11. How can you distinguish coal from diamond?

Ans. Coal is an amorphous form of carbon(c) whereas diamond is a crystalline form of carbon.

12. What do you know about graphite and its use?

Ans. Graphite consists of a layered structure, made of hexagonal rings of carbon. Since layers are not bonded strongly, they can slip past each other. Graphite is thus used as a lubricant in industry. Further, these layers in graphite have mobile electrons in between them. Graphite is a good conductor of electricity and it is also used as an electrode.

13. Water and hydrogen fluoride both are binary covalent compounds but they differ from other binary covalent compounds, why?

Ans. Binary covalent compounds generally exists as low temperature boiling gases except water. Methane (CH_4), ammonia (NH_3), hydrogen sulphide (H_2S) etc. are all covalent compounds which are gases at room temperature.

Water and hydrogen fluoride, on the other hand, are liquids at room temperature. Liquid water has a high boiling point because strong intermolecular forces are present between its molecules.

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MCQs KEY

1	Ⓑ	2	Ⓑ	3	Ⓓ	4	Ⓒ	5	Ⓑ	6	Ⓒ	7	Ⓑ	8	Ⓐ	9	Ⓓ	10	Ⓑ
11	Ⓒ	12	Ⓓ	13	Ⓐ	14	Ⓑ	15	Ⓑ	16	Ⓒ	17	Ⓑ	18	Ⓒ	19	Ⓒ	20	Ⓒ
21	Ⓑ	22	Ⓑ	23	Ⓑ	24	Ⓑ	25	Ⓒ	26	Ⓑ	27	Ⓒ	28	Ⓒ	29	Ⓓ	30	Ⓑ
31	Ⓒ	32	Ⓓ	33	Ⓓ	34	Ⓒ	35	Ⓐ	36	Ⓒ	37	Ⓓ	38	Ⓑ	39	Ⓒ	40	Ⓑ
41	Ⓒ	42	Ⓓ	33	Ⓒ	44	Ⓑ	45	Ⓒ	46	Ⓑ	47	Ⓑ	48	Ⓑ	49	Ⓒ	50	Ⓒ
51	Ⓑ	52	Ⓑ	53	Ⓑ	54	Ⓑ	55	Ⓒ	56	Ⓒ	57	Ⓑ	58	Ⓒ	59	Ⓒ	60	Ⓑ
61	Ⓒ	62	Ⓒ	63	Ⓒ	64	Ⓑ	65	Ⓒ										

EXERCISE

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.

Ⓐ Coordinate covalent bond Ⓑ Ionic bond

Ⓒ Metallic bond Ⓓ Covalent bond

(ii) **Which element is capable of forming all the three types of bonds; covalent, coordinate covalent or ionic?**

Ⓐ Carbon Ⓑ Oxygen Ⓒ Magnesium Ⓓ Silicon

(iii) **Why is H_2O a liquid while H_2S is a gas?**

Ⓐ Because in water, the atomic size of oxygen is smaller than that of sulphur

Ⓑ Because water is a polar compound and there exists strong forces of attraction between its molecules

Ⓒ Because H_2O molecule is lighter than H_2S

Ⓓ Because water can easily freeze into Ice

(iv) **Which of the following bonds is expected to be the weakest?**

Ⓐ C – C Ⓑ Cl – Cl Ⓒ O – O Ⓓ F – F

(v) **Which form of carbon is used as a lubricant?**

Ⓐ Coal Ⓑ Diamond Ⓒ Graphite Ⓓ Charcoal

(vi) **Keeping in view the intermolecular forces of attraction, indicate which compound has the highest boiling point:**

Ⓐ H_2O Ⓑ H_2S Ⓒ HF Ⓓ NH_3

(vii) **Which metal has the lowest melting point?**

Ⓐ Li Ⓑ Na Ⓒ K Ⓓ Rb

(viii) **Which ionic compound has the highest melting point?**

Ⓐ NaCl Ⓑ KCl Ⓒ LiCl Ⓓ RbCl

(ix) **Which compound contains both covalent and ionic bonds?**

Ⓐ $MgCl_2$ Ⓑ NH_4Cl Ⓒ CaO Ⓓ PCl_3

(x) **Which among the following has a double covalent bond?**

Ⓐ Ethane Ⓑ Methane Ⓒ Ethylene Ⓓ Acetylene

MCQs KEY

i	Ⓒ	ii	Ⓐ	iii	Ⓑ	iv	Ⓓ	v	Ⓒ	vi	Ⓐ	vii	Ⓓ	viii	Ⓒ	ix	Ⓑ	x	Ⓒ

2. Questions for Short Answers

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

Ans. 1. Metals lose electrons easily as they have low ionization energy.

2. Non-metals gain electrons easily due to their high electronegativity.

ii. Why does lower molecular mass covalent compound exist as gases or low boiling liquids.

Ans. Covalent compounds with low molecular mass have weak intermolecular forces (like vander waals forces), resulting in low boiling points and their existence, as gases or liquids, at room temperature.

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

Ans. Diamond (Carbon) is an example of a crystalline solid with covalent bonds in its atom.

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

Ans. The metallic bonding in metals, where electrons are delocalized, allows atoms to slide over each other, making metals malleable and ductile.

v. Is coordinate covalent bond a strong bond?

Ans. Yes, a coordinate covalent bond is a strong bond, similar in strength to a covalent bond.

vi. Write down dot and cross formula of HNO_3.

Ans. In the Lewis structure, HNO_3 consists of a hydrogen atom bonded to one oxygen, while the nitrogen atom is bonded to two oxygens (one with a double bond and another with a coordinate bond.

