Chemistry 120
Rio Hondo College
Spring 2015 Exam 3

Name ___Key___

Exam #1 – 100 points
Directions: Answer each question below to the best of your ability. Show all work where calculations are required. An information sheet with a periodic table is attached to the back of the exam; you may remove it if you wish.

1. (27) Fill in the product(s) of each chemical reaction below, then balance the chemical equation. Write 'no reaction' if you do not expect a reaction to occur.

a. ______$Na_2O(s)$ + ______$CO_2(g)$ → $Na_2CO_3(s)$

b. __1__$FeCl_3$ (aq) + __3__NaOH (aq) → 1 $Fe(OH)_3(s)$ + 3 NaCl(aq)

c. __1__H_2SO_4 (aq) + __2__$NaNO_2$ → 2 $HNO_2(aq)$ + 1 $Na_2SO_4(aq)$

d. ______$MgCl_2$ (aq) + $LiNO_3$(aq) → no reaction

e. __4__P(s) + __5__$O_2(g)$ → 2 $P_2O_5(s)$

f. ______$CaSO_4(s)$ $\xrightarrow{\Delta}$ CaO (s) + $SO_3(g)$

g. __2__C_8H_{18} (l) + __25__O_2 (g) → 16 $CO_2(g)$ + 18 $H_2O(g)$

h. ______Ca(s) + __2__HCl(aq) → $CaCl_2(aq)$ + H_2 (g)

i. ______HNO_3 (aq) + ______$NaHCO_3$ (aq) → $NaNO_3(aq)$ + $H_2O(l)$ + $CO_2(g)$

2. (12) Write balanced chemical equations for each of the following reactions. Indicate all states. A reaction does occur in each case; do not write 'no reaction'.
   a. Ethyl butyrate is a liquid that smells like pineapples and has a molecular formula of $C_6H_{12}O_2$. It is burned in air.

      $C_6H_{12}O_2(l) + 8 O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(g)$

   b. Potassium chlorate is strongly heated

      $2KClO_3(s) \xrightarrow{\Delta} 2KCl(s) + 3O_2(g)$

   c. Aqueous solution of sodium chloride and fluorine gas are combined

      $2NaCl(aq) + F_2(g) \longrightarrow 2NaF(aq) + Cl_2(g)$

3. (10) For the reaction below, (i) complete and balance the chemical equation, (ii) provide a complete ionic equation, and (iii) write the net ionic equation. A reaction does occur in each case; do not write 'no reaction'.
   a. Balanced equation: Aqueous beryllium iodide mixes with copper (I) sulfate

      $BeI_2(aq) + Cu_2SO_4(aq) \longrightarrow BeSO_4(aq) + 2CuI(s)$

   b. Complete ionic equation:

      $Be^{+2} + 2I^- + 2Cu^+ + SO_4^{2-} \longrightarrow Be^{+2} + SO_4^{-2} + 2CuI(s)$

   c. Net ionic equation:

      $2Cu^+ + \cancel{SO_4^{2-}}\ 2I^- \longrightarrow 2CuI(s)$

   a. Balanced equation: ~~$Ni(NO_3)_3$ (aq) + 3KBr (aq)~~ ➔

      $Ni(NO_3)_2(aq) + 2KBrO_3(aq) \longrightarrow Ni(BrO_3)_2(s) + 2KNO_3$

   b. Complete ionic equation:

      $Ni^{+2} + 2NO_3^- + 2K^+ + 2BrO_3^- \longrightarrow Ni(BrO_3)_2(s) + 2K^+ + 2NO_3^-$

   c. Net ionic equation:

      $Ni^{+2} + 2BrO_3^- \longrightarrow Ni(BrO_3)_2(s)$

4. (2) Provide the formula of two weak acids.

HF, $HC_2H_3O_2$, H_3PO_4, HCN, $H_2C_2O_4$, etc.

5. (6) Pure oxygen gas can be prepared in the laboratory by the decomposition of solid potassium chlorate to form potassium chloride and oxygen gas. How much oxygen in grams can be prepared from 45.8 g of potassium chlorate?

