Review Package #2

Measurement and Communication
The Mole
Chemical Reactions and Equations
Stoichiometry

1. <u>Measurement and Communication</u>:

A. Scientific Notation:
- Conversion of numbers from decimal into scientific notation and vice versa

B. Uncertainty in Measurement
- Difference between accuracy and precision
- Significant figures (multiplication, division, adding and subtracting)

C. Unit Conversions
- metric SI prefixes (milli, centi, micro, etc.)
- converting between units (ie. millimitres to micrometres, etc.)

2. <u>The Mole</u>:

A. Molar Mass (text pgs. 311-322)

B. Mole Conversions (text pgs. 323-331)
- Converting between moles and atoms/molecules (Avogadro's number; 1 mole = 6.022×10^{23} atoms/molecules/particles)
- Converting between moles and mass (grams)
- Multi-step conversions (ie. grams to moles to molecules)
- Conversions using molar volume (litres per mole) of a gas (at STP 1 mole = 22.4L)

C. Percentage Composition, Empirical and Molecular Formulae (text pgs. 332-339)

D. Molarity (Molar concentration = M)
- Calculating molarity (mol/L) using unit conversions
- Dilutions ($m_1v_1=m_2v_2$)

3. <u>Chemical Reactions and Equations</u>:

A. Balancing Equations (text pgs. 282-289)

B. Classifying Reaction Types (text pgs. 291-296)
- synthesis, decomposition, single replacement, double replacement, neutralization, combustion
- predicting products of reactions

C. Energy of Reactions
- exothermic and endothermic reactions

4. <u>Stoichiometry</u>:

A. Stoichiometry (text pgs. 347-364
- performing mole calculations based on coefficient ratios in a balanced chemical equation (using the flowchart notes)

B. Excess and Limiting Reagents (text pgs. 365-373)
- identifying limiting and excess reagents in a chemical reaction
- calculating the amount of excess reactant
- calculating the amount of product formed in a reaction using the limiting reactant

C. Percent Yield (text pgs. 365-373)
- calculating the efficiency of a chemical reaction from percent yield

Measurement and Communication:

1. Complete the following table of prefixes.

Factor	Prefix	Abbreviation
10^{6}		
	kilo	
		h
10^{1}		
	deci	
		c
10^{-3}		
	micro	
		n
10^{-12}		

2. A student weighed a mass 4 times and obtained the following masses:

25.5g, 29.6g, 23.6g, 27.3g

The actual value is known to be 10.20045g

What can be said about the accuracy and precision of the measurements?

3. Write the following numbers in scientific notation with the same number of significant digits.

a) 0.000005187 _____

b) 7,247 _____

c) 16,140 _____

d) 0.0921 _____

4. Convert the following numbers from scientific notation into decimal form.

a) 4.562×10^{6} _____

b) 8.276×10^{-8} _____

5. Complete the following calculations. Include all units and don't forget about sig figs.

a) 1.0068g + 2.15g + 8.3g =

b) 21.05cm – 12.1cm =

c) $\dfrac{1.50 \times 10^{-2}\ \text{mol}}{40.0\text{mL}}$ =

d) $\dfrac{432.8\text{g}}{21.8\text{cm} \times (7.645\text{cm} - 3.58\text{cm})}$ =

6. Convert 12 milliamperes into megaamperes.

7. Convert 42.6μmol/mL into mol/L.

8. Determine how many significant figures are in each of the following numbers:

a) 1.00300
b) 780.00
c) 0.1110
d) 3000
e) 0.003050
f) 7,000,800
g) 0.00567
h) 3.000

Mole Conversions:

1. Calculate the MOLAR MASS of the following substances.

a) $CuSO_4$
b) $Ca(MnO_4)_2$

2. Calculate the number of moles of CO_2 that would be present in 8.7×10^{18} molecules of CO_2.

3. How many grams of Copper would be present in 4.5×10^{-3} moles of Copper?

4. Calculate the mass (in g) of 2.7×10^{21} molecules of ammonia (NH_3).

5. Determine the mass (in grams) of one atom of Silver.

6. How many molecules are in 75.6g of $CH_3C(OH)_2CH_3$?

7. What is the volume occupied by 15mg of $SbH_{3(g)}$ at STP?

Percentage Composition, Empirical and Molecular Formulae:

1. Write the empirical formula for each of the following compounds.

a) P_4O_{10} _____ c) $Pb_2(CO_3)_4$ _____

b) Mg_2Cl_4 _____ d) N_2O_2 _____

2. Calculate the percentage composition by mass of each of the following compounds.

a) CO_2 b) C_4H_8O

3. Calculate the percentage composition of the bold species in each of the following compounds.

a) $Cu(\mathbf{NO_3})_2$ b) $NaSCN \cdot 5\mathbf{H_2O}$

4. a) A compound has the following composition: 24.24% C, 4.04% H and 71.72% Cl. What is the empirical formula of the compound?

b) If the molecular mass of this compound is 99.5 g/mol, what is the molecular formula?

5. The molar mass of a compound is 58g/mol. What is the molecular formula of the compound if the empirical formula is C_2H_5?

Molarity Calculations:

1. If a 4.50g sample of solid NaOH is dissolved to make 0.500L of solution, what is the molarity of the solution?

2. How many grams of Na_2CO_3 would be required to produce 400.0mL of 0.600M Na_2CO_3?

3. If 75.7g of Magnesium chloride are mixed with sufficient water to make a 0.885M solution, what is the volume of the solution?

