CH 222 Winter 2026:
Problem Set #1
Instructions

Step One:

• **Learn the material** for Problem Set #1 by **reading Chapter 7 (sections 7.3-7.5)** of the textbook and/or by watching the videos found on the website (https://mhchem.org/222video)

• **Try the problems** for Problem Set #1 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 #1:

http://mhchem.org/2/1

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, January 12 (section L1), Wednesday, January 14 (section L2)** *or* **Friday, January 16 (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-1-3.

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

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CH 222 Problem Set #1

Name:

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/2/1**

***** *Covering:* **Chapter Seven (sections 7.3 - 7.5)** *and* **Chapter Guide One**

***** *Important Tables and/or Constants:* **periodic table** found here: http://mhchem.org/pertab

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1. Review from CH 221: Balance the following equations:
   a. $Cr(s) + Cl_2(g) \rightarrow CrCl_3(s)$

   b. $Fe(s) + H_2O(g) \rightarrow Fe_3O_4(s) + H_2(g)$

   c. $SF_4(g) + H_2O(\ell) \rightarrow SO_2(g) + HF(\ell)$

   d. $NH_3(aq) + O_2(aq) \rightarrow NO(g) + H_2O(\ell)$

2. The reaction for the formation of nitric acid is: $\mathbf{3\ NO_2(g) + H_2O(l) \rightarrow 2\ HNO_3(aq) + NO(g)}$
   a. How many grams of NO_2 are needed to react with 2.30 moles of H_2O?
   b. How many grams of NO are produced when 2.04 moles of H_2O react?
   c. How many grams of HNO_3 are produced at the same time that 0.500 mole of NO are produced?
   d. How many grams of NO_2 must react in order to produce 1.23 moles of HNO_3?

3. What mass of HCl, in grams, is required to react with 0.750 g of $Al(OH)_3$? What mass of water, in grams, is produced? What mass of $AlCl_3$, in grams, is produced? The equation:

$$Al(OH)_3(s) + 3\ HCl(aq) \rightarrow AlCl_3(aq) + 3\ H_2O(\ell)$$

4. Hexane (C_6H_{14}) burns in air (O_2) to give CO_2 and H_2O.
   a. Write a balanced equation for this reaction.
   b. If 215 g of C_6H_{14} is mixed with 215 g of O_2, what masses of CO_2 and H_2O are produced in the reaction?
   c. What mass of excess reactant remains at the end of the reaction?

5. Consider the reaction: $2\ CH_3SH\ +\ CO\ \rightarrow\ CH_3COSCH_3\ +\ H_2S$. If you begin with 10.0 g of CH_3SH and excess CO,
    a. What is the theoretical yield of CH_3COSCH_3?
    b. If 8.65 g of CH_3COSCH_3 is isolated, what is the percent yield?

6. A metal M reacts with O_2 according to the equation below. If 0.356 g of the metal M reacts with an excess of oxygen to make 0.452 g of the metal oxide MO_2, use this information to find the identity of the metal M.
$M(s) + O_2(g) \rightarrow MO_2(s)$

7. Saccharin, an artificial sweetener, has the formula $C_7H_5NO_3S$. Suppose you have a sample of a saccharin-containing sweetener with a mass of 0.2140 g. After decomposition to free sulfur and converting it to the SO_4^{2-} ion, the sulfate ion is trapped as the water-insoluble $BaSO_4$. The quantity of $BaSO_4$ obtained is 0.2070 g. What is the mass percent of saccharin in the sample of sweetener? *Hint:* 1 S in $BaSO_4$ comes from 1 S in saccharin, $C_7H_5NO_3S$.

8. To find the formula of a compound composed of iron and carbon monoxide, $Fe_x(CO)_y$, the compound is burned in pure oxygen to give Fe_2O_3 and CO_2. If you burn 1.959 g of $Fe_x(CO)_y$ and obtain 0.799 g of Fe_2O_3 and 2.200 g of CO_2, what is the empirical formula of $Fe_x(CO)_y$?

9. Mesitylene is a liquid hydrocarbon with formula C_xH_y. Burning 0.115 g of the compound in oxygen gives 0.379 g of CO_2 and 0.1035 g of H_2O. What is the empirical formula of mesitylene?

10. Naphthalene, a hydrocarbon, has an approximate molar mass of 128 g/mole. If the combustion of 0.6400 g naphthalene produces 0.3599 g H_2O and 2.200 g CO_2, what is the empirical and molecular formula of this compound?