

Chemistry - Solutions and Concentration

Colligative Properties

Physical properties of a solution that is affected by the number of particles, not the type of particle

Examples: vapor pressure lowering, boiling point elevation, freezing point depression, osmotic pressure

Electrolytes and Nonelectrolytes

Electrolytes are substances that ionize and allow an electrical current to pass through the solution



Nonelectrolytes simply dissolve

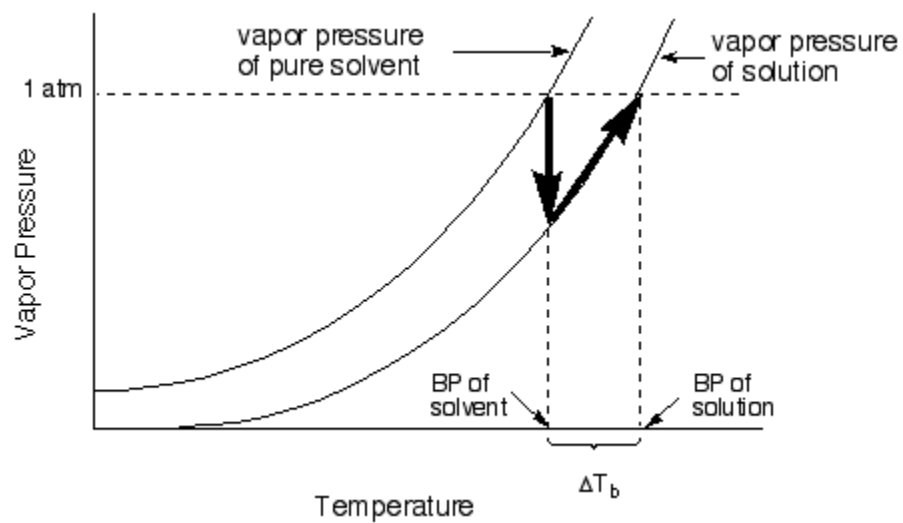


Vapor Pressure

Decrease in vapor pressure due to particles within the solution

Boiling Point Elevation

$$\Delta T_b = K_b m$$



Molal Boiling Point Constants (K_b)		
Solvent	Boiling Point ($^{\circ}\text{C}$)	K_b ($^{\circ}\text{C}/\text{m}$)
Water	100.0	0.512
Benzene	80.1	2.53
Carbon Tetrachloride	76.7	5.03
Ethanol	78.5	1.22
Chloroform	61.7	3.63

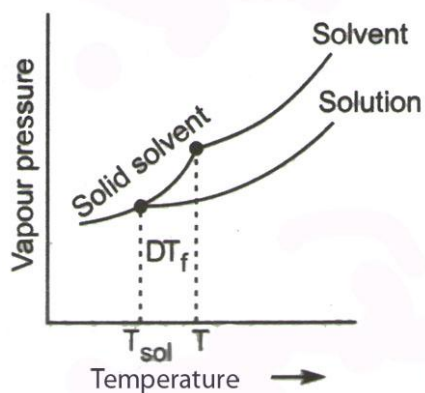
$$\Delta T_b = K_b m$$

Example: What would be the boiling point of a 0.625 m aqueous solution of a nonvolatile nonelectrolyte?

Example: Calculate the change in boiling point were 144 g of sucrose ($\text{C}_6\text{H}_{12}\text{O}_6$) was added to 2.00 kg of water.

Freezing Point Depression

$$\Delta T_f = K_f m$$



Molal Freezing Point Constants (K_f)

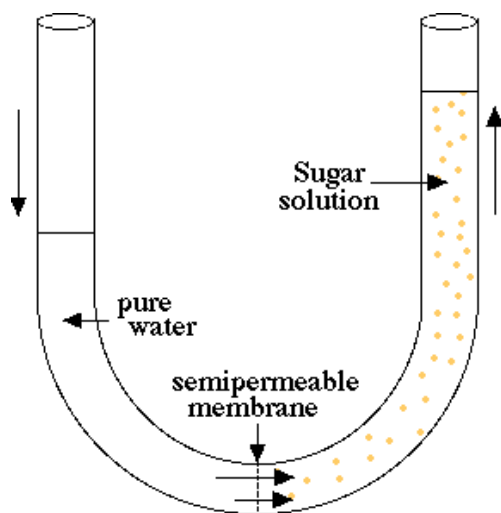
Solvent	Freezing Point ($^{\circ}\text{C}$)	K_f ($^{\circ}\text{C}/\text{m}$)
Water	0.0	1.86
Benzene	5.5	5.12
Carbon Tetrachloride	-23	29.8
Ethanol	-114.1	1.99
Chloroform	-63.5	4.68

Example: What would be the freezing point of a 0.625 m aqueous solution of a nonvolatile nonelectrolyte?

Example: Calculate the change in freezing point were 144 g of sucrose ($C_6H_{12}O_6$) was added to 2.00 kg of water.

Osmotic Pressure and Osmosis

Diffusion of solvent particles across a semipermeable membrane



Final word about changes in BP and FP

Can be used to calculate molar mass

Example: What is the molar mass of a 35.0 g sample of an unknown nonelectrolyte that depresses the freezing point of 0.350 kg of water by 0.50 °C? K_f for water is 1.86°C/m.

Try this on your own:

A 300.0 mg sample of caffeine was dissolved in 10.0 g of camphor ($k_f = 39.7$ °C/m), decreasing the freezing point of camphor by 3.07 °C. What is the molar mass of caffeine?

194 g/mol