Practice Problems for the Chem A Final Exam!
 (Solutions will be posted in the hall outside of room 418 and on the website)
http://blogs.4j.lane.edu/hocken_s/

1. Make the following conversions:

a. 75 milligrams to grams

b. 6.00 x 10^7 micrograms (µg) to kilograms (kg)

c. 472 centimeters to feet

d. 8.0 feet per minute to millimeters per hour

e. 100. cubic inches to cubic centimeters.

f. 14.7 pounds per square inch to kilograms per square meter. (1 pound = 453.8 grams)

g. 0.00246 square millimeters (mm^2) to square nanometers (nm^2)

2. Round each calculator answer to the correct number of significant figures

a. 112.000 / 2.10 = 53.333333 ----->_____   e. 0.00022 x 198 = 0.04356 ----->_____

b. 112.000 + 2.10 = 114.1 -----> _____   f. 3335.67 / 74.126 = 45 ----->_____

c. 12.5 x 16   =   200 ----->_____   g. 75.9762 - 73.97 = 2.0062 ----->_____

d. 153.48 – 2.13 = 151.35 ----> _____   h. 75.97 - 73.97 =   2 ----->_____

3. Iridium has two common isotopes. 62.7% of Iridium ions are Ir-193 (Mass = 192.963 amu) and the remainder are Ir-191 (mass = 190.9606 amu).
a. Calculate the atomic mass of iridium based on the data.

b. How many protons and neutrons are in Ir-193? p_____   n_____

c. How many protons and neutrons are in Ir-191? p_____   n_____

For **#4 and 5**, you should be able to answer all of the problems **without your blue ion sheet.**
(you'll need a periodic table for some of them though.)

4. Calcium (Ca) is element #20.

a. What is the charge on a calcium atom? _____

b. What is the charge on a calcium ion? _____

c. How many protons and how many electrons are in a calcium atom? p _____ e _____

d. How many protons and how many electrons are in a calcium ion? p _____ e _____

e. Which noble gas has the same number of electrons as a calcium ion? _____

Arsenic (As) is element #33.

f. What is the charge on an arsenic atom? _____

g. What is the charge on an arsenide ion? _____

h. How many protons and how many electrons are in an arsenic atom? p _____ e _____

i. How many protons and how many electrons are in an arsenide ion? p _____ e _____

j. Which noble gas has the same number of electrons as the arsenide ion? _____

5. Give the symbol for four ions that have the same number of electrons as Neon.

6a. Fill out the chart:

Symbol	#protons	# neutrons	#electrons	mass#	charge	atomic #
$^{75}As^{+5}$	_____	_____	_____	_____	_____	_____
_____	_____	36	28	66	_____	_____
_____	_____	_____	54	131	_____	53
_____	_____	10	10	_____	-2	_____
_____	_____	_____	9	19	_____	9

6b. How many protons and neutrons are in the most common isotope of phosphorus? p____ n_____

7. Formula Writing: Fill in the missing name or formula. Classify any compounds as ionic or covalent.

copper (II) sulfate   Iron (III) phosphate   zinc phosphate   chlorine

N_2O_4 PF_5 B_2O_3 Al_2O_3

Na_3PO_4 Cl_2O_7 $PbCO_3$ Sn_3N_4

ammonium carbonate	Iron (II) carbonate	Ag_2SO_3	SO_3

ferric hydroxide	CO_2	$SiBr_4$	zinc acetate

BrO	Br_2O	Helium	nitrogen	CuO	Cu_2S

8. a. Write a balanced chemical equation for the reaction that would occur if iodine and iron reacted to form ferric iodide. Include phase subscripts and balance the reaction.

b. What type of compound formed in this reaction? Explain how you know.

c. When the iodine reacted, did it need to gain or lose electrons to form the compound? _____

d. When the iron reacted, did it need to gain or lose electrons to form the compound? _____

9. Consider the elements barium (Ba), oxygen (O_2), sulfur (S), chlorine (Cl_2), potassium (K), and neon (Ne).
a. List any pairs of elements (from the list) that could bond together covalently:

b. When the covalent compounds form, what would each element need to do with its electrons to form the compound? (gain? lose? share?)

c. List any pairs of elements (from the list) that could bond together ionically.

d. List the formulas of any ionic compounds that could form.

e. When the ionic compounds form, what would each element need to do with its electrons to form the compound? (gain? lose? share?)

10. Consider the elements phosphorus (P), Fluorine (F_2), and copper (Cu).
a. If fluorine bonds with phosphorus, what will the fluorine need to lose, gain, or share electrons?

b. If fluorine bonds with copper, will the fluorine need to lose, gain, or share electrons?

