Q.1 What are the physical properties of metals and non-metals?

Metals are generally malleable, ductile, lustrous, and good conductors of heat and electricity. They are solid at room temperature (except mercury), have high melting and boiling points, and are sonorous. Non-metals, on the other hand, are brittle, non-lustrous (except iodine), and poor conductors of heat and electricity (except graphite). They exist in solid, liquid, or gaseous states and have low melting and boiling points. These contrasting properties help in distinguishing metals from non-metals and determine their applications in various fields such as construction, wiring, and gas production.

Q.2 What are metal oxides? Describe their nature.

Metal oxides are compounds formed when metals react with oxygen. They are generally basic in nature and react with acids to form salt and water. For example, magnesium reacts with oxygen to form magnesium oxide (MgO), which is basic. Some metal oxides like aluminum oxide (Al_2O_3) and zinc oxide (ZnO) are amphoteric, meaning they can react with both acids and bases. Metal oxides are usually solid, have high melting points, and are used in industries like ceramics and construction due to their stability and resistance to corrosion.

Q.3 What are ionic bonds? Mention their properties.

Ionic bonds are formed when one atom donates electrons to another atom, creating oppositely charged ions that attract each other. Typically, this occurs between metals (which lose electrons) and non-metals (which gain electrons). For example, in sodium chloride (NaCl), sodium donates one electron to chlorine. Properties of ionic compounds include high melting and boiling points, solubility in water, and the ability to conduct electricity in molten or aqueous states. Ionic compounds form crystalline solids and are generally brittle. They are used in electrolysis, food, and chemical industries.

Q.4 How is an ionic bond formed? Explain with an example.

An ionic bond is formed when a metal transfers electrons to a non-metal, creating a positive and a negative ion. For example, sodium (Na) has one electron in its outer shell and chlorine (Cl) has seven. Sodium donates its electron to chlorine, forming Na^+ and Cl^- ions. These oppositely charged ions attract each other, resulting in the formation of NaCl. This type of bonding usually occurs between elements with large differences in electronegativity. The resulting ionic compound is stable, with a regular lattice structure.

Q.5 What is a covalent bond and how is it formed?

A covalent bond is formed when two non-metal atoms share one or more pairs of electrons to attain a stable electronic configuration. For example, in a hydrogen molecule (H_2), each hydrogen atom has one electron and they share a pair to complete their duplet. Covalent bonds can be single, double, or triple based on the number of shared electron pairs. These bonds lead to the formation of molecules that are generally poor conductors of electricity, have low melting and boiling points, and exist in gaseous or liquid states at room temperature.

Q.6 Differentiate between polar covalent and non-polar covalent bonds.

In polar covalent bonds, the shared electrons are unequally distributed due to a difference in electronegativity between the atoms. This creates a partial positive and partial negative charge, like in HCl. In non-polar covalent bonds, the electrons are equally shared between atoms of the same element or elements with similar electronegativity, like in Cl_2 or O_2. Polar bonds are usually more reactive and soluble in water, while non-polar compounds are insoluble in water but soluble in organic solvents. The polarity affects the physical and chemical properties of the compounds.

Q.7 Explain the occurrence of metals and non-metals in nature.

Metals and non-metals occur naturally, often in combined forms. Metals are generally found in the earth's crust as ores (combined with oxygen, sulphur, or other elements). Highly unreactive metals like gold and platinum occur in free (native) states. Non-metals, such as oxygen and nitrogen, are found in free states in the atmosphere, while others like sulphur and phosphorus occur in combined forms in minerals. The method of extraction or isolation depends on the reactivity of the element. Natural occurrences determine the availability and industrial value of elements.

Q.8 What are minerals, ores, and gangue?

Minerals are naturally occurring inorganic substances found in the earth's crust. Ores are minerals from which metals can be extracted profitably. Gangue refers to the unwanted impurities such as sand, clay, or rocks that are present with the ore. For example, bauxite is an ore of aluminum, and the impurities present in it are gangue. The process of metallurgy involves removing the gangue and extracting the metal from its ore. Understanding these terms is crucial for studying the processes involved in metal extraction.

Q.9 What are the major steps involved in metallurgy?

Metallurgy involves several steps:

1. Concentration – Removal of gangue from the ore using physical or chemical methods.

2. Calcination or Roasting – Heating the ore in absence or presence of air to convert it into metal oxide.

3. Reduction – Conversion of metal oxide to metal using reducing agents like carbon or through electrolysis.

4. Refining – Purification of the extracted metal using methods like electrolytic refining.
 These steps vary depending on the nature and reactivity of the metal, and each is essential to obtain pure metal from its ore.

Q.10 How are metals of low, medium, and high reactivity extracted?

- Low-reactivity metals (e.g., gold, silver) are extracted by physical methods as they occur in native form.

- Medium-reactivity metals (e.g., iron, zinc) are extracted by reducing metal oxides with carbon or carbon monoxide.

- High-reactivity metals (e.g., sodium, potassium, aluminum) are extracted by electrolysis of their molten salts, as they are too reactive to be reduced by carbon.
 The method of extraction depends on the position of the metal in the reactivity series. This classification ensures cost-effective and efficient extraction of metals.