

Exercise

Exercise – Short Questions with Answers

1. Tick (✓) the correct answer.

i. When molten copper and molten zinc are mixed together, they give rise to a new substance called brass. Predict what type of bond is formed between copper and zinc.

- **Answer:** (c) Metallic bond. In brass, both copper and zinc atoms share their delocalized electrons, producing metallic bonding.

ii. Which element is capable of forming all the three types of bonds; covalent, coordinate covalent and ionic?

- **Answer:** (a) Carbon. Carbon forms covalent bonds (in hydrocarbons), coordinate covalent bonds (in CO), and ionic bonds (in metal carbides).

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

- **Answer:** (b) Because water is a polar compound and strong hydrogen bonding exists between its molecules, while H₂S lacks strong hydrogen bonds.

iv. Which of the following bonds is expected to be the weakest?

- **Answer:** (d) F-F. The small size of fluorine atoms causes electron repulsion, weakening the bond.

v. Which form of carbon is used as a lubricant?

- **Answer:** (c) Graphite. Graphite layers can slide over each other easily, making it a good lubricant.

vi. Keeping in view the intermolecular forces of attraction, indicate which compound has the highest boiling point.

- **Answer:** (a) H₂O. Due to strong hydrogen bonding, water has the highest boiling point.

vii. Which metal has the lowest melting point?

- **Answer:** (c) K. Potassium has weaker metallic bonding compared to Li and Na, giving it a lower melting point.

viii. Which ionic compound has the highest melting point?

- **Answer:** (c) LiCl. Because of the small size of Li^+ , it forms strong ionic bonds with Cl^- .

ix. Which compound contains both covalent and ionic bonds?

- **Answer:** (b) NH_4Cl . Ammonium ion (NH_4^+) forms covalent bonds internally, while ionic bonding exists between NH_4^+ and Cl^- .

x. Which among the following has a double covalent bond?

- **Answer:** (c) Ethylene (C_2H_4). Each carbon atom is connected by a double bond.

2. Questions for Short Answers

i. What type of elements lose their outer electrons easily and what type of elements gain electrons easily?

- **Answer:** Metals lose electrons easily due to low electronegativity, while non-metals gain electrons easily due to high electronegativity.

ii. Why do lower molecular mass covalent compounds exist as gases or low boiling liquids?

- **Answer:** Because they have weak intermolecular forces (Van der Waals forces), which require little energy to separate molecules.

iii. Give one example of an element which exists as a crystalline solid and has covalent bonds between its atoms.

- **Answer:** Diamond. It is a crystalline form of carbon with strong covalent bonds between atoms.

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

- **Answer:** The presence of delocalized electrons allows metal ions to slide over each other without breaking bonds, making metals malleable and ductile.

v. Is coordinate covalent bond a strong bond?

- **Answer:** Yes, it is as strong as a normal covalent bond because both electrons are still shared between atoms.

vi. Write down dot and cross formula of HNO_3 .

- **Answer:** In nitric acid (HNO_3), hydrogen is bonded to oxygen, and the nitrogen atom forms covalent and coordinate covalent bonds with oxygen atoms. (Students should draw the Lewis/dot-cross diagram).

3. Constructed Response Questions

i. Why HF is a liquid while HCl is a gas?

- **Answer:** HF has strong hydrogen bonding between its molecules, while HCl lacks hydrogen bonding, so it exists as a gas.

ii. Why are covalent compounds generally not soluble in water?

- **Answer:** Because they are non-polar and water is polar, so they do not interact effectively (like dissolves like principle).

iii. How do metals conduct heat?

- **Answer:** Free-moving delocalized electrons transfer kinetic energy rapidly throughout the metal lattice, allowing efficient heat conduction.

iv. How many oxides does nitrogen form? Write down the formulae of oxides.

- **Answer:** Nitrogen forms several oxides: N_2O , NO , N_2O_3 , NO_2 , N_2O_4 , N_2O_5 .

v. What will happen if NaBr is treated with AgNO_3 in water?

- **Answer:** A white precipitate of AgBr will form due to a double displacement reaction.

vi. Why does iodine exist as a solid while Cl_2 exists as a gas?

- **Answer:** Iodine molecules are larger and have stronger Van der Waals forces, so they exist as solid, while chlorine molecules are lighter and remain as gas.

4. Descriptive Questions

i. Explain the formation of an ionic bond and a covalent bond.

- **Answer:** Ionic bond forms by transfer of electrons from a metal to a non-metal, producing oppositely charged ions (e.g., NaCl). Covalent bond forms by sharing of electron pairs between non-metal atoms (e.g., H_2 , O_2).

ii. How do ions arrange themselves to form NaCl crystal?

- **Answer:** In NaCl , each Na^+ ion is surrounded by six Cl^- ions and each Cl^- ion is surrounded by six Na^+ ions in a cubic lattice arrangement.

iii. Explain the properties of metals keeping in view the nature of metallic bond.

- **Answer:** Metals are malleable, ductile, good conductors of heat and electricity, usually hard and strong, because metallic bonds consist of delocalized electrons moving freely among metal ions.

iv. Compare the properties of ionic and covalent compounds.

- **Answer:** Ionic compounds have high melting and boiling points, are soluble in water, and conduct electricity in molten or solution state. Covalent compounds usually have low melting and boiling points, are poor conductors, and may not dissolve in water.

v. How will you explain the electrical conductivity of graphite crystals?

- **Answer:** In graphite, each carbon atom forms three covalent bonds, leaving one free electron per atom, which is delocalized and moves freely, allowing electrical conductivity.

vi. Why are metals usually hard and heavy?

- **Answer:** Strong metallic bonding and closely packed atoms make metals dense, hard, and heavy.
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5. Investigative Questions

i. The formula of AlCl_3 in vapour phase is Al_2Cl_6 which means it exists as a dimer. Explain the bonding between its two molecules.

- **Answer:** In the vapour (and in the liquid) phase, two AlCl_3 units join to form Al_2Cl_6 because an aluminum atom in AlCl_3 is electron-deficient (it has only six valence electrons). Two chlorine atoms act as bridges between the two aluminum centers: each bridging chlorine donates a lone pair into an empty orbital on an aluminium atom, forming two **coordinate (dative) covalent bonds** ($\text{Cl} \rightarrow \text{Al}$). The result is that each Al attains an octet-like arrangement by sharing electron density from the bridging Cl atoms. The Al_2Cl_6 structure therefore contains four terminal Al–Cl normal covalent bonds (two on each Al) and two Al–Cl (bridge) bonds which have some coordinate character. This dimerisation reduces the electron deficiency and stabilizes the molecules.

ii. Explain the structure of sand (SiO_2).

- **Answer:** Sand is mainly composed of silicon dioxide (SiO_2). In crystalline silica (quartz) and many forms of silica, each silicon atom is covalently bonded to four oxygen atoms arranged at the corners of a tetrahedron (SiO_4 tetrahedron). Each oxygen atom is shared by two silicon atoms (bridging oxygen), so the empirical formula is SiO_2 . The tetrahedra link together to form a **giant three-dimensional covalent network** (a continuous lattice) in which the strong Si–O bonds extend throughout the solid. This network structure explains the high melting point, hardness, chemical inertness (insolubility in water), and low electrical conductivity of silica.