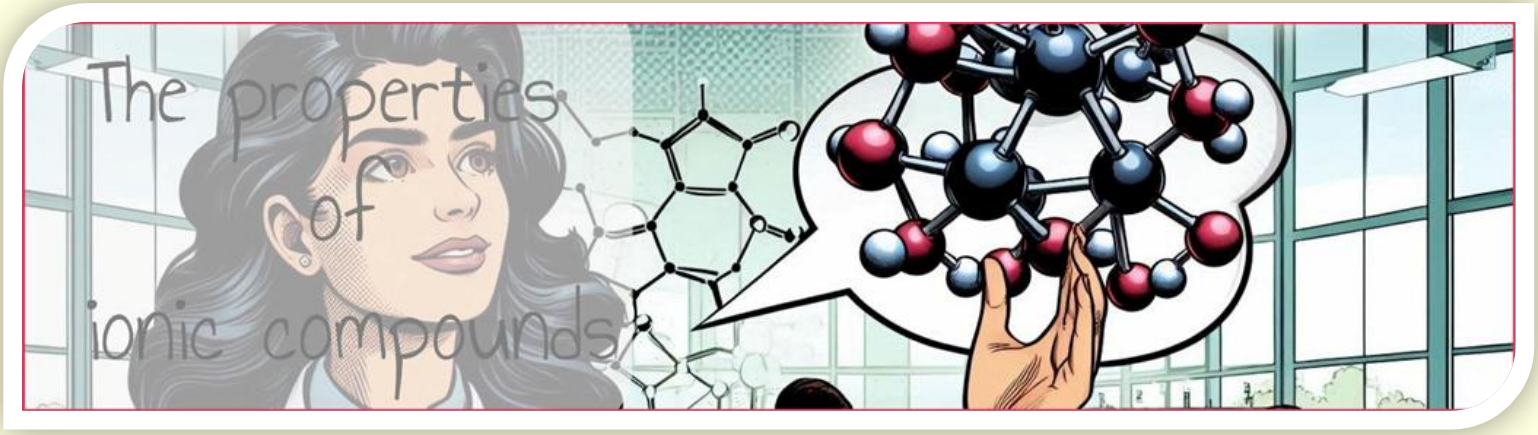
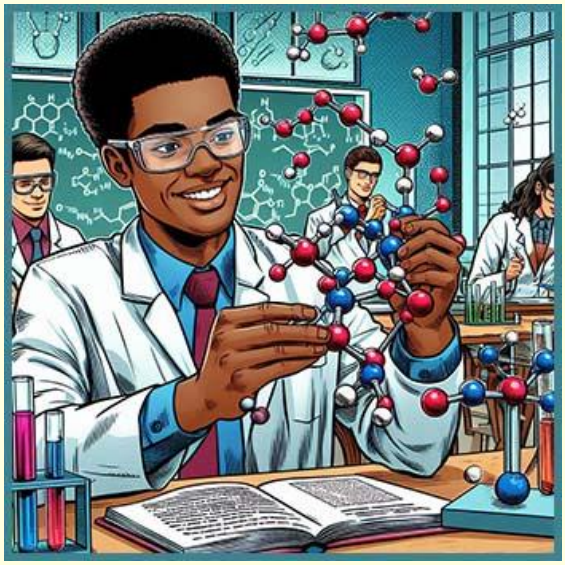


Answer the questions below then check your answers.

1. Define an ionic bond.
2. What type of structure do ionic compounds typically form?
3. What is an electrolyte?
4. Why do ionic compounds have high melting and boiling points?
5. Why are ionic compounds brittle?
6. Explain why ionic compounds conduct electricity when molten but not when solid.
7. Describe the migration of ions in an electrolytic cell using copper chromate as an example.
8. What are ion-dipole forces and how do they affect solubility?
9. Compare and contrast the properties of ionic compounds with covalent compounds.



10. Describe the structure of sodium chloride and explain how this structure relates to its properties.

11. Explain the process of dissolving the purple solid potassium permanganate ($KMnO_4$) in water and the subsequent ion migration in an electric field.

12. Describe the brittleness of ionic compounds in terms of lattice structure and applied stress.

13. Discuss the factors that affect the melting and boiling points of ionic compounds, with specific examples.

14. Discuss the solubility trends of ionic compounds in polar and non-polar solvents, providing examples.

Answers

1. Define an ionic bond.

   Answer: An ionic bond is the electrostatic force of attraction between positively charged cations and negatively charged anions.

2. What type of structure do ionic compounds typically form?

   Answer: Ionic compounds typically form a giant ionic lattice structure.