11. a. Which can more commonly form ions with an "ide" ending: <u>metals</u> or <u>nonmetals</u>?

b. Explain why, in terms of how metals and nonmetals change their numbers of electrons when they form ions.

12. Moles! Make the following conversions.

a. 3.08×10^{22} iron atoms to moles

b. 3.32 grams of hydrogen gas to moles

c. 10.0 moles of carbon dioxide to grams

d. 3.2×10^{20} molecules of carbon dioxide to grams.

e. 3.2×10^{20} molecules of carbon dioxide to atoms.

f.   24 grams of iron to atoms.

g. 16.2 grams of nitrogen triiodide to molecules.

h. 0.0121 moles of nitrogen triiodide to molecules.

i. 0.0121 moles of nitrogen triiodide to atoms.

13. a. Determine the percent composition of each element in $(NH_4)_2S$.

b. How many grams of nitrogen are in 20.0 grams of ammonium sulfide?

c. What mass of carbon is in 15.0 grams of glucose sugar $(C_6H_{12}O_6)$?

d. If you needed to extract 20.0 kg iron from iron III oxide, what mass of iron III oxide would you start with?

14. a. What is the empirical formula of $C_8H_{12}O_4$? of $C_{25}H_{30}$? of $C_6H_{12}O_6$?

b. A compound with a molar mass of roughly 80 amu is 85.7% carbon (by weight), and the remainder is hydrogen. Find the empirical formula and the molecular formula.

c. A compound is 26.6 %potassium, 35.3% chromium, and 38.1% oxygen by mass. Find the empirical formula.

d. A compound is 46.6 % C, 6.84 % H, and 46.5% oxygen by mass. Calculate the empirical formula.

e. The compound in (d) has a molar mass between 400 and 450 g/mole. Find the molecular formula.

f. A compound contains 8.68 grams of carbon per 1.18 grams hydrogen and 2.54 grams nitrogen. Calculate the empirical formula of the compound.

15. A crucible containing copper powder is heated until the copper oxidizes to form copper oxide. The following data is obtained:

Mass of crucible: 26.000 g
Mass of crucible and copper powder (before reaction): 27.021 g
Mass of crucible and copper oxide product (after reaction): 27.272 g

a. Determine these masses:

the mass of copper powder, before the reaction:

the mass of copper oxide that formed:

the mass of oxygen that bonded with copper:

b. What is the percent oxygen in the copper oxide product?

c. Was the product copper (I) oxide or copper (II) oxide? (which one)

16.   An experiment was done to determine the percent iron in iron (III) sulfate.   Some solid iron (III) sulfate was dissolved into water, and then was reacted with Zinc in a single replacement reaction. The iron that formed was washed, dried, and weighed, and the following data was obtained.

       Mass of empty beaker: 54.44 g
       Mass of beaker and solid iron (III) sulfate: 58.84 grams
       Mass of empty evaporating dish: 42.21 grams
       Mass of evaporating dish and iron powder that formed: 43.47 grams

a. Use the lab data to calculate the percent iron in iron (III) sulfate.

b. Write the formula for iron (III) sulfate.

c. Use your formula to calculate the book value for the percent iron in this compound.

d. What was the percent error for the experiment?

e. Write a balanced reaction for zinc reacting with the iron (III) sulfate, with phase subscripts.

17. Reactions!   Predict products for each reaction. A few are N.R. Do phase subscripts and balancing.
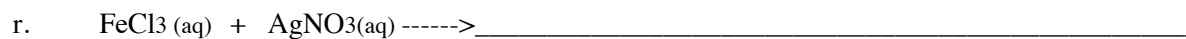
a.   Ca (s) + N2 (g)   ------>_____

