Chemistry Term 2 Review

Topics:

- Chemical Quantities
  - Moles
  - Molar Mass
  - Percent composition
  - Empirical formula
  - Molecular formula
- Ionic Compounds
  - Identification
  - Properties
  - Ionic Bond
  - Polyatomic Ions
  - Naming Rules
    - Transition Metals
  - Formula Writing
    - Balanced Charges
- Covalent Compounds
  - Identification
  - Properties
  - Covalent Bond
  - Naming Rules
    - Prefixes
  - Formula Writing
- Bonding
  - Lewis Dot Structures
  - Molecular shapes
  - Polarity
  - Intermolecular forces
    - Ionic forces
    - Dipole forces
    - Dispersion forces
    - Hydrogen bonds
- Equations and reactions
  - Balancing equations
  - Completing the equation
- Reaction Types
  - Synthesis/Combination
  - Decomposition
  - Single Replacement
  - Double Replacement
  - Combustion
- Stoichiometry
  - Calculations
    - Mass-to-Mass
    - Mass-to-Volume
    - Volume-to-Volume
  - Percent Yield
    - Actual Yield
    - Theoretical Yield
  - Limiting & Excess Reagents

Solve the following problems:

1. Naming: $LiNO_3$, Mg_3N_2, $CoCO_3$, $Ca(ClO_4)_2$, NiS_2, N_3O_5, P_2Cl_6, S_3Br_4, N_3I_7, C_2Cl_4, $NaC_2H_3O_2$, ~~$Ca(ClO_4)$~~, Li_2SO_3, $Fe(OH)_3$, $NaOH$, $Ba(OH)_2$

2. Formula Writing: Aluminum Chloride, Cesium Carbonate, Beryllium Chromate, Iron (III) Nitrate, Nickel (IV) Cyanide, Copper (II) Phosphate, Disulfur Tetroxide, Nitrogen Monoxide, Tricarbon Hexafluoride, Triphosphorous Heptafluoride, Nitrogen Disulfide, Hydrogen fluoride, Hydrogen selenide, Beryllium Hydroxide, Hydrogen phosphate, Hydrogen nitrite, Iron (II) Hydroxide, Hydrogen sulfate

3. During an experiment, 137.3 g of barium nitride are measured into a beaker. How many moles of barium nitride are in the beaker? .3120 mol

4. When preparing to conduct a lab, a student is instructed to obtain 3.36×10^{-3} moles of disulfur tetrachloride. How many grams of disulfur tetrachloride will the student need to obtain? .692 g

5. A balloon is filled with 18.21 g of calcium phosphate. How many molecules of calcium phosphate are contained in the balloon? $3.535 \cdot 10^{22}$ molec

6. Determine the percent composition of:
   a. Sodium sulfate 32.37% Na, 22.58% S, 45.05% O
   b. Carbon tetrachloride 7.81% C, 92.19% Cl
   c. Hydrogen phosphate 3.09% H, 31.60% P, ~~65~~ 65.31% O

7. If a 5.00 g sample of copper reacts with nitrogen, 5.37 g of a compound containing copper and nitrogen is produced.
   a. Determine the percent composition of this compound. 93.1% Cu, 6.9% N
   b. Determine the empirical formula of this compound. Cu_3N
   c. Name this compound. copper (I) nitride

8. Nicotine (which is very, very bad for you) is 74.02% carbon, 8.71% hydrogen and 17.27% nitrogen and has a molar mass of 162.26 g/mol. Determine the empirical and molecular formulas. Make sure you put a box around BOTH formulas! And don't smoke. Or vape. EF = C_5H_7N, MF = $C_{10}H_{14}N_2$

9. A compound is known to contain only iron and fluorine. If 10.21 g of the compound are measured and found to contain 6.07 g of iron, what is the name of the compound? iron (II) fluoride

10. Draw the Lewis dot structure for the following compounds. What is its geometry (molecular shape)? Do you think this would be polar molecule? Why or why not? What are the intermolecular forces that hold the molecules together?
    a. Ammonia (NH_3)
    b. Oxygen difluoride
    c. Silicon tetrachloride
    d. Carbon dioxide
    e. Hydrogen iodide

