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CHM 151 Exam 3: Chapters 3 and 4

You must show all work to receive credit. Clearly mark your final answer!

1. (11 pts) Balancing equations:

   a. _2_ $FeCl_3$ (aq) + ___ $Be_3(PO_4)_2$ (aq) → _3_ $BeCl_2$ (aq) + _2_ $FePO_4$ (aq)

   b. ___ $(NH_4)_2CO_3$ (s) → _2_ NH_3 (g) + ___ CO_2 (g) + ___ H_2O (l)

   c. _2_ N_2 (g) + _5_ O_2 (g) → _2_ N_2O_5 (g)

2. (6 pts) You are working in a chemistry stockroom and are asked to prepare a demo of 1 mole of the following substances. Indicate what type of particle each formula represents (atom, molecule, formula unit). Also determine what mass you must measure to show 1 mole of each of the following.

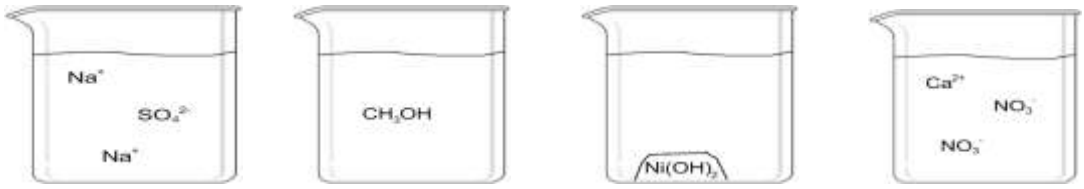
		particle type	**mass**
a.	CCl_4:	__molecule_____	___153.811 g_____
b.	Ca:	__atom_____	___40.08 g_____
c.	$Fe(OH)_3$	__formula unit_____	___106.874 g_____

3. (4 pts) How many molecules of water are in 1.000 teaspoon? (1 teaspoon = 4.914 g at room temperature)

4.914 g H_2O * (1 mol / 18.016 g) * (6.022×10^{23} molecules / 1 mol) = **1.643×10^{23} molecules H_2O**

4. (6 pts) Draw what 1 mole of the following compounds would look like if dissolved in each beaker of water.

Na_2SO_4 **CH_3OH** **$Ni(OH)_2$** **$Ca(NO_3)_2$**



5. (9 pts) A student is asked to combine copper (II) nitrate and sodium carbonate in a lab experiment. Complete the molecular equation with products (including phases) and balancing. Then write the complete ionic and net ionic equations for this reaction.

Molecular: ___ $Cu(NO_3)_2$ (aq) + ___Na_2CO_3(aq) → ___$CuCO_3$(s) + $2NaNO_3$(aq)_____

Ionic: _Cu^{2+}(aq) + $2NO_3^-$(aq) + $2Na^+$(aq) + CO_3^{2-}(aq) → $CuCO_3$(s) + $2Na^+$(aq) + $2NO_3^-$(aq)_____

Net Ionic: __ Cu^{2+}(aq) + CO_3^{2-}(aq) → $CuCO_3$(s) _____

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6. (13 pts) For the following reactants,

a) Determine what type of reaction will occur
   - Combination (C), Decomposition (D), Single-replacement (SR), Double-Replacement/Precipitation (P), Double-replacement/Acid-Base Neutralization (AB), Combustion (B) or No Reaction (NR)
b) Predict the product(s) of the reaction
c) Write correct phases of the product(s)
d) Balance the equation

Reaction Type	**Reactants**	**Products**
__NR___	___Ag(s) + ___$Zn(NO_3)_2$(aq) →	__NR_____
__C___	___K(s) + ___Cl_2(g) →	___2 KCl(s)_____
__B___	_2_C_4H_{10}(l) + _13_O_2(g) →	__8 CO_2(g) + 10 H_2O(g)_____
__SR____	___Ca(s) + _2_HCl(aq) →	_$CaCl_2$(aq) + H_2(g) _____

_D_ 7. (5 pts) When H_2SO_4 reacts with NaOH, which of the following represents the net ionic equation?

