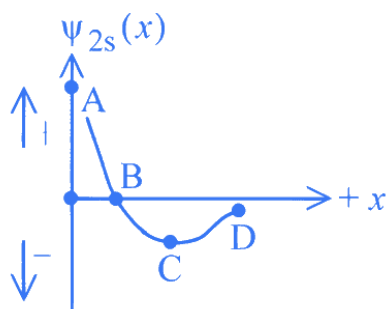


Figure 2. wave function for 2s orbital

Which of the following point in Figure 2 most accurately represents the nodal surface as shown in Figure 1?

(28 Jan 2026 | Shift 1)

- (A) D (B) B
(C) C (D) A

6. Identify the **INCORRECT** statements from the following :

- A. Notation ${}^{24}_{12}\text{Mg}$ represents 24 protons and 12 neutrons.
B. Wavelength of a radiation of frequency $4.5 \times 10^{15} \text{ s}^{-1}$ is $6.7 \times 10^{-8} \text{ m}$.
C. One radiation has wavelength $= \lambda_1 (900 \text{ nm})$ and energy $= E_1$. Other radiation has wavelength $= \lambda_2 (300 \text{ nm})$ and energy $= E_2$. $E_1 : E_2 = 3 : 1$.
D. Number of photons of light of wavelength 2000 pm that provides 1 J of energy is 1.006×10^{16} .

Choose the correct answer from the options given below :

(23 Jan 2026 | Shift 2)

- (A) A and D Only (B) A and C Only
(C) A and B Only (D) B and C Only

7. The number of atomic orbitals from the following having 5 radial nodes is _____.
7s, 7p, 6s, 8p, 8d

(8 Apr 2023 | Shift 2)

8. The orbital having two radial as well as two angular nodes is :

(26 Feb 2021 | Shift 1)

- (A) 3p (B) 5d
(C) 4d (D) 4f

9. 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 $l = 1$.
D. The sum of angular nodes of all the atomic orbitals is 1.
Choose the correct answer from the options given below: (8 Apr 2025 | Shift 2)
- (A) A and B Only (B) A, C and D Only
(C) A and C Only (D) C and D Only
-
10. Which one of the following about an electron occupying the 1 s orbital in a hydrogen atom is incorrect?
(Bohr's radius is represented by a_0) (4 Apr 2025 | Shift 1)
- (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 1 s orbital is spherically symmetrical
-
11. 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 : (24 Jan 2025 | Shift 2)
- (A) (A) only (B) (B) only
(C) (B), (C) and (D) only (D) (A) and (E) only
-
12. Which one of the following sets of ions represents a collection of isoelectronic species?
(Given : Atomic Number :
F : 9, Cl : 17, Na = 11, Mg = 12, Al = 13, K = 19, Ca = 20, Sc = 21) (1 Feb 2023 | Shift 2)
- (A) N^{3-} , O^{2-} , F^- , S^{2-} (B) Ba^{2+} , Sr^{2+} , K^+ , Ca^{2+}
(C) Li^+ , Na^+ , Mg^{2+} , Ca^{2+} (D) K^+ , Cl^- , Ca^{2+} , Sc^{3+}

13. The wave function (Ψ) of 2s is given by

$$\Psi_{2s} = \frac{1}{2\sqrt{2\pi}} \left(\frac{1}{a_0}\right)^{1/2} \left(2 - \frac{r}{a_0}\right) e^{-r/2a_0}$$

At $r = r_0$, radial node is formed. Thus, r_0 in terms of a_0

(30 Jan 2023 | Shift 2)

