# CH 222 Winter 2026: **Problem Set #5** *Instructions*

#### Step One:

• Learn the material for Problem Set #5 by reading Chapter 11 of the textbook and/or by watching the videos found on the website (https://mhchem.org/222video)

• **Try the problems** for Problem Set #5 found on the next pages on your own first. Write your answers in the space provided or write your answers on separate paper (your choice.) Include your name on your problem set!

### Step Two:

Watch the recitation video for Problem Set #5:

### http://mhchem.org/2/5

**Self correct** *all* **of the problems** while viewing the video. Mark correct problems with a star (or other similar mark), and correct all incorrect problems (show the correct answer and the steps required to achieve it.)

### Step Three:

Turn the Problem Set in at the beginning of recitation to the instructor on Monday,
February 16 (section L1), Wednesday, February 18 (section L2) or Friday, February
20 (section L3) The graded problem set will be returned to you the following week during recitation.

Do not include this page to avoid a point penalty; your front page should be page II-5-3.

If you have any questions regarding this assignment, please email (mike.russell@mhcc.edu) the instructor! Good luck on this assignment!

## CH 222 Problem Set #5

<u>Name</u>:

Complete the problem set on your own first using these sheets for your work or separate paper (your choice.) Self correct your work (*all problems!*) using the recitation video for this problem set, found here: http://mhchem.org/2/5

\* Covering: Chapter Eleven and Chapter Guide Five

\* *Important Tables and/or Constants:* periodic table found here: http://mhchem.org/pertab, R = 8.3145 J mol<sup>-1</sup> K<sup>-1</sup>, "Cubic Unit Cells Guide" (*Handout*), "Solids" (*Lab*)

1. Fill in the blanks in the table. All solutions are aqueous.

Compound	Molality	Weight Percent	Mole Fraction
KNO <sub>3</sub>		10.0	
CH <sub>3</sub> CO <sub>2</sub> H	0.0183		
HOCH <sub>2</sub> CH <sub>2</sub> OH			0.0599

2. Concentrated aqueous sulfuric acid has a density of  $1.84 \text{ g/cm}^3$  and is 95.0% by weight H<sub>2</sub>SO<sub>4</sub>. What is the molarity of this acid? What is the molality?

- 3. Silver ion has an average concentration of 28 ppb (parts per billion) in U.S. water supplies.
  - a. What is the molality of the silver ion?
  - b. If you wanted 1.0 x 10<sup>2</sup> g of silver and could recover it chemically from water supplies, what volume of water, in liters, would you have to treat? Assume the density of water is 1.0 g/cm<sup>3</sup>.

4. Hydrogen gas has a Henry's law constant of 1.07 x 10<sup>-6</sup> M/ mm Hg at 25 °C when dissolving in water. If the total pressure of the gas (H<sub>2</sub> plus water vapor) over water is 1.00 atm, what is the concentration of H<sub>2</sub> in the water in grams per milliliter? The vapor pressure of water at 25 °C is 23.8 mm Hg.

5. Nonvolatile urea, (NH<sub>2</sub>)<sub>2</sub>CO, which is widely used in fertilizers and plastics, is quite soluble in water. If you dissolve 9.00 g of urea in 10.0 mL of water, what is the vapor pressure of the solution at 24 °C? Assume the density of water is 1.00 g/ mL, and the vapor pressure of water at 24 °C is 22.4 mm Hg.

6. What is the boiling point of a solution composed of 0.755 g of caffeine,  $C_8H_{10}O_2N_4$ , in 95.6 g of benzene,  $C_6H_6$ ? The normal boiling point for benzene is 80.10 °C and  $K_{bp}$  for benzene = 2.53 °C/m.

7. Some ethylene glycol, HOCH<sub>2</sub>CH<sub>2</sub>OH, is added to your car's cooling system along with 5.0 kg of water. If the freezing point of the water-glycol solution is -15.0 °C, what mass of HOCH<sub>2</sub>CH<sub>2</sub>OH must have been added? The normal freezing point for water is 0.0 °C and  $K_{\rm fp}$  for water = 1.86 °C/*m*.

8. Butylated hydroxyanisole (BHA) is used as an antioxidant in margarine and other fats and oils; it prevents oxidation and prolongs the shelf life of the food. What is the molar mass of BHA if 0.640 g of the compound, dissolved in 25.0 g of chloroform (CHCl<sub>3</sub>), produces a solution whose boiling point is 62.22 °C? The normal boiling point for chloroform is 61.70 °C and  $K_{bp}$  for chloroform = 3.63 °C/ *m*.

9. The organic compound aluminon is used as a reagent to test for the presence of the aluminum ion in aqueous solution. A solution of 2.50 g of aluminon in 50.0 g of water freezes at -0.197 °C. What is the molar mass of aluminon? The normal freezing point for water is 0.000 °C and  $K_{\rm fp}$  for water = 1.86 °C/ *m*.

10. Calculate the osmotic pressure of human blood at 37 °C. Assume blood is isotonic with a 0.154 M NaCl solution, and use a theoretical van't Hoff *i* factor for NaCl.

This page left blank for printing purposes