# Molarity vs. molality

$$\frac{\text{mol solute}}{\text{L of solution}}$$

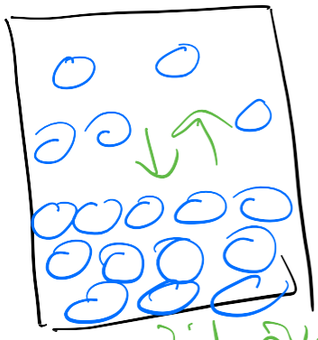
solute

solvent

$$\frac{\text{mol solute}}{\text{Kg of solvent } (H_2O)}$$

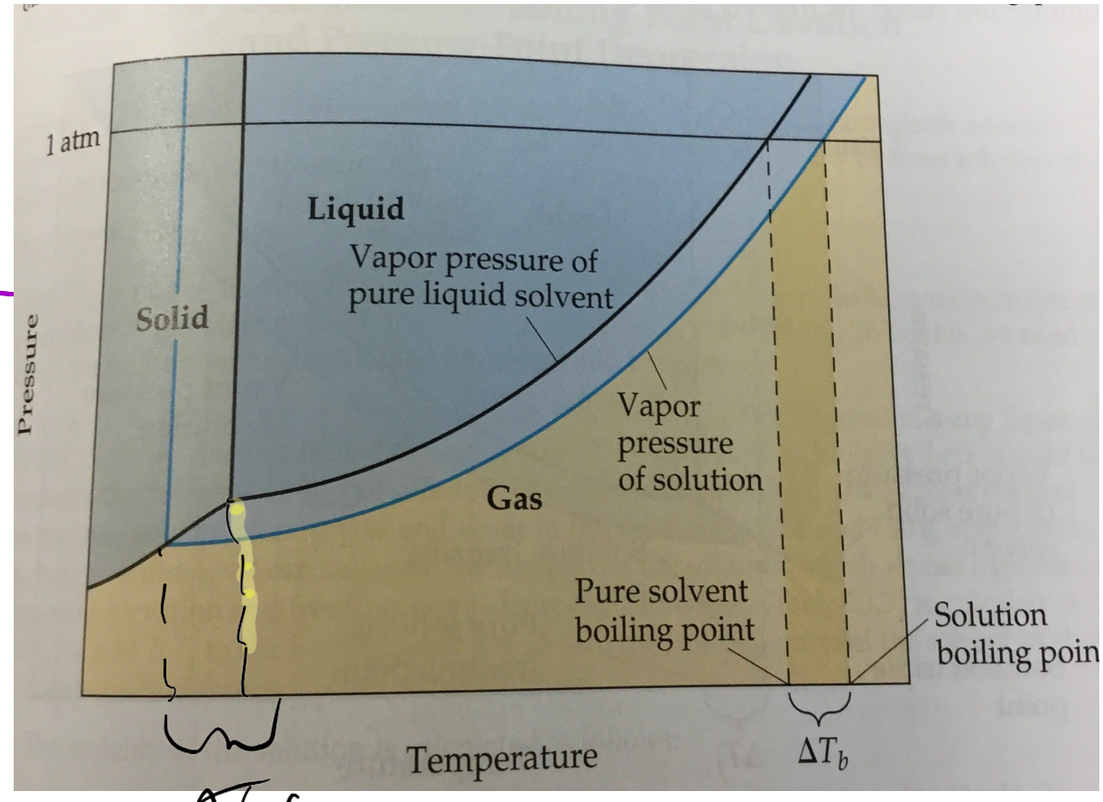
# Colligative Properties

depend on amount of solu not identity

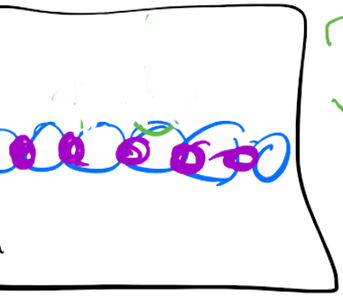


add → solute

equilibrium




$\Delta T_f$



rate of vaporization ↓

→ equilibrium re-established
less molecules in gas phase

★ vapor pressure is lowered

volatile solvent has a vapor pressure

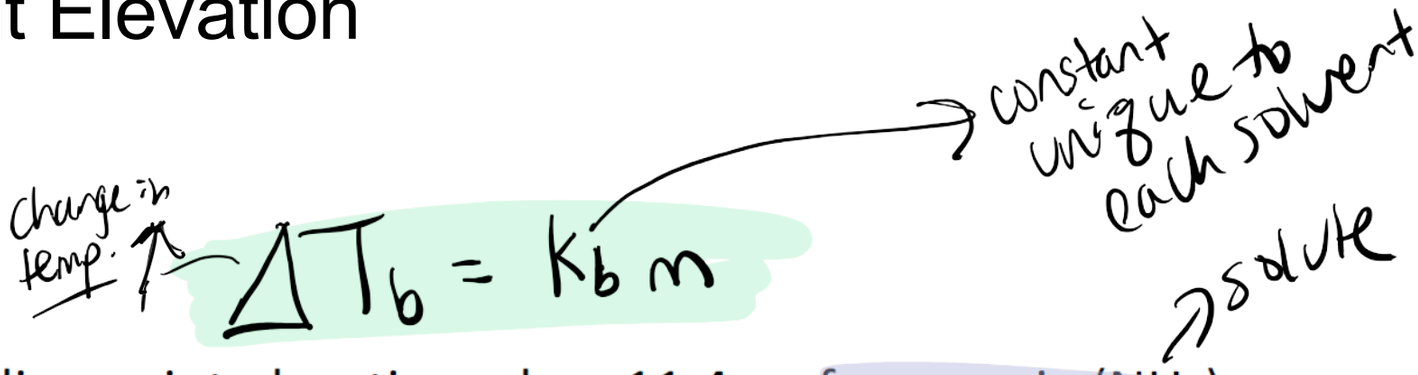
non-volatile solute no measurable vapor pressure

Raoult's Law

# Raoults Law continued

Glycerol is a non-volatile, non-electrolyte with a density of 1.26 g/ml at 25.0° C. Calculate the vapor pressure at 25.0 °C of a solution