

14 • Solutions and Their Properties

STUDY LIST

- Define solute, solvent, and solution
- Define molarity, molality, mole fraction, weight percent, ppm
- Convert one concentration into another
- Realize when density is needed for these calculations

- Define unsaturated, saturated, and supersaturated. (DEMO—Hand warmer)
- Compare these terms with dilute and concentrated. (AgNO_3 970 g/100g & AgCl .00127 g/100g)
- Solids and gases are called soluble and insoluble.
- Liquids are called miscible and immiscible. (TOY—Ocean Waves)

- Henry's Law—solubility of a gas in a liquid is proportional to the pressure of the gas. $S_g = k_H P_g$
- Qualitatively know how pressure and temperature affect the solubility of gases. (Opening Soda & SCUBA divers)

- Know the two big driving forces of the universe: (important preview idea)
 - tend toward minimum Enthalpy (ΔH) ... potential energy
 - tend toward maximum Entropy (ΔS) ... randomness... disorder... spreadioutiness
- Apply the driving forces to the solubility of *gases*:
 - gas + liquid solvent \rightleftharpoons saturated solution of the gas + HEAT
 - (NOTE: equilibrium results when the driving forces work in opposite directions)
- Le Chatelier's Principle:
 - increased pressure of the gas = more gas (equilibrium shifts to the right)
 - increased temperature = more heat (equilibrium shifts to the left)

- Know and be able to do simple problems with Raoult's Law: $P_{\text{solvent}} = X_{\text{solvent}} P^{\circ}_{\text{solvent}}$
- Know what an ideal solution is (IMF of each component = IMF of mixture)
- Know that this has applications in distilling volatile liquids esp. petroleum products. (Online Tutorial about Petroleum Dist.)
- Recognize that a volatile solute (esp. alcohol) will add to the vapor pressure and LOWER the BP whereas solutions of solids in water RAISE the BP.

- Elevation of the BP, ΔT_b

$$\Delta T_b = k_b \cdot m$$
 (k_b = the molal boiling point elevation constant = ΔT_b @ 1 m)

- Depression of the FP/MP, ΔT_f

$$\Delta T_f = k_f \cdot m$$
 (k_f = the molal freezing point depression constant = ΔT_f @ 1 m)
- This can be used to determine molar mass:

$$M = \frac{K_f \times w \times 1000}{\Delta T \times W}$$
 (COMPUTER SIMULATION—RAST)

- Substances that split into ions have a multiplying effect on colligative properties. (elevation of BP in sol'n: sugar vs salt)
- This is called the van't Hoff factor, i . Ex. NaCl , $i=2$; CaCl_2 , $i=3$ (simple for dilute solutions)

- Heats of solution = (DEMO)
 - NRG to break solvent-solvent & solute-solute bonds – NRG by making solute-solvent bonds
 - (esp. hydration) (can be exothermic or endothermic) (endothermic implies Entropy is impt)
 - (DEMO—baggies of NH_4Cl and CaCl_2)