11. Put the following compounds in order from highest melting point to lowest. Explain your order: **Phosphorus trihydride, calcium chloride, silicon dioxide, and hydrogen fluoride.**

12. Write complete, balanced equations for the following reactions, then identify which type of reaction it is:
    a. Calcium reacts with fluorine
    b. Butane, C_4H_{10}, combusts
    c. Aluminum reacts with silver (I) nitrate
    d. Sodium chloride decomposes into its elements
    e. Chromium (III) bromide reacts with ammonium phosphate
    f. Hydrogen sulfate reacts with potassium hydroxide

13. Calcium nitrate reacts with sodium phosphate.
    a. Write the balanced equation.
    b. How many grams of calcium phosphate can be prepared from the mixing of 33.50 g of sodium phosphate with excess calcium nitrate? 31.69 g $Ca_3(PO_4)_2$

14. When 7.85 g of strontium chloride are mixed with excess tin (III) nitrate in a lab, 6.86 g of tin (III) chloride are produced. What is the percent yield of tin (III) chloride in this lab? (Hint: write the equation first) 92.3%

15. During an experiment, 26.8 g of sodium nitride solution are combined with excess cobalt (II) nitrate. If the percent yield of cobalt (II) nitride is determined to be 85.61%, what was the actual yield of cobalt (II) nitride (in g)? (Hint: write the equation first) 28.3 g Co_3N_2

16. When 18.43 g of potassium carbonate and 12.36 g of iron (III) nitrate are combined, a reaction takes place. (Hint: write the equation first)
    a. What is the limiting reagent? $Fe(NO_3)_3$
    b. How many grams of iron (III) carbonate are produced? 7.454 g $Fe_2(CO_3)_3$
    c. What mass of the excess reagent is left over? 7.85 g K_2CO_3

17. During an experiment, 7.536 g of sodium phosphate are mixed with 12.12 g of magnesium nitrate. (Hint: write the equation first)
    a. What is the limiting reagent? Na_3PO_4
    b. If 5.01 g of magnesium phosphate are formed, what is the percent yield in this reaction? 82.9%

18. A student combines 2.94 g strontium hydroxide with 5.07 g hydrogen bromide. (Hint: write the equation first)
    a. What is the limiting reagent? $Sr(OH)_2$
    b. How many grams of the salt produced by this reaction can be formed? 5.98 g $SrBr_2$
    c. What mass of the excess reagent will be left over? 1.16 g HBr

① $LiNO_3$ lithium nitrate
Mg_3N_2 magnesium nitride
$CoCO_3$ cobalt (II) carbonate
$Ca(ClO_4)_2$ calcium perchlorate
NiS_2 Nickel (IV) sulfide
N_3O_5 trinitrogen pentoxide
P_2Cl_6 diphosphorus hexachloride
S_3Br_4 trisulfur tetrabromide
N_3I_7 ~~trito~~ nitrogen heptaiodide
C_2Cl_4 dicarbon tetrachloride
$NaC_2H_3O_2$ sodium acetate
Li_2SO_3 lithium sulfite
$Fe(OH)_3$ iron (III) hydroxide
$NaOH$ sodium hydroxide
$Ba(OH)_2$ barium hydroxide

② Aluminum chloride $AlCl_3$
cesium carbonate Cs_2CO_3
beryllium chromate $BeCrO_4$
iron(III) nitrate $Fe(NO_3)_3$
Nickel (IV) cyanide $Ni(CN)_4$
copper (II) phosphate $Cu_3(PO_4)_2$
disulfur tetroxide S_2O_4
nitrogen monoxide NO
tricarbon hexafluoride C_3F_6
triphosphorus heptafluoride P_3F_7
nitrogen disulfide NS_2
hydrogen fluoride HF
hydrogen selenide H_2Se
beryllium hydroxide $Be(OH)_2$
hydrogen phosphate H_3PO_4
hydrogen nitrite HNO_2

iron (II) hydroxide $Fe(OH)_2$
hydrogen sulfate H_2SO_4

③ $(x)\ mol = \frac{137.3g\ Ba_3N_2}{} \Big| \frac{1\ mol}{~~430.~~\ 440.01g} = \boxed{.3120\ mol}$

④ ~~%~~ $(x)\ g = \frac{3.36 \cdot 10^{-3}\ mol\ S_2Cl_4}{} \Big| \frac{205.94\ g}{1\ mol} = \boxed{.692\ g}$