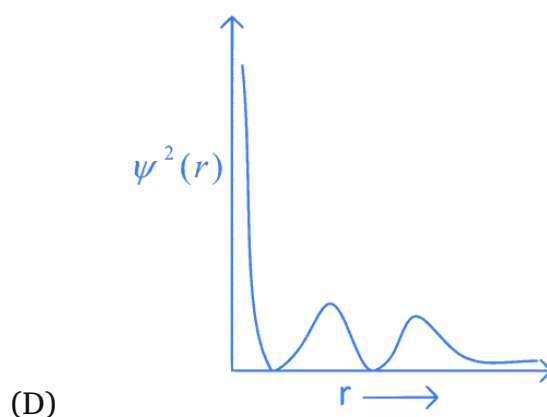
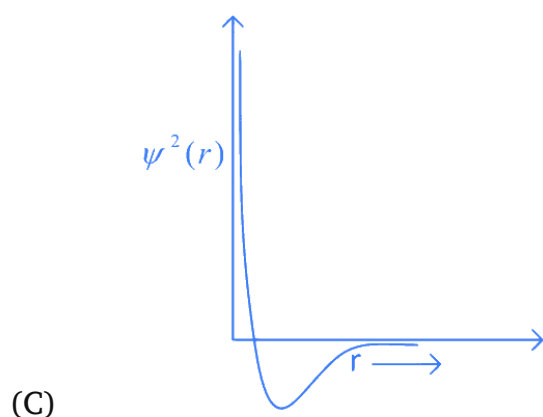
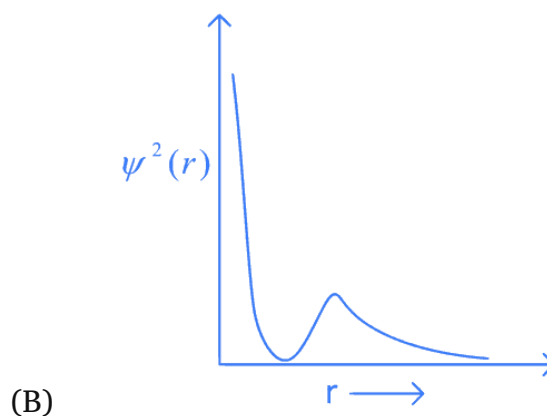
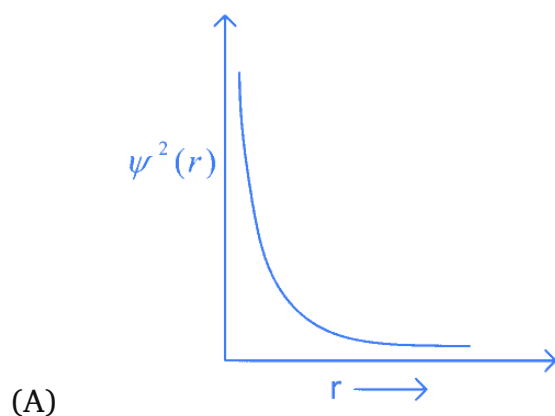
- (A) $r_0 = a_0$ (B) $r_0 = 4a_0$
(C) $r_0 = 2a_0$ (D) $r_0 = \frac{a_0}{2}$

14. The number of s-electrons present in an ion with 55 protons in its unipositive state is

(24 Jan 2023 | Shift 2)

- (A) 10 (B) 9
(C) 12 (D) 8

15. Which of the following is the correct plot for the probability density $\psi^2(r)$ as a function of distance 'r' of the electron from the nucleus for 2s orbital? (29 Jun 2022 | Shift 2)



16. The number of radial and angular nodes in 4d orbital are, respectively

(26 Jun 2022 | Shift 2)

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

17. The pair, in which ions are isoelectronic with Al^{3+} is :

(25 Jun 2022 | Shift 1)

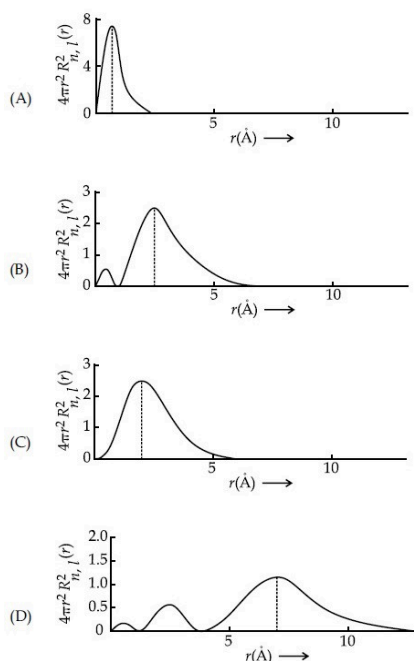
- (A) Br^- and Be^{2+} (B) Cl^- and Li^+
(C) S^{2-} and K^+ (D) O^{2-} and Mg^{2+}

18. A certain orbital has no angular nodes and two radial nodes. The orbital is :

(18 Mar 2021 | Shift 1)

- (A) 2s (B) 3s
(C) 3p (D) 2p

19. The plots of radial distribution functions for various orbitals of hydrogen atom against 'r' are given below :



The correct plot for 3s orbital is :

(25 Feb 2021 | Shift 1)

- (A) (B) (B) (A)
(C) (C) (D) (D)

20. A proton and a Li^{3+} nucleus are accelerated by the same potential. If λ_{Li} and λ_p denote the de Broglie wavelengths of Li^{3+} and proton respectively, then the value of $\frac{\lambda_{\text{Li}}}{\lambda_p}$ is $x \times 10^{-1}$.