b.   FeCl3 (aq) + Ag2SO4(aq) ------>_____

c.   Al (s) + Ni(NO3)2(aq)   ------>_____

d.   C4H10 (l) + O2 (g) ------>_____

e.   HNO3(aq) + Al (s) ------>

f. H_2O (l) + Al (s) + ----->_____

g. $C_{10}H_{16}O$ (l) + O_2 (g) ----->_____

h.   HCl(aq) + Li_2CO_3(aq) ----->_____

i.   K(s) + O_2 (g)   ----->_____

j. F_2 (g) + $FeCl_3$(aq) ----->_____

k. C_3H_7OH (l) + O_2 (g) ----->_____

l.   Zn (s) + $Al(NO_3)_3$(aq) ----->_____

m. H_2O (l) +   Li (s) + ----->_____

n.   P(s) +   Na(s) ----->_____

o. I_2 (s) +   NaCl (aq)----->_____

p. $Al(NO_3)_3$ (aq) +   NaCl (aq) ----->_____

q.   HCl(aq) + $Ba(OH)_2$ (aq) ----->_____

r. $FeCl_3$ (aq) + $AgNO_3$(aq) ----->_____

s. $Pb(NO_3)_4$(aq) +   Zn (s) ----->_____

t.   Pb (s) + H_2O (l) ----->_____

u.   Al (s) + $HC_2H_3O_2$(aq) ----->_____

v. HNO_3(aq) + $MgCO_3$ (s) ----->_____

w. $Al(NO_3)_3$ + Li_2CO_3(aq) ----->_____

x.   K(s) + Cl_2 (g) ------->_____

y. N_2 (g)   +   Na(s) -----> _____

z. C_9H_{20} (l) + O_2 (g) ----->_____

18. $3\ Zn_{(s)}\ +\ 7\ H_2SO_{4(aq)}\ +\ K_2Cr_2O_{7(aq)}\ \text{-----}>\ Cr_2(SO_4)_{3(aq)}\ +\ 7\ H_2O_{(l)}\ +\ 3\ ZnSO_{4(aq)}\ +\ K_2SO_{4(aq)}$
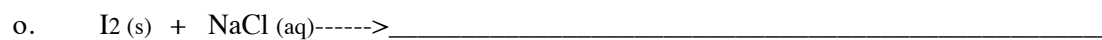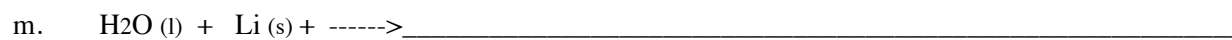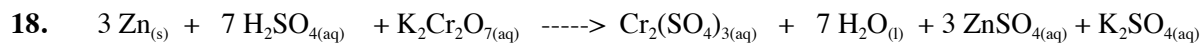
a. If 10.0 grams of H_2SO_4 react, what mass of zinc sulfate will be produced?

b. If 6.55 grams of zinc sulfate are collected in (a), what was the percent yield?

c. How many moles of H_2SO_4 are needed to produce 0.211 moles of chromium sulfate?

d. How many water molecules will form, if 0.0201 moles of zinc react?

e. How many moles of H_2SO_4 must react in order to form 0.34 moles of potassium sulfate?
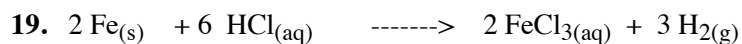
19. $2\ Fe_{(s)}\ +\ 6\ HCl_{(aq)}\ \text{------->}\ 2\ FeCl_{3(aq)}\ +\ 3\ H_{2(g)}$
a. If 50.0 grams of iron are allowed to react with 85.0 grams of HCl, how many grams of iron chloride can form?

b. If 1.0 x 10²³ iron atoms are allowed to react with 22.0 grams of acid, how many moles of hydrogen gas can form?

c. If 0.10 moles of iron are allowed to react with 14.2 grams of acid, what mass of hydrogen gas can form?

19, continued. $2\ Fe_{(s)}\ +6\ HCl_{(aq)}\quad\text{------>}\quad 2\ FeCl_{3(aq)}\ +\ 3\ H_{2(g)}$
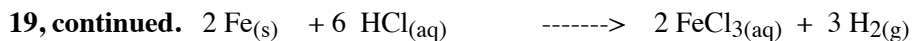
Suppose that a 0.100 mole piece of iron is placed into a solution containing 0.200 moles of hydrochloric acid, and is left alone for a few days.

d. When the reaction is done, how many moles of hydrogen gas should have formed?

e. What one of these shows reasonable values for the amounts of Fe and HCl that are leftover after the rxn? You should be able to choose the right answer without doing any more math.

   a. 0.000 moles of iron, and 0.150 moles of HCl

   b. 0.000 moles of iron, and 0.250 moles of HCl

   c. 0.133 moles of iron, and 0.000 moles of HCl

   d. 0.033 moles of iron, and 0.000 moles of HCl

20. a. Calculate the molarity of a solution that contains 5.48 grams of $CaBr_2$ per 425 mL solution.

b. What mass of LiCl must be dissolved, in order to make 1450 mL of 0.400 Molar LiCl?

c. If a solution contains 0.292 moles of LiCl per 150. mL solution, what is the molarity?

d. How many moles of $CaBr_2$ would be required to make 200. mL of 0.350 M $CaBr_2$ solution?

e. What is the molarity of a solution containing 10.0 grams $C_6H_{12}O_6$ per 50.0 mL solution volume?

f. Which of the $CaBr_2$ solutions (above) was more dilute? _____ Which was more concentrated? _____

21. An experiment was done to determine molarity of a hydrochloric acid (HCl) solution. The solution of hydrochloric acid is added to some zinc wire in a beaker, and is allowed to react for several days. The zinc wire that remains after the reaction is washed, dried, and weighed. The same beaker was used throughout the experiment, and the following data was obtained:

