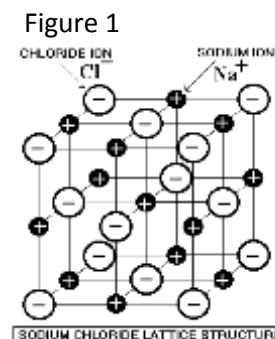


## Comparing the Physical Properties of Ionic and Molecular Solids

### Introduction:

The atoms in solids are held together a number of different ways. Some solids, called molecular solids, consist of atoms held together by covalent bonds. Ionic solids consist of alternating arrangements of positive and negative ions in three dimensional space. The crystal structure of an ionic solid is such that each positive ion is surrounded by a collection of negative ions and vice versa. The forces holding the ionic crystal together result from the electrostatic attraction of oppositely charged ions, forming the lattice structure. (Figure 1)

The physical properties that you will explore are *conductivity* (ability to conduct electricity), *hardness* (resistance to being scratched), *solubility* (ability to dissolve in water), *melting point* (the temperature that a substance changes from a solid to a liquid) and *boiling point* (the temperature that a substance changes from a liquid to a gas).



### Question:

How do ionic and molecular solids compare on the basis of hardness, solubility, conductivity, melting point and boiling point?

### Materials:

- Eye protection
- Potassium iodide, KI(s)
- Sodium chloride, NaCl(s)
- Sucrose, C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>(s)
- Ascorbic Acid, C<sub>6</sub>H<sub>8</sub>O<sub>6</sub>(s)
- Distilled water
- Paper towel
- Scoop
- 4 small test tubes
- Test tube rack
- Low-voltage conductivity apparatus
- Electronic resources

### Procedure:

- Copy Table 1 into your note book.
- Hardness:** Put samples of each solid about the size of a match head on a piece of paper towel. Use the scoop to crush some of the crystals of each solid. Rank the relative hardness of each sample. Record the rankings in the observations table. (1 is the most hard and 4 is the least hard)
- Melting Point and Boiling Point:** Using electronic resources, list the melting points and boiling points for each solid in the observations table.
- Solubility:** Test the solubility of the solids in water by adding a few crystals of each solid to 2 mL - 3 mL of water in the small test tube. Cover the top and shake. Record the rankings in the observations table. Save the solutions for part 5.
- Electrical Conductivity:** Using the solutions from part 4, test for conductivity using the low-voltage conductivity apparatus.

### Observations:

**Table 1: Physical Properties of Different Compounds**

Compound	Hardness Ranking	Melting Point (°C)	Boiling Point (°C)	Solubility	Electrical Conductivity	Type of Compound (Ionic or Covalent?)

**Analysis:**

1. Explain how the relative hardness of solids can be related to the strength of the forces of attraction between the particles of a solid.
2. Explain how the magnitude of the melting and boiling temperatures can be related to the strength of the forces of attraction between the particles of a solid.
3. Explain how solubility in water can be used (or not used) to identify whether a compound is ionic or molecular.
4. Explain how electrical conductivity in water can be used to identify whether a compound is ionic or molecular.

**Conclusions:**

1. Briefly summarize the physical properties studied in this experiment for ionic and molecular compounds.