a. No net ionic equation (no reaction)
b. $Na^+(aq) + SO_4^{2-}(aq) \rightarrow Na_2SO_4(s)$
c. $Na^+(aq) + SO_4^{2-}(aq) \rightarrow Na_2SO_4(aq)$
d. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
e. $H^+(aq) + OH^-(aq) \rightarrow H_2O(aq)$

8. (5 pts) Identify the oxidation number of **each element** in the following substances:

a) CdS Cd: +2, S: -2 b) ClO_4^{1-} Cl: +7, O: -2 c) O_2(g) O_2: 0

9. (5 pts) In the following equation, identify the a) species being reduced, b) species being oxidized, c) reducing agent, and d) oxidizing agent.

$$Cu(NO_3)_2\ (aq) + Ni\ (s) \rightarrow Ni(NO_3)_2\ (aq) + Cu\ (s)$$

Oxidized: __Ni_____ Oxidizing agent: _$Cu(NO_3)_2$_____

Reduced: __Cu^{2+} in $Cu(NO_3)_2$_ Reducing agent: __Ni_____

_C_ 10. (5 pts) What will be the concentration (in M) of a solution made by adding 2.3656 g of NaOH to 500.00 mL of deionized water?

a. 0.0047312 M
b. 0.059143 M
c. 0.11829 M
d. 1.1828 M

11. (2 pts) What is the concentration of the above solution if you **add** 500.0 mL of water to it?

Double volume = ½ concentration 0.11829 M / 2 = **0.059143 M**

$M_1V_1 = M_2V_2$ (0.11829 M)(500.00 mL) = (x M)(1000.0 mL)

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12. (14 pts) In lab, you are asked to combine solid NaOH and aqueous $FeCl_3$ in a beaker and separate the precipitate. Complete the equation by indicating the phases of the products and balancing it. Then determine the theoretical mass of precipitate.

_3_NaOH (s) + ____ $FeCl_3$ (aq) → ___ $Fe(OH)_3$_(s)_ + _3__ NaCl_(aq)_

a) (10 pts) Determine the theoretical mass of precipitate formed if 2.6890 g of NaOH are reacted with 25.54 mL of 0.5012 M $FeCl_3$.

2.6890 g NaOH * (1 mol / 39.998 g) * (1 mol $Fe(OH)_3$ / 3 mol NaOH) * (106.874 g $Fe(OH)_3$ / 1 mol) = 2.39499 g $Fe(OH)_3$

(0.02554 L)(0.5012 mol/L) = 0.0128006 mol $FeCl_3$ * (1 mol $Fe(OH)_3$ / 1 mol $FeCl_3$) * (106.874 g / 1 mol) = 1.36806 g $Fe(OH)_3$

Theoretical mass = 1.368 g $Fe(OH)_3$

b) (2 pts) Calculate the percent yield if 1.2556 g of precipitate are actually formed.

1.2556 g / 1.368 g x 100% = **91.78%**

14. (8 pts) Complete the equation below with products, phases, and balancing:

H_2CO_3 (aq) + 2 LiOH(aq) → Li_2CO_3(aq) + $2H_2O$(l)

You begin a titration with 1.012 M of base in a buret. From the buret, you deliver 14.53 mL of the base to a flask containing 30.00 mL of acid in order to reach a nice, light pink end point. Based on your data, what is the concentration of the acid?

(1.012 mol/L)(0.01453 L) = 0.014704 mol LiOH * (1 mol H_2CO_3 / 2 mol LiOH) = 0.0735218 mol H_2CO_3

0.0735218 mol H_2CO_3 / 0.03000 L = **0.2451 M H_2CO_3**

15. (7 pts) Find the empirical formula of pentane (a major component of a fuel mixtures) if it contains 85.62% Carbon and 14.37% Hydrogen.

85.62% C → 85.62 g C * (1 mol / 12.011 g) = 7.1285 mol C / 7.1285 = 1

empirical formula: **CH_2**

14.37% H → 14.37 g H * (1 mol / 1.008 g) = 14.256 mol H / 7.1285 = 2

What is the molecular formula of pentane if its actual molar mass is 70.135 g/mol?

CH_2 = 14.027 g/mol 70.135 / 14.027 = 5 $(CH_2)_5$ → **C_5H_{10} (molecular formula)**