$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$

$45.8\,g\ KClO_3 \times \frac{1\,mol\ KClO_3}{122.55\,g} \times \frac{3\,mol\ O_2}{2\,mol\ KClO_3} \times \frac{32.00\,g}{1\,mol\ O_2} = 17.9\,g\ O_2$

6. When phosphine gas combines with oxygen gas, tetraphosphorus decoxide and water are produced:

$$4\ PH_3\ (g) + 8\ O_2\ (g) \rightarrow P_4O_{10}\ (s) + 6\ H_2O\ (g)$$

a. (10) How many grams of P_4O_{10} will be produced when 35.0 g of PH_3 reacts with 76.5 g of oxygen gas in a closed container?

LR $35.0\,g\ PH_3 \times \frac{1\,mol\ PH_3}{34.00\,g} \times \frac{1\,mol\ P_4O_{10}}{4\,mol\ PH_3} = 0.2573529\ moles\ P_4O_{10}$

XS $76.5\,g\ O_2 \times \frac{1\,mol\ O_2}{32.00\,g} \times \frac{1\,mol\ P_4O_{10}}{8\,mol\ O_2} = 0.2988281\ moles\ P_4O_{10}$

$0.2573529\ mole\ P_4O_{10} \times \frac{283.88\,g}{1\,mol\ P_4O_{10}} = 73.1\,g\ P_4O_{10}$

b. (6) Which reagent was in excess, and how many grams of it remain unreacted at the end of part (a)?

O_2 is in excess

$0.2988281\ mol\ P_4O_{10}$
$-\ 0.2573529\ mol\ P_4O_{10}$

$0.0414752\ mol\ P_4O_{10} \times \frac{8\,mol\ O_2}{1\,mol\ P_4O_{10}} \times \frac{32.00\,g}{1\,mol\ O_2} = 10.6\,g\ O_2$

7. (5) A laboratory procedure calls for making 500.0 mL of a 1.4 M KNO_3 solution. How much KNO_3 in μg is needed?

$$500.0\,mL \times \frac{1\,L}{1000\,mL} \times \frac{1.4\,mol\,KNO_3}{L} \times \frac{101.10\,g}{1\,mol\,KNO_3} = 70.77\,g\,KNO_3$$

$$70.77\,g \times \frac{10^6\,\mu g}{1\,g} = 7.077 \times 10^7\,\mu g\,KNO_3$$

$$7.1 \times 10^7\,\mu g\,KNO_3$$

8. (5) How much of a 12.0 M HNO_3 solution should you use to make 850.0 mL of a 0.250 M HNO_3 solution?

M_1 = 12.0 M, V_2 = 850.0 mL, M_2 = 0.250 M, $V_1 = ?$

$$M_1V_1 = M_2V_2$$

$$V_1 = \frac{M_2V_2}{M_1} = \frac{(0.250\,M)(850.0\,mL)}{(12.0\,M)}$$

$= 17.7\,mL$ of the 12.0 M HNO_3 solution.

9. (5) What is the molarity of $ZnCl_2$ (aq) that forms when 15.0 g of zinc completely reacts with $CuCl_2$ (aq) according to the following reaction? (Assume a final volume of 175 mL)

$$175\,mL \times \frac{1\,L}{1000\,mL} = 0.175\,L$$

$$Zn\,(s) + CuCl_2\,(aq) \rightarrow ZnCl_2 + Cu\,(s)$$

$$15.0\,g\,Zn(s) \times \frac{1\,mol\,Zn}{65.39\,g} \times \frac{1\,mol\,ZnCl_2}{1\,mol\,Zn} = \frac{0.22939287\,mol\,ZnCl_2}{0.175\,L}$$

$= 1.31\,M\,ZnCl_2$

10. (12) The titration of a 20.0 mL sample of an H_2SO_4 solution of unknown concentration requires 22.87 mL of a 0.158 M KOH solution to reach the equivalence point. What is the concentration of the unknown H_2SO_4 solution?

$$H_2SO_4 (aq) + 2KOH (aq) \rightarrow 2H_2O (l) + K_2SO_4 (aq)$$

$$22.87 \text{ ml} \times \frac{1 \text{ L}}{1000 \text{ ml}} \times \frac{0.158 \text{ mol KOH}}{1 \text{ L}} \times \frac{1 \text{ mol } H_2SO_4}{2 \text{ mol KOH}}$$

$$= \frac{0.00180673 \text{ mol } H_2SO_4}{20.0 \text{ ml} \times \frac{1 \text{ L}}{1000 \text{ ml}}}$$

$$= 0.090 \text{ M } H_2SO_4$$

Extra Credit: (5) Draw an example of how water solvates Mg^{2+} and SO_4^{2-}