

Chem 122 -- Problem Set 5

1. For each of the following reactions, write the balanced overall (molecular) reaction and the ionic and net ionic equations/reactions:

- a) $\text{BaCl}_2(\text{aq}) + \text{ZnSO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + \text{ZnCl}_2(\text{aq})$
- b) $\text{Cu}(\text{NO}_3)_2(\text{aq}) + \text{Na}_2\text{S}(\text{aq}) \rightarrow \text{CuS}(\text{s}) + 2\text{NaNO}_3(\text{aq})$
- c) $\text{CaCl}_2(\text{aq}) + \text{Na}_2\text{CO}_3(\text{aq}) \rightarrow \text{CaCO}_3(\text{s}) + 2\text{NaCl}(\text{aq})$
- d) $\text{AgNO}_3(\text{aq}) + \text{NaI}(\text{aq}) \rightarrow \text{AgI}(\text{s}) + \text{NaNO}_3(\text{aq})$
- e) $\text{NaOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{NaCl}(\text{aq})$
- f) $\text{Pb}(\text{NO}_3)_2(\text{aq}) + \text{Na}_2\text{CrO}_4(\text{aq}) \rightarrow \text{PbCrO}_4(\text{s}) + 2\text{NaNO}_3(\text{aq})$
- g) $\text{CuCl}_2(\text{aq}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Cu}(\text{OH})_2(\text{s}) + 2\text{NaCl}(\text{aq})$
- h) $\text{ZnCl}_2(\text{aq}) + \text{H}_2\text{S}(\text{aq}) \rightarrow \text{ZnS}(\text{s}) + 2\text{HCl}(\text{aq})$
- i) $2\text{AgNO}_3(\text{aq}) + (\text{NH}_4)_2\text{SO}_4(\text{aq}) \rightarrow \text{Ag}_2\text{SO}_4(\text{s}) + 2\text{NH}_4\text{NO}_3(\text{aq})$
- j) $\text{NH}_4\text{Cl}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NH}_3(\text{g}) + \text{H}_2\text{O}(\text{l}) + \text{NaCl}(\text{aq})$

2. Using the following compounds, write out their chemical formulas, ionic formulas and determine if they are water soluble or water insoluble:

- a) Silver chloride
- b) Ammonium chloride
- c) Barium iodide
- d) Sodium hydroxide
- e) Sodium sulfate
- f) Ammonium sulfate
- g) Lithium bromide
- h) Mercurous chloride
- i) Sodium sulfide
- j) Calcium sulfate
- k) Barium sulfate
- l) Strontium nitrate
- m) Silver chloride
- n) Silver nitrate
- o) Cupric sulfide
- p) Cupric hydroxide
- q) Ammonium nitrate
- r) Ferric hydroxide
- s) Lead chloride
- t) Nickel sulfide
- u) Gold (III) chloride
- v) Zinc sulfate
- w) Calcium carbonate
- x) Strontium carbonate
- y) Sodium perchlorate
- z) Mercuric sulfate

For the next four questions, refer to the following table and this generic question: calculate the mole fraction of each component in an ideal solution of the following at 40°C:

Question number	1 st Chemical	Amount (g)	MW (g/mol)	2 ^d Chemical	Amount (g)	MW (g/mol)
3	n-propyl alcohol	5	60	Benzene	25	78
4	Butyl alcohol	10	74	n-propyl alcohol	10	60
5	Methyl alcohol	30	32	CCl ₄	25	143
6	Cyclohexane	75	84	Benzene	30	78

For Questions 7 through 10, refer to the following table:

Chemical	Vapor Pressure of Pure Liquid at 40°C (torr)
Benzene	4.62
Butyl alcohol	8.74
Carbon tetrachloride (CCl ₄)	4.6
Cyclohexane	6.82
Methyl alcohol	1.57
n-propyl alcohol	2.55

- Determine the vapor pressure of the benzene component of the solution in Question # 3.
- Determine the vapor pressure of the butyl alcohol component of the solution in Question #4.
- Determine the vapor pressure of the CCl₄ component in Question #5.
- Determine the vapor pressure of the cyclohexane component of the solution in Question #6.
- 750 mL water are mixed with 500 g NaCl. The density of water is 1 g/ml. What is the ΔT_b and ΔT_f ?
- 1000 mL water are mixed with 25 g CaCl₂. The density of the water is 1 g/ml. What is the ΔT_b and ΔT_f ?
- 250 mL water are mixed with 50 g propylene glycol (MW = 76 g/mol). The density of water is 1 g/mL. What is the ΔT_b and ΔT_f ?
- What is the osmotic pressure of a solution of 8.0 g of urea (CON₂H₄; non-ionic) in 1.0 L of aqueous solution at 25°C?

15. What must be the concentration of sugar in tree sap if the sap is to rise to the top of a 125-ft tree at 25°C as the result of osmotic pressure? Assume that the density of the tree sap is 1.00 g/mL.
16. To be used as an IV nutrient, a glucose solution must be isotonic with blood, which has an osmotic pressure of 7.7 atm. What must be the concentration of the glucose solution?
17. A solution was prepared by dissolving 25 g of naphthalene (C₁₀H₈) in 100 g benzene, C₆H₆. Calculate the molality of the naphthalene.
18. A solution was prepared by dissolving 200 g ethylene glycol (MW = 62 g/mol) in 250 mL water. If the density of the water is 0.985 g/mL, calculate the molality of the ethylene glycol.
19. A solution of 4.50 g of a compound with the empirical formula C₃H₄ in 30.0 g CCl₄ has a boiling point elevation of 3.77°C. What is the molecular formula of the compound? The K_b for CCl₄ is 5.02°C/m.
20. An osmotic pressure of 3.56 torr is measured for 0.288 g of a protein in 25 mL of solution at 25°C. What is the molar mass of the protein?