Lab: Recognising ionic, molecular covalent, metallic and network structures

Introduction:

Solid crystals consist of a regular array of particles located at the lattice points in a three-dimensional lattice work. A compound is defined as the chemical combination of two or more elements. A chemical bond is the "glue" that holds atoms of different elements together. Bonds can be classified into two general types: ionic and covalent.

The units which occupy the lattice points in an ionic crystal are alternately spaced positive and negative ions. The force of attraction between the oppositely charged ions constitutes an ionic bond.

Some substances are composed of molecules rather than ions. Molecules are neutral species composed of atoms which are held together by covalent bonds. Covalent bonds are the result of an attraction between the positive nuclei of two atoms and the negative electrons shared by the two atoms.

When molecules of gases condense, they form molecular liquids and molecular crystals. In these crystals molecules occupy the lattice points. The force of attraction which hold molecules together in a molecular crystal are called Van der Waals forces. The molecules in a molecular crystal are composed of atoms which are held together by covalent bonds.

Metals make up the majority of the elements in the periodic table, and they constitute the third type of solid aggregate. Metallic properties such as electrical conductivity both in the solid state and liquid phase are a direct result of the "metallic bond". The lattice points of these crystals are occupied by positive metallic ions surrounded by a "sea" or "gas" of delocalised, mobile electrons. The force of attraction between the positive metal ions and the surrounding "sea" of electrons constitutes the metallic bond.

Network crystals such as asbestos, graphite and diamond consist of one, two, or three-dimensional network of atoms located at the lattice points and joined by covalent bonds. The 3-dimensional crystals have very high melting points, are extremely hard and do not conduct electricity in either solid or liquid state.

Properties such as melting point, boiling point, solubility, electrical conductivity and colour are some properties that can be used to distinguish between different aggregates. In this experiment you have to allocate a structure to each of the four unknown substances provided.

PreLab Assignment:

1. Explain the terms a) ionic bonding b)covalent bonding c)metallic bonding d) network
   Illustrate your answer by reference to chlorine, magnesium, magnesium chloride and carbon.
2. How is "melting time" related to the melting point of substances.
3. How can the electrical conductivity of a solution be tested?
4. Predict the following:
   a) solubility of sodium iodide in water
   b) melting time of sodium iodide
   c) electrical conductivity of a glucose solution
   d) solubility of benzoic acid, C_6H_5COOH in I) water and II) methanol
5. Predict how the melting point and solubility of magnesium oxide will compare with that of zinc sulphide.

Objective:

Devise a plan to distinguish the four labelled substances given to you, which contains either an ionic, molecular covalent, metallic or a network solid.

Planning:

Design a procedure using appropriate apparatus and materials.

Your procedure must take into account of suitable quantities, concentrations and safety concerns. You must write your procedures in your lab book and obtain my approval before starting the experiment. I will prohibit any procedure I deem dangerous.

Time will be saved if you show me your procedure *before* you come to the lab.

Your procedure must allow you to collect sufficient relevant data to determine the nature of each type of solid in the four provided to you.

Design a suitable data table to include all your observations.

Planning, Data Collection and Data Analysis should be important aspects of your report.