Exploring Colligative Properties: Understanding the Behaviour of Solutions

Student Name: _____

Class: _____

Due Date: _____

Introduction

Colligative properties are a fundamental concept in chemistry that deals with the behaviour of solutions. This worksheet is designed for students of classes 9 to 12, following the NCERT curriculum, to provide a comprehensive understanding of the key concepts, including elevation in boiling point, depression in freezing point, relative lowering in vapour pressure, and osmotic pressure.

Section 1: Multiple Choice Questions

1. What is the definition of colligative properties?

1. a) Properties of a solution that depend on the concentration of the solute
2. b) Properties of a solution that depend on the temperature of the solution
3. c) Properties of a solution that depend on the pressure of the solution
4. d) Properties of a solution that depend on the volume of the solution

Answer: a) Properties of a solution that depend on the concentration of the solute

2. Which of the following is an example of a colligative property?

1. a) Elevation in boiling point
2. b) Depression in freezing point
3. c) Relative lowering in vapour pressure
4. d) All of the above

Answer: d) All of the above

Section 2: Short Answer Questions

1. Explain the concept of elevation in boiling point. Give an example of how it is used in industry.

Answer: Elevation in boiling point is the increase in boiling point of a solution compared to the boiling point of the pure solvent. This occurs because the presence of a non-volatile solute reduces the vapour pressure of the solvent, making it more difficult for the solvent to boil. For example, the boiling point of a solution of sugar in water is higher than the boiling point of pure water, which is used in the production of sugar syrup.

2. Describe the concept of depression in freezing point. Give an example of how it is used in industry.

Answer: Depression in freezing point is the decrease in freezing point of a solution compared to the freezing point of the pure solvent. This occurs because the presence of a non-volatile solute disrupts the formation of a crystal lattice structure, making it more difficult for the solvent to freeze. For example, the freezing point of a solution of salt in water is lower than the freezing point of pure water, which is used in the production of ice cream.

Section 3: Long Answer Questions

1. Explain the concept of relative lowering in vapour pressure. Give an example of how it is used in industry.

Answer: Relative lowering in vapour pressure is the decrease in vapour pressure of a solution compared to the vapour pressure of the pure solvent. This occurs because the presence of a non-volatile solute reduces the number of solvent molecules available for evaporation. For example, the vapour pressure of a solution of perfume in water is lower than the vapour pressure of pure water, which is used in the production of perfumes.

2. Describe the concept of osmotic pressure. Give an example of how it is used in industry.

Answer: Osmotic pressure is the pressure exerted by a solution to prevent the flow of solvent molecules into the solution through a semipermeable membrane. This occurs because the presence of a non-volatile solute creates a concentration gradient across the membrane, causing water to flow into the solution. For example, osmotic pressure is used in dialysis to remove waste products from the blood.

Section 4: Activities

1. Design an experiment to demonstrate the elevation in boiling point of a solution.

2. Research and present on the applications of colligative properties in industry.

3. Create a diagram to illustrate the concept of relative lowering in vapour pressure.

Section 5: Case Study

Read the following case study and answer the questions that follow:

A company produces a sugar syrup by dissolving sugar in water. The boiling point of the syrup is higher than the boiling point of pure water. Explain why this occurs and how it is used in industry.

Questions:

1. What is the reason for the elevation in boiling point of the sugar syrup?
2. How is the elevation in boiling point used in industry?

Answer:

1. The elevation in boiling point occurs because the presence of sugar reduces the vapour pressure of the water, making it more difficult for the water to boil.
2. The elevation in boiling point is used in industry to produce sugar syrup, which is used in the production of sweets and other food products.

Conclusion

In conclusion, colligative properties are a fundamental concept in chemistry that deals with the behaviour of solutions. This worksheet has provided a comprehensive understanding of the key concepts, including elevation in boiling point, depression in freezing point, relative lowering in vapour pressure, and osmotic pressure. The activities and case study have provided opportunities for students to apply their knowledge and skills to real-world scenarios.