CH 221 Fall 2021:
Problem Set #4
Instructions

Step One (all sections):

Learn the material for Problem Set #4 by **reading Chapter 4** of the textbook and/or by watching the videos found on our website (https://mhchem.org/221)

Try the problems for Problem Set #4 found on the next pages on your own first. Use separate paper and write out your answers, showing all of your work. If you write the answers on the problem set itself, you will receive fewer points. Include your name on your problem set!

Step Two:

<u>Section 01 and H1</u>: We will go over Problem Set #4 during recitation. ***Self correct all problems*** of your problem set before turning it in at the end of the class on October 27.

<u>Section W1</u>: **Watch the recitation video** for Problem Set #4:
http://mhchem.org/w/m.htm

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.)

Submit Problem Set #4 via email (mike.russell@mhcc.edu) as a single PDF file (use CamScanner (https://camscanner.com), CombinePDF (https://combinepdf.com), etc.) **by 11:59 PM Wednesday, October 27.**

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

CH 221 Problem Set #4

* Complete problem set on separate pieces of paper showing all work, circling final answers, etc.
* Self correct your work before turning it in to the instructor.

Covering: **Chapter Four** *and* **Chapter Guide Four**
Important Tables and/or Constants: **Solubility Table** (in the "Net Ionics" lab or here: **https://mhchem.org/sol**) -
Use the Net Ionics solubility table when answering questions about solubility in CH 221)

1. Balance the following equations:
   a. $Cr(s) + Cl_2(g) \rightarrow CrCl_3(s)$
   b. $SiO_2(s) + C(s) \rightarrow Si(s) + CO(g)$
   c. $Fe(s) + H_2O(g) \rightarrow Fe_3O_4(s) + H_2(g)$
2. Balance the following equations and name each reactant and product:
   a. $SF_4(g) + H_2O(\ell) \rightarrow SO_2(g) + HF(\ell)$
   b. $NH_3(aq) + O_2(aq) \rightarrow NO(g) + H_2O(\ell)$
   c. $BF_3(g) + H_2O(\ell) \rightarrow HF(aq) + H_3BO_3(aq)$
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. Write a balanced equation for this reaction. 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? 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. $\mathbf{M(s) + O_2(g) \rightarrow MO_2(s)}$
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?
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. Benzoquinone, a chemical used in the dye industry and in photography, is an organic compound containing only C, H and O. What is the empirical formula of the compound if 0.105 g of the compound gives 0.257 g of CO_2 and 0.0350 g of H_2O when burned completely in oxygen? What is the molecular formula if the molar mass of the compound = 108 g/mol?

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Note: For questions #11 - 13, use the **solubility table** found in the "**Net Ionic Reactions**" Lab, available in the Chemistry 221 Companion or on the website (http://mhchem.org/221/classroom/lab.htm) or here (https://mhchem.org/sol).

11. Decide whether each of the following is water-soluble. If soluble, tell what ions are produced. Describe them as strong electrolyte, weak electrolyte or non-electrolyte when placed in water.
    a. $NiCl_2$
    b. $Cr(NO_3)_3$
    c. ethanol
    d. ammonia
    e. $BaSO_4$

12. Predict the products of each precipitation reaction. Balance the completed equation, and then write the net ionic equation.
    a. $Pb(NO_3)_2(aq) + KBr(aq) \rightarrow$
    b. $Ca(NO_3)_2(aq) + KF(aq) \rightarrow$

13. Balance the following equations, and then write the net ionic equation. Identify the spectator ions, if any.
    a. $Mg(OH)_2(s) + HCl(aq) \rightarrow MgCl_2(aq) + H_2O(\ell)$
    b. $HNO_3(aq) + CaCO_3(s) \rightarrow Ca(NO_3)_2(aq) + H_2O(\ell) + CO_2(g)$