

Colligative Properties



Colligative Properties

- _____ – physical properties of solutions that are affected only by the number of particles NOT the identity of the solute
- They include:
 1. _____
 2. _____
 3. _____
 4. _____
- In all of these we will be comparing a pure substance to a mixture

Vapor Pressure Lowering

- _____ – the pressure exerted in a closed container by liquid particles that have escaped to the surface and entered the gas phase



Vapor Pressure Lowering

- The vapor pressure of a mixture is lower than a non volatile pure substance due to the fewer number of particles that are able to escape into the gas phase



Boiling Point Elevation

- The boiling point of a solution is the point at which enough energy has been added to overcome the intermolecular forces that hold the solute in the solution.

Boiling Point Elevation

- The boiling point of a mixture is higher than the boiling point of a pure substance
- The difference in boiling points can be calculated by the equation:
- $\Delta T_b = K_b m i$

Boiling Point Elevation

- $\Delta T_b = K_b m i$ (ion factor)
- ΔT_b = change in boiling point
 - (boiling point elevation)
- K_b = Boiling point elevation constant
 - (will always get from chart)
- m = molality
- i = ion factor = number of particles that the molecule breaks into

K_b

- K_b will always be given to you in the chart along with the solution's boiling point

TABLE 13.4 Molal Boiling-Point-Elevation and Freezing-Point-Depression Constants

Solvent	Normal Boiling Point (°C)	K_b (°C/m)	Normal Freezing Point (°C)	K_f (°C/m)
Water, H ₂ O	100.0	0.52	0.0	1.86
Benzene, C ₆ H ₆	80.1	2.53	5.5	5.12
Ethanol, C ₂ H ₅ OH	78.4	1.22	-114.6	1.99
Carbon tetrachloride, CCl ₄	76.8	5.02	-22.3	29.8
Chloroform, CHCl ₃	61.2	3.63	-63.5	4.68

molality (m)

- _____ = moles solute / kg solvent
- Example:
- What is the molality of a solution with 4.5 g of NaCl dissolved in 100.0 g of H₂O?

Ion Factor (n)

- See if the compound is ionic or molecular.
- If it is molecular (all non metals) the ion factor will be _____
- If the substance is ionic, the ion factor will be equal to the number of _____ that make up the compound

Ion Factor (n)

- For example
- What will be the ion factor in the following compounds
- C₆H₁₂O₆
- NaCl
- CaCl₂
- Na₃PO₄

Freezing Point Depression

- The _____ of a solution is the point where enough energy has been removed from the solution to slow the molecules down and increase intermolecular forces so the solution becomes a solid

Freezing Point Depression

- The freezing point of a mixture is lower than the freezing point of a pure substance
- The difference in freezing points can be calculated by the equation:
- $\Delta T_f = K_f m i$

Freezing Point Depression

- $\Delta T_f = K_f m$ (ion factor)
- ΔT_f = change in freezing point
 - (freezing point depression)
- K_f = Freezing point depression constant
 - (will always get from chart)
- m = molality
- i = ion factor = number of particles that the molecule breaks into

K_f

- K_f will always be given to you in the chart along with the solution's freezing point

Calculations with BPE & FPD

- What are the boiling points and freezing points of a 0.029 m aqueous solution of NaCl?

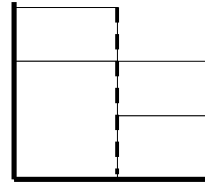
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BP & FP

- What are the boiling point & freezing point of a 0.050 m solution of a non-electrolyte in ethanol?

What is Osmosis?



- Suppose a salt solution and water are separated by a semipermeable membrane
- Water will move through the membrane from into the salt solution to equalize the concentrations on each side of the membrane.
- This is osmosis

Osmotic Pressure

- Osmotic pressure is the pressure exerted on the semi permeable membrane by the movement of the water

