Some Review Problems for Exam 1 – Chem 1A

(Note: this set of problems is **not** comprehensive. Make sure to review everything on the "Things to Know" handout and the lecture notes.)

1. For the reaction:

   $AlCl_{3\,(aq)} + Mg_{(s)} \rightarrow Al_{(s)} + MgCl_{2\,(aq)}$

   a. How many moles of magnesium are required to react with 5.0 moles of aluminum chloride?

   b. If you start with 50.0 mg of magnesium, how many moles of aluminum can be formed?

   c. Starting with 3.00 g $AlCl_3$, calculate the mass of Mg needed to react.

   d. If you would like to produce 5.0×10^{24} atoms of Al, how many cubic centimeters of Mg must you start with, if Mg has a density of 1.738 g/cm^3?
2. Calculate the mass percent of each element in $Fe_2(C_2O_4)_3$.
3. Write the balanced equation for the combination reaction that would occur between aluminum metal and fluorine gas.
4. a. If you mix 20.0 grams S_8 and 10.0 grams Cl_2, what mass of S_2Cl_2 will be formed?

   $$S_{8\,(s)} + Cl_{2\,(g)} \rightarrow S_2Cl_{2\,(g)}$$

   b. What mass of Cl_2 is needed to produce 85.0 kg of disulfur dichloride?

   c. If the percent yield of this reaction is known to be 86.5 %, what mass of S_8 should you start with to obtain 25.0 g of disulfur dichloride?
5. Rubidium (Rb) consists of two isotopes, ^{85}Rb and ^{87}Rb. Which is more abundant? Explain how you can tell.
6. How many hydrogen atoms are in 2.0 nanograms (ng) of pentane (C_5H_{12})?
7. A compound containing C, H, and O is analyzed by combusting the compound and collecting the water and carbon dioxide produced. If 2.317 g of the compound produces 6.111 g CO_2 and 1.390 g H_2O, determine the empirical formula of this compound.
8. If 5.00 g of $Al(OH)_3$ and 8.00 g of HCl are mixed,

   a. Write the balanced equation for this reaction.

   b. What mass of water will be obtained?

   c. What is the mass of the excess reactant remaining?
9. If 50.0 grams of octane (C_8H_{18}) was burned in excess oxygen, what masses of carbon dioxide and water would be produced?
10. The density of $CO_{2\,(g)}$ at room temperature and pressure is 1.80 g/L. How many CO_2 molecules are there per cubic inch of volume? (1 in = 2.54 cm)
11. Silicon has three stable isotopes. Their masses and percent natural abundances are shown below. Calculate the weighted-average atomic mass of silicon.

^{28}Si	27.97693 amu	92.23 %
^{29}Si	28.97649 amu	4.67 %
^{30}Si	29.97376 amu	3.10 %

12. Write the balanced net ionic equations for the following reactions. Also be able to write the molecular and total ionic equations.

    $CuSO_{4\,(aq)} + Na_3PO_{4\,(aq)} \rightarrow$

    $Ba(OH)_{2\,(aq)} + HC_2H_3O_{2\,(aq)} \rightarrow$

$Na_2S_{(aq)}$ + $AgNO_{3\,(aq)}$ →

$HI_{(aq)}$ + $Li_2CO_{3\,(aq)}$ →

$H_2SO_{3\,(aq)}$ + excess $KOH_{(aq)}$ →

13. An unknown compound is 54.5 % C, 13.7 % H, and 31.8 % N by mass. Its molar mass is approximately 90 g/mol. Determine the empirical formula and the molecular formula of this compound.
14. Be able to name all of the compounds on this handout.
    Be able to classify each of the reactions on this handout.
15. a. How many grams of H_2SO_4 are in 50.0 mL of 6.0 M $H_2SO_{4\,(aq)}$?
    b. What volume of 2.35 M NaOH solution will contain 5.00 g NaOH?
    c. If 35.0 g of Na_2SO_4 are dissolved in 253 mL of solution, what is the molarity of Na_2SO_4 in the solution?
16. Given the following oxidation-reduction reactions, determine all oxidation numbers and state which element is oxidized and which element is reduced.
    a. $Mn^{2+} + H_2O_2 + 2\ OH^- \rightarrow MnO_2 + 2\ H_2O$
    b. $Cr_2O_7^{2-} + 6\ Cl^- + 14\ H^+ \rightarrow 2\ Cr^{3+} + 3\ Cl_2 + 7\ H_2O$
17. Using the activity series in your textbook, predict the outcome of the following:
    a. $Al_{(s)} + H_2SO_{4\,(aq)} \rightarrow$
    b. $Pb_{(s)} + Sn(NO_3)_{2\,(aq)} \rightarrow$
    c. $Sn_{(s)} + Pb(NO_3)_{2\,(aq)} \rightarrow$
18. Silver consists of two isotopes, ^{107}Ag with a mass of 106.90509 amu, and ^{109}Ag with a mass of 108.9047 amu. Calculate the abundance of each isotope.
19. Name each of the following compounds.

