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Class	9th	Chapter	03
Subject	Solved	Board	Punjab

CHAPTER 3: CHEMICAL BONDING

EXERCISE MULTIPLE CHOICE QUESTIONS (MCQs)

(i) Which of the following is an ionic compound? Answer: (c) NaCl

(ii) A covalent bond formed by the mutual sharing of one electron pair is: Answer: (a) Single covalent bond

(iii) Intermolecular forces are: Answer: (d) weaker than intramolecular forces

(iv) The bond angle in water molecule is: Answer: (b) 104.5°

(v) Which molecule contains a triple covalent bond? Answer: (c) N2

(vi) The force of attraction holding oppositely charged ions together is: Answer: (b) Electrostatic force

(vii) Which of the following substances has a crystal lattice structure? Answer: (a) Sodium chloride

(viii) Coordinate covalent bond is represented by: Answer: (c) an arrow pointing from donor to acceptor

(ix) Hydrogen bonding is prominent in: Answer: (b) Water (H2O)

(x) Metals are good conductors of heat and electricity due to: Answer: (d) mobile free electrons

EXERCISE QUESTIONS FOR SHORT ANSWERS

i. Why do atoms form chemical bonds?

Answer: Atoms form chemical bonds to lower their potential energy and achieve stability by attaining a complete valence shell configuration (duplet or octet rule) similar to noble gases.

ii. Explain why a covalent bond can be single, double, or triple.

Answer: A covalent bond can be single, double, or triple depending on the number of electron pairs shared between the combining atoms; one pair forms a single bond, two pairs form a double bond, and three pairs form a triple bond.

iii. Why is H2O a liquid while H2S is a gas?

Answer: Water molecules form strong intermolecular hydrogen bonds due to the high electronegativity and small size of oxygen, whereas hydrogen sulfide does not form significant hydrogen bonds, resulting in lower boiling points and a gaseous state at room temperature.

iv. Which property of metals makes them malleable and ductile?

Answer: The presence of a sea of mobile free electrons surrounding positive metal ions allows metal ions to slide over each other without breaking the crystal lattice when a force is applied.

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v. Is a coordinate covalent bond a stronger bond than a normal covalent bond?

Answer: No, a coordinate covalent bond is generally comparable in strength to a normal single covalent bond, though it is formed by the donation of a complete electron pair from a single atom.

vi. What type of atoms form a metallic bond? Give a comparison with ionic bonds.

Answer: Metallic bonds are formed between metal atoms which have low ionization energies and lose valence electrons easily. In contrast, ionic bonds are formed between atoms with large differences in electronegativity through complete transfer of electrons from metals to non-metals.

vii. Why do ionic compounds have high melting and boiling points?

Answer: Ionic compounds have high melting and boiling points because strong electrostatic forces of attraction hold the oppositely charged ions tightly together in a rigid crystal lattice, requiring a large amount of thermal energy to break.

viii. How does electronegativity difference affect the nature of a chemical bond?

Answer: A very large electronegativity difference between bonded atoms results in an ionic bond due to complete electron transfer, while a small or zero electronegativity difference results in a covalent bond due to electron sharing.

EXERCISE CONSTRUCTED RESPONSE QUESTIONS

i. Draw electron cross and dot structures for N2, O2, and CO2. Answer:

- N2: Two nitrogen atoms share three electron pairs forming a triple covalent bond with a lone pair on each nitrogen.
- O2: Two oxygen atoms share two electron pairs forming a double covalent bond with two lone pairs on each oxygen.
- CO2: A central carbon atom shares two electron pairs with each of the two oxygen atoms, forming two double bonds.

ii. Why do noble gases not form chemical bonds under normal conditions?

Answer: Noble gases do not form chemical bonds because they already possess stable valence electron configurations (a duplet in helium and an octet in other noble gases), possessing minimum energy and maximum stability.

iii. Explain the formation of ammonium ion (NH4+) using a coordinate covalent bond.

Answer: An ammonium ion is formed when a hydrogen ion (proton, H+) with an empty orbital accepts the lone pair of electrons residing on the nitrogen atom of an ammonia molecule (NH3) through a coordinate covalent bond.

iv. Why do covalent compounds generally have low melting and boiling points?