made by adding 50.0 ml of glycerol to 500.0 ml of water. The vapor pressure of pure water at 25 C is 23.8 torr and its density is 1.00 g/ml. The molar mass of glycerol is 92.09 g/mol.

# Boiling Point Elevation




What is the boiling point elevation when 11.4 g of ammonia ($NH_3$) is dissolved in 200. g of water? $K_b$ for water is 0.520°C/m.

**Freezing Point depression**

$\Delta Tf = k_f \ m$

# Electrolytes vs. non electrolytes

glucose $C_6H_{12}O_6$ vs. NaCl → $Na^+$ + $Cl^-$

if have 0.100m solution of each which solution will have a lower freezing point?

Van Hoff factor "i"

$\Delta T_f = i K_f m$

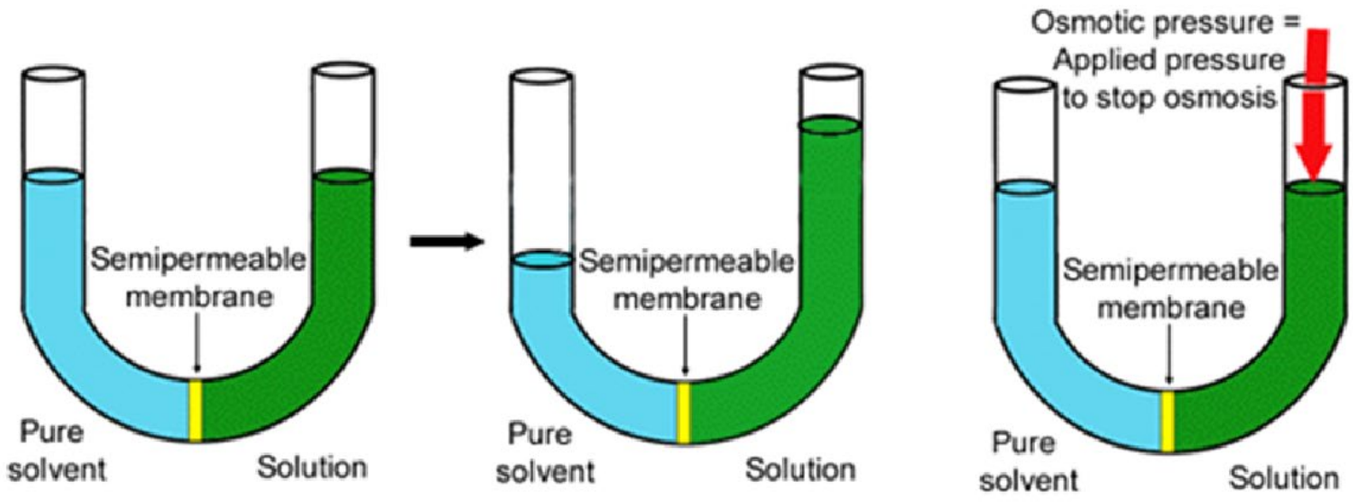
for NaCl $i = 2$

for glucose

$i = 1$

# Osmotic Pressure

The minimum pressure that stops the osmosis is equal to the osmotic pressure of the solution

