PABNA UNIVERSITY OF SCIENCE & TECHNOLOGY

ASSINGMENT

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5. (a) Give the defects of Rutherford's model of atom. What suggestions were given by Bohr to remove these defects?

Answer: - Defects of Rutherford's Atomic Model:

1. According to classical electromagnetic theory, an electron moving in a circular orbit around the nucleus would continuously emit radiation, lose energy, and spiral into the nucleus. Thus, Rutherford's model could not explain the stability of atoms.
2. It failed to explain the discrete line spectra observed in atoms, particularly in hydrogen.

- Bohr's Suggestions to Overcome the Defects:

1. Electrons revolve around the nucleus in specific stable orbits without emitting radiation. These are called quantized orbits.
2. Electrons emit or absorb energy only when they jump from one allowed orbit to another, and the energy difference corresponds to the observed spectral lines.

5. (b) What do you understand by the term "Quantum number"? How many quantum numbers has an electron in an orbital? Explain the significance of each quantum number.

Answer: - Quantum numbers are a set of numerical values that provide information about the position and energy of an electron in an atom.

- An electron in an orbital is described by four quantum numbers:

1. Principal Quantum Number (n): Represents the main energy level or shell.
2. Azimuthal Quantum Number (l): Represents the subshell (s, p, d, f) and determines the shape of the orbital.
3. Magnetic Quantum Number (m): Represents the orientation of the orbital in space.
4. Spin Quantum Number (s): Represents the spin direction of the electron (either + or -).

Each quantum number gives specific information about the electron's arrangement and behavior in the atom.

6. (a) Compare the properties of ionic and covalent compounds. Give two examples of each type of compounds.

Answer: - Ionic Compounds:

- Formed by the transfer of electrons.
- High melting and boiling points.
- Conduct electricity in molten or aqueous state.
- Generally soluble in water.
- Examples: Sodium chloride (NaCl), Magnesium oxide (MgO).

- Covalent Compounds:

- Formed by the sharing of electrons.
- Low melting and boiling points.
- Poor conductors of electricity.
- Generally soluble in organic solvents.
- Examples: Water (HO), Carbon dioxide (CO).

6. (b) What is a co-ordinate covalent bond? How does it differ from a normal covalent bond.

Answer: - A co-ordinate covalent bond (also called a dative bond) is a type of covalent bond in which both electrons of the shared pair come from the same atom.

- Difference from Normal Covalent Bond:

- In a normal covalent bond, each atom contributes one electron to the shared pair.
- In a co-ordinate bond, only one atom donates both electrons.

Example: Formation of ammonium ion (NH).

7. (a) What do you understand by hydrogen bonds? Classify them with examples. Explain why water has abnormally high boiling point.

Answer: - Hydrogen bond is a weak bond formed between a hydrogen atom attached to an electronegative atom (like O, N, or F) and another electronegative atom.

- Types of Hydrogen Bonds:

1. Intermolecular Hydrogen Bond: Between two molecules (e.g., HO).
2. Intramolecular Hydrogen Bond: Within the same molecule (e.g., o-nitrophenol).

- Reason for High Boiling Point of Water:

Strong hydrogen bonding in water molecules requires more energy to break, resulting in a higher boiling point.

7. (b) Why bond angles of HO and NH are 104.5 and 107 respectively although central atoms are sp hybridized?

Answer: - Both HO and NH are sp hybridized but have different bond angles due to lone pair repulsions.

- In NH: One lone pair causes a bond angle of about 107.

- In HO: Two lone pairs cause greater repulsion, reducing the bond angle to about 104.5.

8. (a) What do you mean by the 'ionization potential' of an element? Why the first ionization potential of an element is less than the second ionization potential? How does the ionization potential of an element vary with atomic volume?

Answer: - Ionization potential is the energy required to remove the outermost electron from a gaseous atom.

- First ionization potential is lower because the electron is removed from a neutral atom.

- Second ionization potential is higher because removal from a positively charged ion requires more energy.

- Variation with Atomic Volume:

- Increases across a period (atomic volume decreases).

- Decreases down a group (atomic volume increases).

8. (b) What do you mean by f-block elements? Why f-block elements are called inner transition elements?

Answer: - f-block elements are those in which the last electron enters an f-orbital.

- Includes lanthanides and actinides.

- Called inner transition elements because f-orbitals are filled inside (n-1)d orbitals, representing inner shell transitions.