    Volume of acid used (measured by grad. cylinder): 60.0 mL
    Mass of empty beaker: 52.00 g
    Mass of beaker and zinc wire (before the reaction): 58.33 grams
    Mass of beaker and zinc wire (after drying in the oven): 56.77 grams

a. Write the reaction that occurred between zinc and hydrochloric acid. Include subscripts.

b. Determine the mass of zinc that was consumed by the reaction with HCl.

c. Use stoichiometry to determine the moles of HCl required to react with the mass of zinc calculated in (b).

d. Calculate the molarity of the HCl solution.

e. What would be a sign that the reaction was complete.. how would the contents of the beaker look when the HCl was first added, vs how would it look after the reaction was done?

f. Which substance was the limiting reactant in this experiment?

22. For each atom or ion:
a. Write the electron configuration.
b. Underline the valence electrons, and indicate the number of valence electrons it has.

Am   At

Cs   Mg

Ge   magnesium ion

Br   bromide ion

S   sulfide ion

C   Nb

c. Give the formula for 3 other ions (include at least 1 cation and 1 anion) that have the same number of electrons as bromide ion.

d. Give the formula for 3 ions (include at least 1 cation and 1 anion) that have the same number of electrons as Xenon.

23. For each pair, which "thing" has more energy?
(assume that the electrons mentioned are in the same type of element.)

a.   An electron in a 4s orbital   or   An electron in a 3s orbital

b.   EM radiation with a frequency of 1.21×10^{14} Hz.   or   with a frequency of 8.21×10^{13} Hz.

c.   An electron in a 5s orbital   or   An electron in a 5f orbital

d.   EM radiation with a wavelength of 1774 nm   or   with a wavelength of 344 nm.

e.   yellow light   or   green light

f.   An electron that is 0.2 nm away from the nucleus, or an electron that is 0.08 nm away from the nucleus.

g.   a radio wave   or   an infrared wave

h.   ultraviolet radiation   or   microwave radiation

24. For each pair, indicate whether they are attracted to or repelled by each other, and explain your answer.

a.   the nucleus and an electron

b.   an electron and another electron

c.   an electron and a proton

25. Use your answer(s) to #24 to explain why higher n-level has higher/lower (which one?) potential energy.

26a. Determine the frequency of EM radiation with a photon energy of 6.99×10^{-26} J.

b. Determine the photon energy of EM radiation with a wavelength of 4.1 nm.

c. Find the wavelength, in nm, of EM radiation with a frequency of 1.21×10^{14} Hz.

d. Find the frequency of EM radiation with a wavelength of 5.8×10^{-6} meters.

e. Find the wavelength of EM radiation with a photon energy of 7.18×10^{-18} J.
Report your answer in m and nm.

C   Li   Bk   Zr   B   Pb   P   Br   Ba   Ni   Au   Xe   W   Sm   Se   K

27. Choose from the above list of elements to answer the questions below.

An element with 5 valence electrons._____

An element with 7 valence electrons. _____

An element in the same family as magnesium. _____

An element in the same period as magnesium. _____

A halogen. _____

An alkali earth metal. _____

A metal with 4 valence electrons. _____

A nonmetal with 4 valence electrons. _____

An element with an electron configuration ending in p^3. _____

An alkali metal. _____

An actinide. _____   A lanthanide. _____

An element with partially filled f-orbitals. _____

An element with partially filled d-orbitals. _____

A representative element. _____

A transition metal. _____

A noble gas. _____

An inner transition metal. _____

An element with 1 valence electron. _____

An element with 3 valence electrons. _____

An element with 8 valence electrons. _____

An element in the same family as oxygen. _____

An element with an electron configuration ending in p^6. _____

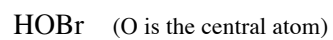An element with an electron configuration ending in d^2. _____

An element that tends to form a +1 ion. _____

An element that is completely inert (non-reactive.) _____

An element that tend for form ions by gaining 2 electrons. _____

An element that tends to form ions by gaining 1 electron. _____

28. a. Draw the Lewis dot structure for each of these.

PI_3 SO_3 HOBr   (O is the central atom)

CH_2S $CFBr_2H$
(C is the central atom)   (C is the central atom)

CO_3^{-2} IO_3^{-1} IO_2^{-1}

CF_2H_2 SO_2 NO_2^{+1}
(C is the central atom)

OF_2 OH^{-1} NH_3

PO_4^{-3} NO_3^{-1} SO_3^{-2}

CSe_2 SSe_2 SI_2

CN^{-1} H_2 F_2 O_2 N_2

b. The lines in your dot structures represent bonds. Are these ionic or covalent bonds (which one)? Explain your answer in terms of what is going on with the electrons.