	INDIAN SCHOOL AL WADI AL KABIR	
Class: XI	**DEPARTMENT OF SCIENCE 2025– 2026** **SUBJECT: CHEMISTRY**	**Date: 09/05/2025**
Worksheet: 02	**CHAPTER 2: STRUCTURE OF ATOM**	**Note:** **A4 FILE FORMAT**
CLASS & SEC:	**NAME OF THE STUDENT:**	**ROLL NO.**

Multiple Choice Questions:

1. What is the maximum number of electrons that can exist in a subshell?
   a. $2n^2$
   b. $4l + 2$
   c. $2l + 1$
   d. $4l - 2$

2. For an electron with principal quantum number 3, how many orbitals are possible?
   a. 5
   b. 7
   c. 9
   d. 3

3. How can an electron transition to a higher Bohr orbit?
   a. By emission of electromagnetic radiation
   b. Without any energy exchange
   c. By absorption of electromagnetic radiation of specific frequency
   d. By absorption of any electromagnetic radiation

4. Which quantum number identifies two electrons in the same orbital?
   a. Principal quantum number
   b. Angular momentum quantum number
   c. Magnetic quantum number
   d. Spin quantum number

5. Which statement about orbital nodes is correct?
   a. Angular nodes equal principal quantum number
   b. Total nodes = n - 1
   c. Radial nodes = n + l - 1
   d. Angular nodes = n + l

6. The Heisenberg Uncertainty Principle is most applicable to:
   a. Macroscopic objects
   b. Subatomic particles
   c. Planetary motion
   d. Sound waves

7. An orbital where n = 4 and l = 2 is designated as:
   a. 4s
   b. 4p
   c. 4d
   d. 4f

8. Which of the following quantum numbers determines the shape of an orbital?

a. Principal quantum number (n)
b. Azimuthal quantum number (*l*)
c. Magnetic quantum number (*ml*)
d. Spin quantum number (*ms*)

9. The energy of an electron in the hydrogen atom is primarily determined by which quantum number?
   a. *n*
   b. *l*
   c. *ml*
   d. *ms*
   e.

10. Which of the following statements about the Bohr model of the atom is incorrect?
   a. Electrons move in circular orbits around the nucleus.
   b. Each orbit corresponds to a specific energy level.
   c. Electrons can exist between energy levels.
   d. The energy of an electron is quantized.

11. Assertion: In an atom, electrons in the same orbital must have opposite spins.
    Reason: The Pauli Exclusion Principle states that no two electrons in an atom can have the same set of four quantum numbers
   a. Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
   b. Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
   c. Assertion is correct, but reason is a wrong statement.
   d. Assertion is wrong, but reason is a correct statement.

12. Assertion: The angular momentum of an electron in a hydrogen atom is quantized.
    Reason: According to Bohr's model, the angular momentum of an electron is an integral multiple of $nh/2\pi$.
   a. Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
   b. Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.

c.Assertion is correct, but reason is a wrong statement.
d.Assertion is wrong, but reason is a correct statement

2 Marks Questions

13. What are radial nodes, and how many radial nodes are present in the 3p orbital?

14. State Hund's Rule of Maximum Multiplicity and explain its significance in electronic configuration.

15. What is the significance of the principal quantum number (n) in determining the properties of an electron in an atom?

16. Explain why the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^2$ does not represent a ground state configuration.

3 Marks Questions

17. Discuss the Heisenberg's uncertainty principle and its implications on the concept of definite paths for electrons.

18. How does the Pauli Exclusion Principle help in determining the electronic configuration of an atom?

19. Calculate the wavelength of an electron moving with a velocity of 2.5×10^6 m/s
(Use mass of electron$=9.1\times10^{-31}$ kg and $h=6.626\times10^{-34}$ Js)

20. Calculate the uncertainty in the position of a particle with a mass of 1.0kg and an uncertainty in velocity of 0.1m/s. Use Heisenberg's uncertainty principle,
where $h=6.626\times10^{-34}$ Js

5 Marks Questions

21.a. Calculate the energy change when an electron in a hydrogen atom transitions from the n=5 to the n=2 level.
b. Differentiate between an atomic orbital and a Bohr orbit in terms of their descriptions of electron position.

22. Explain the concept of atomic orbitals and how they are determined by quantum numbers. Provide examples of how the quantum numbers n,l, and ml define specific orbitals.

Case study Questions

23. Read the given passage and answer the questions given below:

The de Broglie hypothesis proposed that particles can exhibit wave-like behaviour. The wavelength associated with a moving particle is given by $\lambda = h/mv$, where h is Planck's constant, m is the mass, and v is the velocity of the particle. The Heisenberg Uncertainty Principle states that it is impossible to simultaneously know both the position and momentum of a particle with absolute certainty. The principle can be expressed as $\Delta x \cdot \Delta p \geq h4\pi$ where Δx is the uncertainty in position and Δp is the uncertainty in momentum. Electrons in an atom are described by a set of four quantum numbers: principal (n), azimuthal (l), magnetic (ml), and spin (ms). The principal quantum number defines the energy level; the azimuthal quantum number defines the shape of the orbital; the magnetic quantum number defines the orientation; and the spin quantum number describes the electron's spin direction.