Answer: Covalent compounds consist of neutral molecules held together by weak intermolecular forces, which require very little thermal energy to overcome compared to ionic crystal lattices.

v. How does hydrogen bonding affect the physical properties of substances?

Answer: Hydrogen bonding significantly increases melting points, boiling points, viscosity, and heat of vaporization, and it explains why ice is less dense than liquid water due to an open open-cage crystal structure.

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vi. Explain why solid sodium chloride does not conduct electricity, but molten or aqueous sodium chloride does.

Answer: In solid sodium chloride, ions are locked in a fixed crystal lattice and cannot move. When melted or dissolved in water, the crystal lattice breaks down, freeing the ions to move and carry electric current.

vii. What is the role of delocalized electrons in metallic bonding?

Answer: Delocalized electrons move freely throughout the metal lattice, acting as an electrostatic "glue" that holds the positive metal ions together and facilitating high electrical and thermal conductivity.

viii. Why is the bond angle in H2O (104.5°) less than the tetrahedral angle (109.5°)?

Answer: The bond angle in water is compressed to 104.5° because of stronger repulsion exerted by the two lone pairs of electrons on the central oxygen atom compared to the bond pairs.

EXERCISE DESCRIPTIVE QUESTIONS

i. Define chemical bond and explain the octet and duplet rules.

Answer: A chemical bond is the attractive force that holds atoms or ions together to form chemical substances. The duplet rule states that an atom achieves stability when its valence shell contains 2 electrons (like helium), while the octet rule states that atoms tend to acquire 8 electrons in their valence shell to achieve the stable electronic configuration of noble gases.

ii. Describe ionic bonding in detail with suitable examples.

Answer: Ionic bonding is formed by the complete transfer of one or more electrons from an atom of low ionization energy (metal) to an atom of high electron affinity (non-metal). The resulting oppositely charged ions attract each other via strong electrostatic forces. Example: Sodium (Na) transfers an electron to chlorine (Cl) to form sodium chloride (NaCl).

iii. What is a covalent bond? Discuss its types with examples.

Answer: A covalent bond is formed by the mutual sharing of electron pairs between two atoms. Types include:

- Single covalent bond: Sharing of one electron pair (e.g., H2, Cl2).
- Double covalent bond: Sharing of two electron pairs (e.g., O2, C2H4).
- Triple covalent bond: Sharing of three electron pairs (e.g., N2, C2H2).

iv. What is a coordinate covalent bond? Explain with examples like BF3-NH3 or NH4+.

Answer: A coordinate covalent bond (dative covalent bond) is a type of covalent bond where the shared electron pair is contributed by only one of the participating atoms. Example: In the formation of the ammonium ion (NH4+), ammonia donates its lone pair of nitrogen to a hydrogen ion.

v. Discuss metallic bonding and explain the electron gas model.

Answer: Metallic bonding is the attraction between positive metal ions and surrounding mobile, delocalized valence electrons. According to the electron gas model, valence electrons detach from individual metal atoms and form a shared "sea" or "gas" of electrons flowing freely through the lattice of positive metal ions, providing strength, malleability, and conductivity.

vi. Define intermolecular forces and explain dipole-dipole forces and hydrogen bonding.

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Answer: Intermolecular forces are weak attractive forces acting between neighboring molecules.

- Dipole-dipole forces: Electrostatic attractions between the partial positive end of one polar molecule and the partial negative end of another.
- Hydrogen bonding: A particularly strong type of dipole-dipole attraction occurring when hydrogen is covalently bonded to highly electronegative atoms (N, O, F).

EXERCISE INVESTIGATIVE QUESTIONS

i. Ice floats on water. Explain this phenomenon on the basis of hydrogen bonding and molecular structure.

Answer: As water freezes into ice, hydrogen bonds lock the water molecules into an open, rigid hexagonal crystal lattice structure that takes up more volume than liquid water. This expansion decreases the density of ice compared to liquid water, causing ice to float.

ii. Why do substances with giant covalent structures, such as diamond and silicon dioxide, have extremely high melting points?

Answer: Diamond and silicon dioxide possess continuous three-dimensional networks of strong covalent bonds extending throughout the entire crystal. Melting these substances requires breaking a vast number of strong covalent bonds simultaneously, which demands immense thermal energy.

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