⑤ $(x)\ molec = \frac{18.21g\ Ca_3(PO_4)_2}{} \Big| \frac{1\ mol}{310.18g} \Big| \frac{6.022 \cdot 10^{23}\ molec}{1\ mol}$

$= \boxed{3.535 \cdot 10^{22}\ molec}$

⑥ a) Na_2SO_4

Na: $\frac{45.98g}{142.05g} = \boxed{32.37\%\ Na}$

S: $\frac{32.07g}{142.05g} = \boxed{22.58\%\ S}$

O: $\frac{64.00g}{142.05g} = \boxed{45.05\%\ O}$

~~⑦ 5.00g copper + nitrogen → 5.37g compound~~
~~0.37g~~

⑥ b) CCl_4

C: $\frac{12.01g}{153.81g} = \boxed{7.81\%\ C}$

Cl: $\frac{141.80g}{153.81g} = \boxed{92.19\%\ Cl}$

c) H_3PO_4

H: $\frac{3.03g}{98.00g} = \boxed{3.09\%\ H}$

P: $\frac{30.97g}{98.00g} = \boxed{31.60\%\ P}$

O: $\frac{64.00g}{98.00g} = \boxed{65.31\%\ O}$

(7) copper + nitrogen → compound
5.00g ? = .37g 5.37g

a) Cu: $\frac{5.00g}{5.37g}$ = **93.1% Cu**

N: $\frac{.37g}{5.37g}$ = **6.9% N**

b) * you can start with the masses of Cu + N from the problem or start with % from a

$\frac{93.1\text{ g Cu}}{} \Big| \frac{1\text{ mol}}{63.55g} = \frac{1.46\text{ mol Cu}}{.49} = 3$

$\frac{6.9\text{ g N}}{} \Big| \frac{1\text{ mol}}{14.01g} = \frac{.49\text{ mol N}}{.49} = 1$

EF = Cu_3N

OR

$\frac{5.00\text{g Cu}}{} \Big| \frac{1\text{ mol}}{63.55g} = \frac{.0787\text{ mol Cu}}{.0264} = 3$

$\frac{.37\text{ g N}}{} \Big| \frac{1\text{ mol}}{14.01g} = \frac{.0264\text{ mol N}}{.0264} = 1$

EF = Cu_3N

c) **Cu_3N = copper (I) nitride**

(8) $\frac{74.02g\text{ C}}{} \Big| \frac{1\text{ mol}}{12.01g} = \frac{6.163\text{ mol C}}{1.233} = 5$

$\frac{8.71g\text{ H}}{} \Big| \frac{1\text{ mol}}{1.01g} = \frac{8.62\text{ mol H}}{1.233} = 7$

$\frac{17.27g\text{ N}}{} \Big| \frac{1\text{ mol}}{14.01g} = \frac{1.233\text{ mol N}}{1.233} = 1$

EF = C_5H_7N

$\frac{MF}{EF} = \frac{162.26\text{ g/mol}}{81.13\text{ g/mol}} = 2$

MF = $C_{10}H_{14}N_2$

(9) iron + fluorine → compound

6.07g ? = 4.14g 10.21 g

Determine Formula

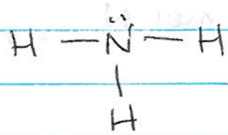
$\frac{6.07\text{g Fe}}{} \Big| \frac{1\text{mol}}{55.85\text{g}} = \frac{.109 \text{ mol Fe}}{.109} = 1$

$\frac{4.14\text{g F}}{} \Big| \frac{1\text{mol}}{19.00\text{g}} = \frac{.218 \text{ mol F}}{.109} = 2$