3. What is an electrolyte?

   Answer: An electrolyte is a substance that produces ions when dissolved in water and conducts electricity.

4. Why do ionic compounds have high melting and boiling points?

   Answer: Ionic compounds have high melting and boiling points because of the strong electrostatic forces of attraction between the ions, which require a lot of energy to break.

5. Why are ionic compounds brittle?

   Answer: Ionic compounds are brittle because when the lattice structure is disrupted, like-charged ions are forced next to each other, resulting in repulsion and the shattering of the lattice.

6. Explain why ionic compounds conduct electricity when molten but not when solid.

   Answer: Ionic compounds conduct electricity when molten because the ions are free to move and carry charge. In solid form, the ions are fixed in place within the lattice and cannot move.

7. Describe the migration of ions in an electrolytic cell using copper chromate as an example.

Answer: In an electrolytic cell with copper chromate, the blue Cu^{2+} ions migrate towards the cathode (negative electrode), while the yellow CrO_4^{2-} ions migrate towards the anode (positive electrode).

8. What are ion-dipole forces and how do they affect solubility?

   Answer: Ion-dipole forces are the attractions between an ion and the partial charges on a polar molecule, such as water. These forces help dissolve ionic compounds as the ions interact with the solvent molecules.

9. Compare and contrast the properties of ionic compounds with covalent compounds.

   Answer: Ionic compounds have high melting and boiling points, are usually soluble in water, conduct electricity when molten or dissolved, and are brittle. Covalent compounds generally have lower melting and boiling points, may be soluble in non-polar solvents, do not conduct electricity, and are not brittle.

10. Describe the structure of sodium chloride and explain how this structure relates to its properties.

    Answer: Sodium chloride has a giant ionic lattice structure where each Na^+ ion is surrounded by six Cl^- ions and vice versa. This structure results in strong electrostatic forces that give NaCl its high melting and boiling points, solubility in water, and electrical conductivity when molten or dissolved.

11. Explain the process of dissolving the purple solid potassium permanganate ($KMnO_4$) in water and the subsequent ion migration in an electric field.

Answer: When potassium permanganate dissolves in water, it dissociates into K^+ and MnO_4^- ions. In an electric field, K^+ ions migrate towards the cathode (negative electrode) and MnO_4^- ions migrate towards the anode (positive electrode), demonstrating the movement of ions within the solution. Or in terms of colour and reactions we have:

1. The MnO_4^- ions (permanganate ions) migrate towards the anode.
2. At the anode, these MnO_4^- ions are oxidised, leading to the formation of MnO_2 (manganese dioxide), which is a brown or black solid.
3. Thus, the colour change at the anode would involve the purple colour of the permanganate ions (MnO_4^-) diminishing and the appearance of brown or black MnO_2.
4. At the Cathode (Negative Electrode):
5. The K^+ ions (potassium ions) migrate towards the cathode.
6. At the cathode, typically, water is reduced to form hydrogen gas (H_2) and hydroxide ions (OH^-).
7. However, since the solution is already purple due to MnO_4^-, the reduction of water at the cathode doesn't produce a significant colour change.
8. Thus, there might be little to no observable colour change at the cathode if the primary reaction is the reduction of water, but there may be effervescence due to hydrogen gas formation.

12. Describe the brittleness of ionic compounds in terms of lattice structure and applied stress.

Answer: Ionic compounds are brittle because their lattice structure is composed of alternating positive and negative ions. When stress is applied, ions of the same charge can be forced adjacent to each other, resulting in strong repulsive forces that cause the lattice to shatter along cleavage planes.

13. Discuss the factors that affect the melting and boiling points of ionic compounds, with specific examples.

    Answer: The melting and boiling points of ionic compounds are affected by the charge and size of the ions. Higher charges result in stronger electrostatic attractions, raising the melting and boiling points. Smaller ions also lead to stronger attractions due to closer ion proximity. For example, MgO has higher melting and boiling points than NaCl due to the +2 and -2 charges in MgO compared to the +1 and -1 charges in NaCl.

14. Analyse the solubility trends of ionic compounds in polar and non-polar solvents, providing examples.

    Answer: Ionic compounds are generally soluble in polar solvents like water because of the ion-dipole interactions that stabilize the ions in solution. For example, NaCl is soluble in water but insoluble in non-polar solvents like hexane because non-polar solvents cannot sufficiently stabilize the ions. Conversely, non-polar covalent compounds dissolve better in non-polar solvents due to similar intermolecular forces.