3. Constructed Response Questions

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

Ans. HF is a liquid because it has a strong hydrogen bonding due to high electronegativity of Flurine, which keeps HF molecules closely associated. On the other hand, HCl has weaker Vander Walls forces and no hydrogen bonding, so it exists as a gas.

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

Ans. Covalent compounds are non-polar or weakly polar, while water is a polar solvent. Due to this, they do not dissolve in water because "like dissolves like" principle does not apply.

iii. How do metals conduct heat?

Ans. Metals conduct heat due to the movement of free electrons in the metallic lattice, which transfer energy efficiently across the structure.

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

Ans. Nitrous forms five oxides:

1. Nitrous oxide (N_2O)
2. Nitric oxide (NO)
3. Dinitrogen trioxide (N_2O_3)
4. Nitrogen dioxide (NO_2)
5. Dinitrogen pentaoxide (N_2O_5)

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

Ans. $AgNO_3$ reacts with NaBr to form a white precipitate of AgBr:

$$AgNO_3 + NaBr \longrightarrow AgBr + NaNO_3$$

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

Ans. Iodine molecules have stronger Vander Waals forces due to their larger size and higher molecular mass, which holds the molecules together as a solid. Chlorine (Cl_2) being smaller, has weaker forces, so it exists as a gas.

4. Descriptive Questions

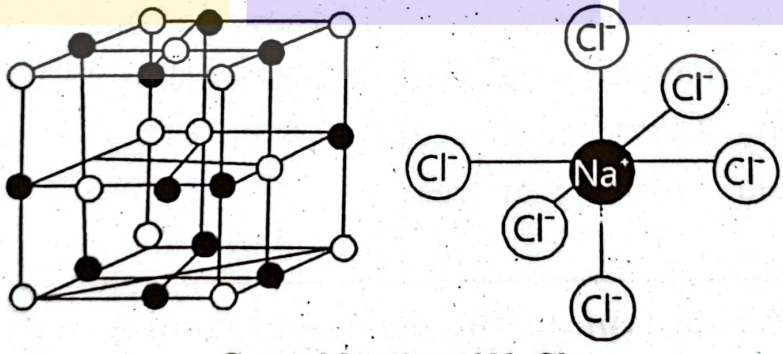
i. Explain the formation of an ionic bond and a covalent bond.

Ans. **Ionic Bond:** Ionic bond is formed when one atom transfers electrons to another atom, creating positive and negative ions. The electrostatic force between these ions forms the bond e.g. NaCl.

Covalent Bond: Covalent bond is formed when two atoms share electrons to achieve stability e.g H_2, Cl_2 etc.

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

Ans. In NaCl, the ions arrange themselves in a cubic lattice structure where each Na^+ ion is surrounded by six Cl^- (Chloride) ions and vice versa. This arrangement maximizes the electrostatic attractions and minimizes repulsions.



Crystal Lattice of NaCl

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

Ans. Metals have metallic bonding, where electrons are delocalized and free to move. This gives metals their properties:

Conductivity: Force electrons allow the conduction of heat and electricity.

Malleability and ductility: Atoms can slide past each other with breaking bonds.

Luster: Delocalized electrons reflect light.

High melting and boiling points: Strong metallic bonds hold the lattice together.

iv. Compare the properties of ionic and covalent compounds.

Ans. Ionic Compounds	Covalent Compounds
1. In ionic compounds oppositely charged ions are properly arranged to give a crystalline structure. As a whole the compound is neutral. There exists a strong electrostatic force between their ions.	1. Covalent compounds mostly exists as discrete neutral molecules. There exists a strong electrostatic attraction between the two nuclei and the shared electrons.
2. Ionic compounds are usually solids having high melting and boiling points.	2. High molecular mass covalent compounds exists as solids. Generally, they have lower melting and boiling points.
3. Ionic compounds are generally soluble in polar solvent like water.	3. They are usually insoluble in water but soluble in non-polar solvents like ether benzene and acetone.
4. They are usually good conductor of electricity in molten state or in solution form. Their conductance is due to the presence of free ions.	4. They are usually bad conductor of electricity.

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

Ans. Graphite conducts electricity because it has localized electrons in its structure. In graphite, each carbon atom is covalently bonded to three other carbon atoms in hexagonal layers, leaving one electron per carbon atom free to move. Therefore electrons act as charge carriers, allowing graphite to conduct electricity along the layers.

vi. Why are metals usually hard and heavy?

Ans. Metals are usually hard and heavy due to their metallic bonding. In metallic structures:

Strong forces of attraction exist between positively charged metal ions and delocalized electrons, which makes metals hard.

Metals have a dense atomic packing structure, where atoms are closely packed together, increasing their density and making them heavy.

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?

Ans. In the vapour phase, $AlCl_3$ exists as a dimer Al_2Cl_6 to achieve stability:

1. Each aluminium atom in $AlCl_3$ is electron deficient and accepts a lone pair of electrons from a chlorine atom of another $AlCl_3$ molecule.
2. This results in the formation of coordinate covalent bonds (bridging bonds) between the two molecules, creating Al_2Cl_6 dimer structure.
3. The bridging chlorine atoms share electrons between two aluminium atoms, stabilizing the molecule.

ii. Explain the structure of sand (SiO_2).

Ans. Sand primarily consists of silicon dioxide (SiO_2), which has a giant covalent structure:

1. Each silicon (Si) atom is covalently bonded to four Oxygen (O) atoms in a tetrahedral arrangement.
2. Each oxygen atom is shared between two silicon atoms, forming a 3D network of strong Si – O bonds.
3. This structure gives SiO_2 its hardness, high melting point and insolubility in water.

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