The value of x is _____. (Rounded off to the nearest integer)

[Mass of $\text{Li}^{3+} = 8.3$ mass of proton]

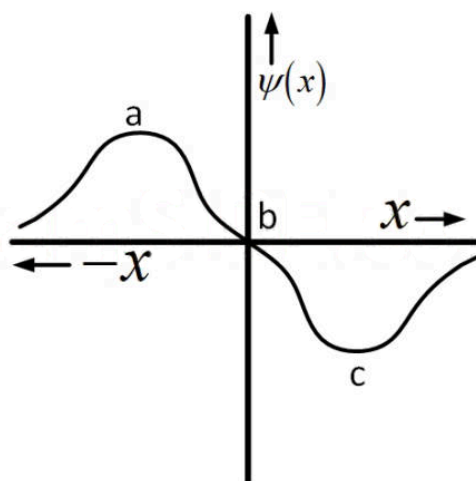
(24 Feb 2021 | Shift 1)

21. The correct statement about probability density (except at infinite distance from nucleus) is :

(5 Sept 2020 | Shift 2)

- (A) It can be zero for 1s orbital (B) It can be zero for 3p orbital
(C) It can never be zero for 2s orbital (D) It can negative for 2p orbital

22. The electrons are more likely to be found :



(12 Apr 2019 | Shift 1)

- (A) only in the region a (B) in the region a and c
(C) only in the region c (D) in the region a and b

23. The isoelectronic set of ions is :

(10 Apr 2019 | Shift 1)

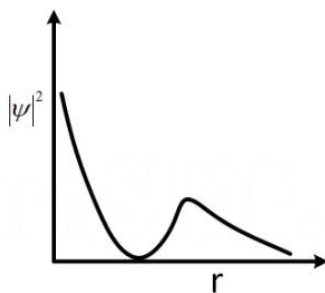
- (A) F^- , Li^+ , Na^+ and Mg^{2+} (B) Li^+ , Na^+ , O^{2-} and F^-
(C) N^{3-} , O^{2-} , F^- and Na^+ (D) N^{3-} , Li^+ , Mg^{2+} and O^{2-}

24. The group having isoelectronic species is:

(2 Apr 2017 | Single sitting)

- (A) O^{2-} , F^- , Na^+ , Mg^{2+} (B) O^{2-} , F^- , Na, Mg^{2+}
(C) O^- , F^- , Na^+ , Mg^{2+} (D) O^- , F^- , Na, Mg^+

25. The graph between $|\psi|^2$ and r (radial distance) is shown below. This represents :



(10 Apr 2019 | Shift 1)

- (A) 3s orbital
(B) 2s orbital
(C) 2p orbital
(D) 1s orbital

26. Which one of the following about an electron occupying the 1s orbital in a hydrogen atom is incorrect ?

(The Bohr radius is represented by a_0)

(9 Apr 2019 | Shift 2)

- (A) The probability density of finding the electron is maximum at the nucleus.
(B) The electron can be found at a distance $2a_0$ from the nucleus
(C) The total energy of the electron is maximum when it is at a distance a_0 from the nucleus.
(D) The magnitude of potential energy is double that of its kinetic energy on an average.

27. Which of the following statements is **false** ?

(16 Apr 2018 | Shift 1)

- (A) Photon has momentum as well as wavelength.
(B) Splitting of spectral lines in electrical field is called Stark effect.
(C) Rydberg constant has unit of energy.
(D) Frequency of emitted radiation from a black body goes from a lower wavelength to higher wavelength as the temperature increases.

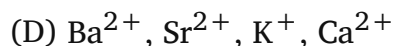
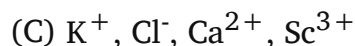
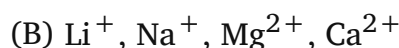
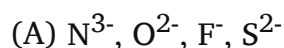
28. Which one of the following constitutes a group of the isoelectronic species?

(27 Apr 2008 | Single sitting)

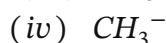
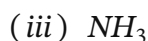
- (A) C_2^{2-} , O_2^- , CO, NO
(B) NO^+ , C_2^{2-} , CN^- , N_2
(C) CN^- , N_2 , O_2^{2-} , C_2^{2-}
(D) N_2 , O_2^- , NO^+ , CO

29. Which of the following sets of ions represents a collection of isoelectronic species?

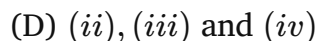
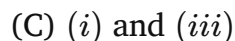
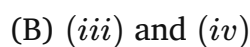
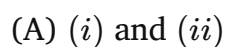
(30 Apr 2006 | Single sitting)



30. Pick out the isoelectronic structure from the following :

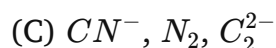
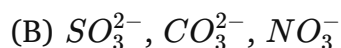
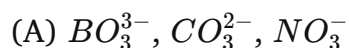


(8 May 2005 | Single sitting)



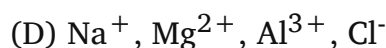
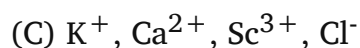
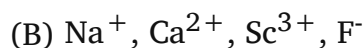
31. Of the following sets which one does NOT contain isoelectronic species?

(8 May 2005 | Single sitting)



32. Which one of the following sets of ions represents the collection of isoelectronic species? (Atomic nos. : F = 9, Cl = 17, Na = 11, Mg = 12, Al = 13, K = 19, Ca = 20, Sc = 21)

(23 May 2004 | Single sitting)



33. Which one of the following groupings represents a collection of isoelectronic species? (At. nos. : Cs : 55, Br : 35)

(26 Apr 2003 | Single sitting)

