What are Colligative Properties?

Worksheet

Colligative properties depend only on the concentration of solute particles (typically expressed in molality), not on what the particles are. Examples include freezing point depression (Tf = Kf m) and boiling point elevation (Tb = Kb m).

Questions

1. Colligative properties depend on

A) molecular identity of solute
B) number of solute particles
C) molar mass of solute
D) temperature only

2. Why does salt lower the freezing point of water?

A) It makes water colder
B) It disrupts hydrogen bonding, lowering the freezing point
C) Salt particles absorb heat
D) It increases density

3. Osmotic pressure formula?

A) = M R T
B) = i M R T
C) = Kb m
D) = K V

4. 0.1 m NaCl vs 0.1 m glucose: which has greater freezing point depression?

A) Glucose
B) NaCl
C) Equal
D) Cannot determine

5. A 0.1 m NaCl solution has Kf(water) = 1.86 Kkg/mol. Calculate freezing point depression.

6. Calculate boiling point elevation for 0.5 m glucose (non-electrolyte). Kb(water) = 0.51 Kkg/mol.

7. Why does salt melt ice even though it lowers the freezing point?

8. Define: Define colligative properties.

9. Define: What are the four colligative properties?

10. Define: Freezing point depression formula?

Answer Key

1. B) number of solute particles - They depend on concentration and particle count, not what the particles are.

2. B) It disrupts hydrogen bonding, lowering the freezing point - Solute particles interfere with solvent structure, requiring lower temperature to form a solid.

3. B) = i M R T - Osmotic pressure depends on solute concentration (M), ideal gas constant (R), temperature (T), and van 't Hoff factor (i).

4. B) NaCl - NaCl ionizes (i 2), so Tf = 2 Kf 0.1; glucose (i = 1), so Tf = Kf 0.1. NaCl has twice the effect.

5. NaCl 2 ions, so i = 2 (van 't Hoff factor) Tf = i Kf m = 2 1.86 0.1 = 0.372 K Freezing point = 0C 0.372C 0.37C

6. Glucose doesn't ionize, so i = 1 Tb = i Kb m = 1 0.51 0.5 = 0.255 K Boiling point = 100C + 0.255C 100.26C

7. Salt dissolves on ice surface freezing point lowers Ice (solid) is now above its new freezing point melts This effect is used for de-icing roads in winter.

8. Properties that depend only on the number of solute particles, not their identity or mass.

9. Freezing point depression, boiling point elevation, vapor pressure lowering, osmotic pressure.

10. Tf = i Kf m, where i = van 't Hoff factor, Kf = freezing point depression constant, m = molality.