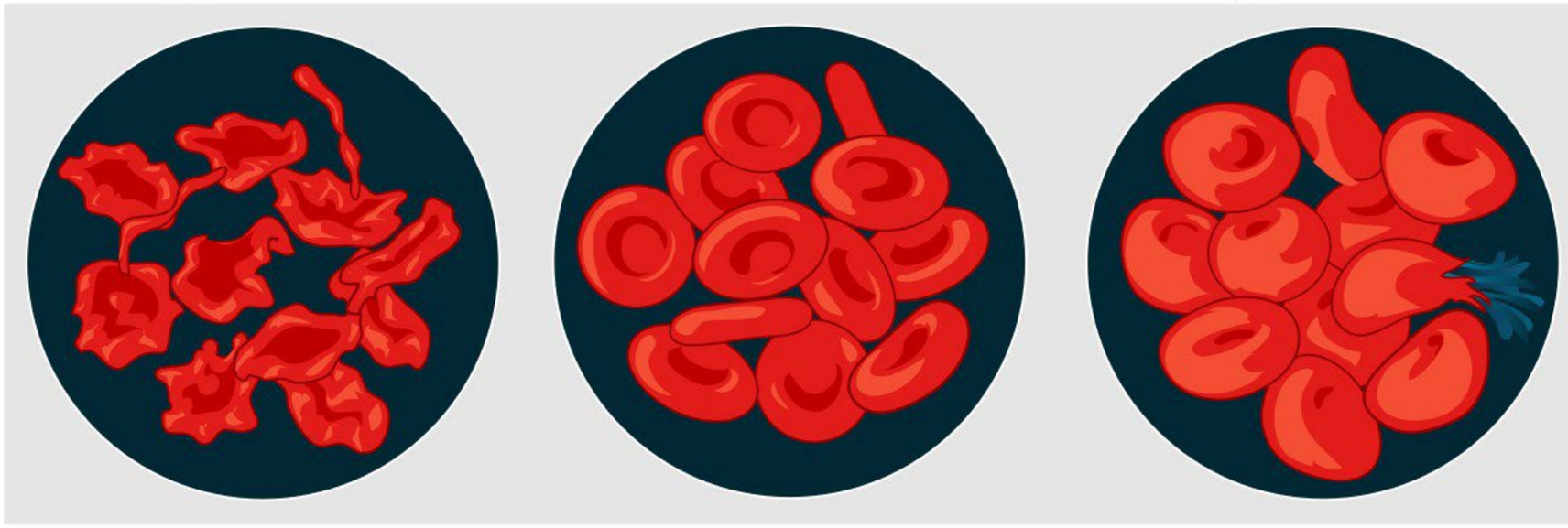


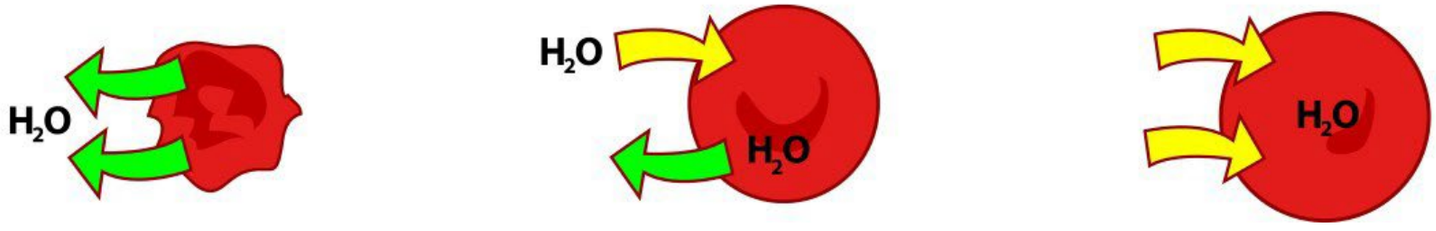
# Osmosis in Blood Cells

Hypertonic

Isotonic

Hypotonic





The average osmotic pressure of blood is 7.7 atm at 25°C. What concentration of glucose will be isotonic with blood?

$$\pi = MRT$$

# Osmotic Pressure and Molar Mass Example

A solution is prepared by dissolving 35.0 g of hemoglobin in enough water to make up 1.00 L in volume. The osmotic pressure of the solution is found to be 10.0 mmHg at 25.0 °C. Calculate the molar mass of hemoglobin.