

I. Concentration:

	solution (S)	solute (U)	solvent (V)	
M	L	$n_u = \frac{m}{MW_u}$		$M = \frac{n_u}{V_S(L)}$
N		n_u		$N = M * \#_{eq}$
x		n_u		$x_u = \frac{n_u}{n_u + n_v}, x_v = \frac{n_v}{n_u + n_v}$
P		m_u		$m\% = \frac{m_u}{m_u + m_v}$
m		n_u	Kg	$m = \frac{n_u}{m_v(Kg)}$

$$m_s = m_u + m_v \quad D_s = \frac{m_s}{V_S(L)}$$

Concentration conversion: $M \rightarrow$ assume 1L; $m \rightarrow$ assume 1kg; $\chi_A \rightarrow$ assume 1mole; $m\% \rightarrow$ assume 100g

II. Solution formation:

$$\Delta H_{\text{solution}} = \Delta H_{\text{solute}} + \Delta H_{\text{solvent}} + \Delta H_{\text{mix}}$$

$\Delta H_{\text{solution}} < 0$, exothermic, heat released, T increase

$\Delta H_{\text{solution}} > 0$, endothermic, heat absorbed, T decrease

III. Solubility:

Liquid-liquid solution: Like dissolve like.

Solid-liquid solution: polar solid dissolve in H₂O

Factors affect solubility: Temperature, Pressure

Temperature:

Solid: T increase, Solubility increase

Gas: T increase, Solubility decrease

Pressure:

P increase, S increase,

Henry's Law: $C_g = k_H P_g$

C_g = concentration of dissolved gas

k_H = constant

P_g = partial pressure of gas solute above the solution

IV. Colligative properties:

Vapor pressure lowering: non-volatile solution:

$$\text{Raoult's Law: } P_{\text{soln}} = \chi_{\text{solv}} P_{\text{solv}}^{\circ}$$

P_{soln} = vapor pressure of **solution**

χ_{solv} = mole fraction of **solvent**

P_{solv}° = vapor pressure of **pure solvent**

volatile solution:

$$P_{\text{soln}} = \sum \chi_{\text{solv}} P_{\text{solv}}^{\circ}$$

Boiling point elevation:

$$\Delta T_b = i K_b m_{\text{solute}}$$

Freezing point depression:

$$\Delta T_f = i K_f m_{\text{solute}}$$

Osmotic pressure:

$$\Pi = i MRT$$

Ch 10

10.I

1. **(L1_C)** Calculate the molality of an aqueous solution that is 8.1% by mass calcium chloride. You might need to know that the density is 1.20 g/mL. **[0.794]**
2. **(L1_C)** What is the molality of an aqueous solution containing FeCl_3 (MM = 162.2 g/mol) with a mole fraction of FeCl_3 of 0.15? **[9.8]**
3. **(L1_A)** Determine the mass in grams of pentane that must be added to 10 g of benzene to make a 20 m solution. Give your answer to 2 decimal places. **[14.43]**
4. **(L1_C)** A 5 mass % aqueous solution of nitric acid (HNO_3) has a density of 1.05 g/mL. Calculate the molarity of the solution. Give your answer to 2 decimal places. **[0.83]**
5. **(L2_C)** How many moles of solute particles are present in 50 mL of 3 M Na_3PO_4 ? Because Blackboard Learn is so messed up, then take the LOG (base 10) of your answer and put it in using 2 decimal places!!!! **[-0.22]**

10.II

6. **(L2_C)** A flask containing solid ammonium chloride becomes colder as water is added and the salt dissolves. Is the magnitude of the lattice energy of NH_4Cl **larger** or smaller than the combined hydration energy of the ions?

10.III

7. **(L2_A)** Which of the following is more soluble in water, **methanol** or $\text{CCl}_2\text{H}_2(l)$.

10.IV

8. **(L2_C)** Consider the solutions, 0.04 m urea [$(\text{NH}_2)_2\text{C=O}$], 0.04 m AgNO_3 and 0.04 m CaCl_2 . Which has (i) the highest osmotic pressure, (ii) the highest vapor pressure, (iii) the highest boiling point? **[(a) 0.04 m CaCl_2 (b) 0.04 m urea (c) 0.04 m CaCl_2]**
9. **(L3_C)** Calculate the boiling point (in degrees C) of a solution made by dissolving 3 g of ethylene glycol ($\text{HOCH}_2\text{CH}_2\text{OH}$) in 10 g of water. The K_{bp} of the solvent is 0.512 K/m and the normal boiling point is 373 K. Enter your answer to 2 decimal places. **[102.48]**
10. **(L3_T)** When 5 g of an unknown non-electrolyte is dissolved in 50.0 g of acetone, the boiling point increased by 2 degrees C. If the K_{bp} of the solvent is 1.71 K/m, calculate the molar mass of the unknown solute. **[85.5]**
11. **(L3_C)** When 3 grams of a protein were dissolved in 50 mL of solution at 27 degrees C, the osmotic pressure was found to be 800 torr. Calculate the molar mass of the protein. **[1403]**

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