FeF_2

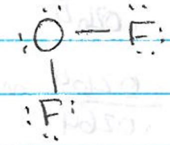
FeF_2 = iron (II) fluoride

(10) a) NH_3



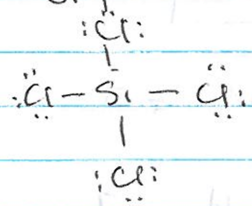
Pyramidal
polar - slice N away from H
H - bond

b) OF_2



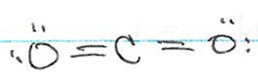
bent
Polar - slice O away from F
dipole

c) $SiCl_4$



tetrahedral
nonpolar - can't slice Cl from Si
dispersion

d) CO_2



linear
nonpolar - no slicing, even pull
dispersion

e) HI

linear
polar - slice H away from I
dipole

(11) highest MP $CaCl_2$ ionic

HF H-bonds

PH_3 dipole

lowest MP SiO_2 dispersion

ionic compounds have ionic forces holding different molecules together. Ionic forces are very strongly + attractive so it takes a lot of heat to overcome attraction & get molecules to move farther apart & melt. HF has next highest MP because H-bonds are not as strongly attractive as ionic bonds but more strongly attractive than dipole & dispersion. Dipole (PH_3) is next, then dispersion (SiO_2). Non polar molecules have lowest MP because they are only weakly attracted to each other. It doesn't take much heat to overcome attraction between molecules & get them to separate.

(12) a) $Ca + F_2 \rightarrow CaF_2$ combination

b) $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$ combustion

c) $Al + 3AgNO_3 \rightarrow Al(NO_3)_3 + Ag$ Single replace

d) $2NaCl \rightarrow 2Na + Cl_2$ decomp

e) $CrBr_3 + (NH_4)_3PO_4 \rightarrow 3NH_4Br + CrPO_4$ double rep.

f) $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2HOH$ double

$(2H_2O)$

(13) a) $2Ca(NO_3)_2 + 2Na_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6NaNO_3$

b) (x)g $Ca_3(PO_4)_2$ =

33.50 g Na_3PO_4	1 mol Na_3PO_4	1 mol $Ca_3(PO_4)_2$	310.18 g $Ca_3(PO_4)_2$
	163.94 g Na_3PO_4	2 mol Na_3PO_4	1 mol $Ca_3(PO_4)_2$

= **31.69 g $Ca_3(PO_4)_2$**

(14) $3SrCl_2 + 2Sn(NO_3)_3 \rightarrow 2SnCl_3 + 3Sr(NO_3)_2$

get theoretical yield from 7.85g $SrCl_2$

$$\frac{(x)\,g}{SnCl_3} = \frac{7.85\,g\ SrCl_2}{} \left| \frac{1\ mol\ SrCl_2}{158.62\,g\ SrCl_2} \right| \frac{2\ mol\ SnCl_3}{3\ mol\ SrCl_2} \left| \frac{225.21\,g\ SnCl_3}{1\ mol\ SnCl_3} \right. = 7.43\,g\ SnCl_3\ (TY)$$

$$\%\ yield = \frac{Actual}{theoretical} = \frac{6.86\,g}{7.43\,g} \cdot 100 = \sout{92.3\%}\ \boxed{92.3\%}$$

(15) $2Na_3N + 3Co(NO_3)_2 \rightarrow Co_3N_2 + 6NaNO_3$

$$\frac{(x)\,g}{Co_3N_2} = \frac{26.8\,g\ Na_3N}{} \left| \frac{1\ mol\ Na_3N}{82.98\,g\ Na_3N} \right| \frac{1\ mol\ Co_3N_2}{2\ mol\ Na_3N} \left| \frac{204.81\,g\ Co_3N_2}{1\ mol\ Co_3N_2} \right. = 33.1\,g\ Co_3N_2$$

$$\%\ yield = \frac{actual}{theoretical}$$

$$.8561 = \frac{actual}{33.1\,g} \qquad \boxed{actual = 28.3\,g}$$

(16) $3K_2CO_3 + 2Fe(NO_3)_3 \rightarrow 6KNO_3 + Fe_2(CO_3)_3$

b) $$\frac{(x)\,g}{Fe_2(CO_3)_3} = \frac{18.43\,g\ K_2CO_3}{} \left| \frac{1\ mol\ K_2CO_3}{138.21\,g\ K_2CO_3} \right| \frac{1\ mol\ Fe_2(CO_3)_3}{3\ mol\ K_2CO_3} \left| \frac{291.73\,g\ Fe_2(CO_3)_3}{1\ mol\ Fe_2(CO_3)_3} \right.$$