1. Calculate the de Broglie wavelength of a proton moving at 1×10^{5}m/s. Assume the mass of a proton is 1.67×10^{-27}kg.

2. Which set of quantum numbers is not possible?

   a. n=2, l=1, ml=0, m_s= + ½
   b. n=3, l=2, ml=2, m_s= − ½
   c. n=3, l=3, ml=0, m_s=+ ½
   d. n=4, l=0, ml=0, m_s =+ ½

3. If the uncertainty in the position of an electron is decreased, what happens to the uncertainty in its momentum?

   a. It increases
   b. It decreases
   c. It remains the same
   d. It becomes zero

4. What is the formula used to calculate the energy of a photon from its wavelength?

Answers

1.	b. $4l + 2$
2	c. 9
3.	c. By absorption of electromagnetic radiation of specific frequency
4.	d. Spin quantum number
5.	b. Total nodes = n – 1
6.	b. Subatomic particles
7.	c. 4d
8.	b. Azimuthal quantum number (l)
9.	*a. n*
10.	c.Electrons can exist between energy levels.

11.	a. Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
12.	a. Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
13.	Radial nodes are regions where the probability density of finding an electron is zero. The 3p orbital has 1 radial node.
14.	Hund's Rule of Maximum Multiplicity states that for degenerate orbitals (orbitals with the same energy), electrons will fill each orbital singly before any orbital gets a second electron, and all singly occupied orbitals will have electrons with the same spin. This rule is significant because it minimizes electron-electron repulsions, leading to a more stable configuration with lower energy.
15.	The principal quantum number (*n*) determines the energy level and size of an electron's orbital. It indicates the shell in which the electron resides, with higher *n* values corresponding to higher energy levels and larger orbitals. This quantum number is crucial for defining the electron's distance from the nucleus and its potential energy
16.	In the ground state, electrons fill orbitals in order of increasing energy, following the Aufbau Principle. The correct ground state configuration would be $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$
17.	Heisenberg's uncertainty principle states that one cannot simultaneously know the exact position and momentum of an electron, implying that electrons do not have precise orbits.
18.	The Pauli Exclusion Principle states that no two electrons can have the same set of four quantum numbers, ensuring unique electron configurations.
19.	$\lambda = \frac{h}{m \cdot v}$ $\lambda = \frac{6.626\times10^{-34}}{9.1\times10^{-31}\times2.5\times10^{6}} = 2.9 \times 10^{-10}$ m
20.	$\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$ $\Delta x \geq \frac{6.626\times10^{-34}}{4\pi\times0.1} = 5.3 \times 10^{-34}$ m
21.	a. $\Delta E=-2.18\times10^{-18}(1/5^2 - 1/2^2)= 45.78\text{x}10^{-20}$ J b. An atomic orbital is a region in space where there is a high probability of finding an electron, described by wavefunctions and quantum mechanics. A Bohr orbit, in contrast, is a fixed circular path at a certain distance from the nucleus, as proposed by Bohr's model. Atomic orbitals provide a more accurate representation of electron behaviour.
22.	Atomic Orbitals: Atomic orbitals are regions in an atom where there is a high probability of finding electrons. They are solutions to the Schrödinger equation for electrons in atoms and describe the spatial distribution of electrons. Quantum Numbers: Principal Quantum Number (*n*): Determines the energy level and size of the orbital. Higher *n* values correspond to higher energy levels and larger orbitals. For example, n=1 for the first energy level, n=2for the second, and so on.

	Azimuthal Quantum Number (*l*): Determines the shape of the orbital. The value of *l* ranges from 0 to *n*−1. Each value of *l* corresponds to a specific type of orbital (0 = s, 1 = p, 2 = d, 3 = f). For example, *l*=0 for s orbitals, which are spherical. Magnetic Quantum Number (*ml*): Determines the orientation of the orbital in space. The value of *ml* ranges from −*l* to +*l*. For example, for a p orbital (*l*=1), *ml* can be -1, 0, or +1, corresponding to the *px*, *py*, and *pz* orbitals. Examples: An electron with *n*=2, *l*=1, and *ml*=0 is in a 2*p* orbital oriented along the *y*-axis (assuming *ml*=0 corresponds to the *py* orbital in a particular coordinate system). An electron in the 3*dxy* orbital would have *n*=3, *l*=2, and a specific *ml* value corresponding to the *xy* plane.
23.	1. $\lambda = 3.96 \times 10^{-12}$ m 2. c. n=3, l=3, ml=0, ms=+ ½ 3. a. It increases 4. $E = hc/\lambda$

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