$(NH_4)_2SO_3$	PI_3
$SnCl_2$	$AuIO_4$
$H_2C_2O_4$	Cu_2CrO_4

20. Write formulas for each of the following compounds.

barium acetate	carbon disulfide
sulfuric acid	silver oxide
lead (IV) hypobromite	aluminum carbonate

21. How many protons, electrons, and neutrons are in an atom of ^{109}Ag?
22. Give three examples of each of the following:
    a. inner transition elements
    b. halogens
    c. elements in the 5th period
    d. main group elements
23. Balance and classify each of the following reactions:
    a. $N_2O_{(g)} \rightarrow N_{2\,(g)} + O_{2\,(g)}$
    b. $C_7H_{14}O_{2\,(l)} + O_{2\,(g)} \rightarrow H_2O_{(g)} + CO_{2\,(g)}$
24. Write and balance the equation for the combination reaction that would occur between potassium metal and nitrogen gas. Include phase symbols.
25. Titanium has a density of 4.51 g/cm^3. Calculate the volume of a 2.00 kg piece of titanium, in cubic inches. (1 inch = 2.54 cm exactly)
26. $HBr_{(aq)} + Al_{(s)} \rightarrow H_{2\,(g)} + AlBr_{3\,(aq)}$
    a. What mass of HBr is required to react with 0.500 g of aluminum?

b. How many molecules of H_2 will be produced from this reaction? (Starting with 0.500 g Al)

27. $Fe_{(s)} + H_2O_{(g)} \rightarrow Fe_3O_{4\,(s)} + H_{2\,(g)}$

If 50.0 g iron and 30.0 g water are combined,

a. What mass of iron oxide will be formed in theory?

c. What mass of the excess reactant will be left over?

d. If the actual yield of iron oxide is 60.2 g, calculate the percent yield of this reaction.

Answers:

1a. 7.5 mol
1b. 0.00137 mol
1c. 0.820 g
1d. 1.7×10^2 cm^3
2. 29.73 % Fe
19.18 % C
51.10 % O
3. $2Al + 3F_2 \rightarrow 2AlF_3$
4a. 19.0 g
4b. 44.6 kg
4c. 13.7 g
5. ^{85}Rb is more abundant
6. 2.0×10^{14} atoms
7. $C_9H_{10}O_2$
8a. $Al(OH)_3 + 3\ HCl \rightarrow 3\ H_2O + AlCl_3$
8b. 3.46 g
8c. 0.99 g left
9. 154 g CO_2, 71.0 g H_2O
10. 4.04×10^{20} molecules/in^3
11. 28.09 amu
12. see separate sheet of answers
13. ef = C_2H_6N, mf = $C_4H_{12}N_2$
15. a. 24 g H_2SO_4
b. 53.2 mL solution
c. 0.974 M Na_2SO_4
16 a. Mn is ox, O is red.
b. Cr is red., Cl is ox.
17. a. will react, b. won't, c. will react (see answers for reactions.)
18. Using wt. ave mass of 107.8682 from the per. table in the text, abundance of ^{107}Ag = 51.835% and ^{109}Ag = 48.165%
19, 20: see answers
21. 47 protons, 47 e^-, 62 n^0
22, 23, 24: see answers
25. 27.1 in^3
26a. 4.50 g HBr
26b. 1.67×10^{22} H_2 molecules
27a. 69.1 g Fe_3O_4
27b. 8.5 g water left
27c. 87.1 % yield