$= 12.97\ g\ Fe_2(CO_3)_3$

$$= \frac{12.36\,g\ Fe(NO_3)_3}{} \left| \frac{1\ mol\ Fe(NO_3)_3}{241.88\,g\ Fe(NO_3)_3} \right| \frac{1\ mol\ Fe_2(CO_3)_3}{2\ mol\ Fe(NO_3)_3} \left| \frac{291.73\,g\ Fe_2(CO_3)_3}{1\ mol\ Fe_2(CO_3)_3} \right.$$

$= \boxed{7.454\ g\ Fe_2(CO_3)_3}$

a) LR = $Fe(NO_3)_3$

ER = K_2CO_3

(16) c) $12.97\ g\ Fe_2(CO_3)_3 - 7.454\ g\ Fe_2(CO_3)_3 = 5.52\ g\ Fe_2(CO_3)_3$

$5.52\ g\ Fe_2(CO_3)_3$	$1\ mol\ Fe_2(CO_3)_3$	$3\ mol\ K_2CO_3$	$138.21\ g\ K_2CO_3$
	$291.73\ g\ Fe_2(CO_3)_3$	$1\ mol\ Fe_2(CO_3)_3$	$1\ mol\ K_2CO_3$

= **$7.85\ g\ K_2CO_3$ left over**

(17) $2Na_3PO_4 + 3Mg(NO_3)_2 \rightarrow 6NaNO_3 + Mg_3(PO_4)_2$

a) $(x)\ g\ Mg_3(PO_4)_2$ =

$7.536\ g\ Na_3PO_4$	$1\ mol\ Na_3PO_4$	$1\ mol\ Mg_3(PO_4)_2$	$262.87\ g\ Mg_3(PO_4)_2$
	$163.94\ g\ Na_3PO_4$	$2\ mol\ Na_3PO_4$	$1\ mol\ Mg_3(PO_4)_2$

TY → $= 6.042\ g\ Mg_3(PO_4)_2$

$(x)\ g\ Mg_3(PO_4)_2$ =

$12.12\ g\ Mg(NO_3)_2$	$1\ mol\ Mg(NO_3)_2$	$1\ mol\ Mg_3(PO_4)_2$	$262.87\ g\ Mg_3(PO_4)_2$
	$148.33\ g\ Mg(NO_3)_2$	$3\ mol\ Mg(NO_3)_2$	$1\ mol\ Mg_3(PO_4)_2$

LR = Na_3PO_4 $= 7.160\ g\ Mg_3(PO_4)_2$

b) % yield = $\frac{\text{actual}}{\text{theoretical}} = \frac{5.01\ g}{6.042\ g}$ = **82.9 %**

mass of $Mg_3(PO_4)_2 = 6.042\ g\ Mg_3(PO_4)_2$ (theoretical)

LR = Na_3PO_4
ER = $Mg(NO_3)_2$

(18) $Sr(OH)_2 + 2HBr \rightarrow SrBr_2 + 2HOH$

b)

$$\frac{2.94\text{ g } Sr(OH)_2}{} \times \frac{1\text{ mol } Sr(OH)_2}{121.64\text{ g } Sr(OH)_2} \times \frac{1\text{ mol } SrBr_2}{1\text{ mol } Sr(OH)_2} \times \frac{247.42\text{ g } SrBr_2}{1\text{ mol } SrBr_2} = \boxed{5.98\text{ g } SrBr_2}$$

$$\frac{5.07\text{ g } HBr}{} \times \frac{1\text{ mol } HBr}{80.91\text{ g } HBr} \times \frac{1\text{ mol } SrBr_2}{2\text{ mol } HBr} \times \frac{247.42\text{ g } SrBr_2}{1\text{ mol } SrBr_2} = 7.75\text{ g } SrBr_2$$

a) LR = ~~2.94~~ $Sr(OH)_2$
ER = HBr

c) $7.75\text{ g } SrBr_2 - 5.98\text{ g } SrBr_2 = 1.77\text{ g } SrBr_2$

$$\frac{1.77\text{ g } SrBr_2}{} \times \frac{1\text{ mol } SrBr_2}{247.42\text{ g } SrBr_2} \times \frac{2\text{ mol } HBr}{1\text{ mol } SrBr_2} \times \frac{80.91\text{ g } HBr}{1\text{ mol } HBr} = \boxed{1.16\text{ g } HBr}$$