4. How many mL of 16.4 M H_2SO_4 are needed to prepare 755mL of 0.25M H_2SO_4?

Chemical Reactions and Equations:

1. Balance and classify the following chemical reactions. Type of Reaction

a) ___KNO_3 → ___KNO_2 + ___O_2

_____

b) ___CaC_2 + ___O_2 → ___Ca + ___CO_2

_____

c) ___C_5H_{12} + ___O_2 → ___CO_2 + ___H_2O

_____

d) ___K_2SO_4 + ___$BaCl_2$ → ___KCl + ___$BaSO_4$

_____

e) ___KOH + ___H_2SO_4 → ___K_2SO_4 + ___H_2O

_____

f) ___$Ca(OH)_2$ + ___NH_4Cl → ___NH_4OH + ___$CaCl_2$

_____

g) ___C_4H_9S + ___O_2 → ___CO_2 + ___SO_2 + ___H_2O

_____

h) ___$C_{15}H_{30}$ + ___O_2 → ___CO_2 + ___H_2O

_____

i) ___BN + ___F_2 → ___BF_3 + ___N_2

_____

j) ___Na + ___ZnI_2 → ___NaI + ___Zn

_____

2. Classify, complete AND balance the following chemical equations. Type of Reaction

a) ___$Ni_{(s)}$ + ___$Cu(NO_3)_{2(aq)}$ →

_____

b) ___$Fe_{(s)}$ + ___$O_{2(g)}$ →

_____

c) ___$NaCl_{(s)}$ →

_____

d) ___ $H_2SO_{4(aq)}$ + ___$NaOH_{(aq)}$ →

_____

e) ___$C_4H_{10(l)}$ + ___$O_{2(g)}$ →

_____

f) ___$Ag_{(s)}$ + ___$Cl_{2(g)}$ →

_____

g) ___$Cl_{2(g)}$ + ___$KI_{(s)}$ →

_____

h) ___$Fe_{(s)}$ + ___$AgCl_{(aq)}$ →

_____

i) ___$AgNO_{3(aq)}$ + ___$BaCl_{2(aq)}$ →

_____

j) ___$BaCO_{3(aq)}$ + ___$Sr(OH)_{2(aq)}$ →

_____

k) ___$C_2H_5OH_{(l)}$ + ___$O_{2(g)}$ → _____

l) ___$HNO_{3(aq)}$ + ___$KOH_{(aq)}$ →

_____

<u>Energy of Reactions</u>:

1. Define ENDOTHERMIC and EXOTHERMIC reactions.

Endothermic:_____

_____

_

Exothermic: _____

_____

_

2. Classify the following reactions as either endothermic or exothermic.

a) $2C + O_2 \rightarrow 2CO_2 + energy$

_____

b) $N_2O_4 + energy \rightarrow N_2 + 2O_2$ _____

c) $AB + C \rightarrow CB + A + 56.9kJ$

_____

d) $AB + CD \rightarrow AD + BC \quad \Delta H = -256.4kJ$

_____

Stoichiometry:

1. Ammonia combines with oxygen gas in the following reaction:

$$4\ NH_3 + 5O_2 \rightarrow 6H_2O + 4NO$$

a) How many moles of NH_3 are needed to combine with 3.57 moles of O_2 gas?

b) If 1.5 grams of NO is produced in the above reaction, how many grams of NH_3 were reacted?

2. $3Na_2CO_3 + 2FeCl_3 \rightarrow 6NaCl + Fe_2(CO)_3$

a) How many grams of NaCl will be produced from the reaction of 0.080moles of Na_2CO_3 with excess $FeCl_3$?

b) How many grams of $FeCl_3$ would be needed to react with 4.2g of Na_2CO_3?

3. $3Mg + 2AlCl_3 \rightarrow 3MgCl_2 + 2Al$

a) How many grams of $MgCl_2$ would be formed if 50.0mL of 0.200M $AlCl_3$ is reacted with excess Mg?

b) How many mL of 0.150M $AlCl_3$ would be needed to react completely with 2.00g of Mg?

Excess and Limiting Reagents/Percent Yield:

1. $2Fe_2S_3 + 9O_2 \rightarrow 2Fe_2O_3 + 6\ SO_2$

In a chemical reaction 6.92g of Fe_2S_3 is combined with 4.54g of oxygen gas.
a) Which reactant is the **LIMITING** reagent?

b) How many grams of the **EXCESS** reactant will be **left over** after the reaction is complete?

c) How many grams of Fe_2O_3 can be formed in this reaction?

2. What mass of P_4 will be produced when 41.5g of $Ca_3(PO_4)_2$, 26.3g of SiO_2, and 7.80g of C are reacted according to the following balanced equation?

$$2\ Ca_3(PO_4)_2 + 6\ SiO_2 + 10C \rightarrow P_4 + 6CaSiO_3 + 10CO$$

3. $4Al + 3O_2 \rightarrow 2Al_2O_3$

a) How many grams of aluminum oxide, Al_2O_3, would be expected to form in the reaction of 15.0g Al with 18.43g of oxygen gas?

b) If the actual yield of Al_2O_3 produced in the reaction was only 22.4g Al_2O_3, what would the PERCENT YIELD of the reaction be?