Chemistry 120
Rio Hondo College
Fall 2014

Name: - KEY -

Exam #3—100 points

Directions: Answer each question below to the best of your ability. Show all work where calculations are required. Always indicate the states of all species when writing chemical reactions; if you do not indicate a state I will assume that you mean that the chemical is in an aqueous solution.

1. (26) Fill in the product(s) of each chemical reaction below, then balance the chemical equation. Write "no rxn." If you do not expect a reaction to occur.

(a) $AgNO_3(aq) + KCl(aq) \rightarrow AgCl_{(s)} + KNO_3$ (2)

(b) $2\,C_6H_{14}(\ell) + 19\,O_2(g) \rightarrow 12\,CO_{2(g)} + 14\,H_2O_{(g)}$ (3)

1 9.5 6 7

(c) $2\,Al(s) + 3\,Zn(NO_3)_2(aq) \rightarrow 2\,Al(NO_3)_{3\,(aq)} + 3\,Zn_{(s)}$ (3)

(d) $Mg(s) + 2\,HCl(aq) \rightarrow MgCl_2 + H_{2\,(g)}$ (3)

(e) $Na_2O(s) + CO_2(g) \rightarrow Na_2CO_{3\,(s)}$ (3)

(f) $MgCl_2(aq) + LiNO_3(aq) \rightarrow$ no rxn (3)

(g) $Ca(s) + 2\,H_2O(\ell) \rightarrow Ca(OH)_2 + H_{2\,(g)}$ (3)

(h) $2\,HI(aq) + Li_2SO_3(aq) \rightarrow H_2O_{(\ell)} + SO_{2\,(g)} + 2\,LiI$ (3)

(i) $CaSO_4(s) \xrightarrow{\Delta} CaO_{(s)} + SO_{3\,(g)}$ (3)

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) Aqueous solutions of nickel (II) nitrate and potassium hydroxide are combined.

   $Ni(NO_3)_2 + 2KOH \longrightarrow Ni(OH)_{2(s)} + 2KNO_3$ (4)

   (b) Ethyl butyrate is a liquid which smells like pineapples and has molecular formula $C_6H_{12}O_2$. It is burned in air.

   $C_6H_{12}O_{2(l)} + 8O_{2(g)} \longrightarrow 6CO_{2(g)} + 6H_2O_{(g)}$ (4)

   (c) Aqueous solutions of ammonium chloride and barium hydroxide are mixed together.

   $2NH_4Cl + Ba(OH)_2 \longrightarrow 2NH_{3\,(aq)\ \text{or}\ (g)} + 2H_2O_{(l)} + BaCl_2$ (4)

3. (10) For the reactions below, (i) complete and balance the chemical equation, (ii) provide a complete ionic equation, and (iii) write the net ionic equations. A reaction does occur in each case; do not write "no reaction."

   (2) (i) Balanced equation: $KHCO_3(aq) + HBr(aq) \longrightarrow KBr + H_2O_{(l)} + CO_{2(g)}$

   (2) (ii) Complete ionic equation: $K^+ + HCO_3^- + H^+ + Br^- \longrightarrow K^+ + Br^- + H_2O_{(l)} + CO_{2(g)}$

   (1) (iii) Net ionic equation: $H^+ + HCO_3^- \longrightarrow H_2O_{(l)} + CO_{2(g)}$

   (2) (i) Balanced equation: $HNO_3(aq) + KF(aq) \longrightarrow HF_{(aq)} + KNO_3$

   (2) (ii) Complete ionic equation: $H^+ + NO_3^- + K^+ + F^- \longrightarrow HF + K^+ + NO_3^-$

   (1) (iii) Net ionic equation: $H^+ + F^- \longrightarrow HF$

4. (3) List the formulas of any three *weak* acids.

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

5. (8) Stearic acid is a fatty acid with formula $C_{18}H_{36}O_2$ which is found in large concentrations in some high-fat foods. Suppose that a 1.00 gram sample of stearic acid is burned in excess oxygen. How many grams of carbon dioxide should be produced in this reaction?

$$C_{18}H_{36}O_2 + 26O_2 \longrightarrow 18CO_2 + 18H_2O \quad (4)$$

$$1.00\text{ g S.A.} \left| \frac{1\text{ mol S.A.}}{284.47\text{ g}} \right| \frac{18\text{ mol } CO_2}{1\text{ mol S.A.}} \left| \frac{44.01\text{ g } CO_2}{1\text{ mol } CO_2} \right\} (2)$$

(1) (1)

$$= 2.78\text{ g}$$

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

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

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

PH_3: $35.0\text{ g } PH_3 \left| \frac{1\text{ mol } PH_3}{34.00\text{ g } PH_3} \right| \frac{1\text{ mol } P_4O_{10}}{4\text{ mol } PH_3} \left| \frac{283.88\text{ g}}{1\text{ mol } P_4O_{10}} \right. = 73.057$ (4) → 73.1 g

O_2: $76.5\text{ g } O_2 \left| \frac{1\text{ mol } O_2}{32.00\text{ g } O_2} \right| \frac{1\text{ mol } P_4O_{10}}{8\text{ mol } O_2} \left| \frac{283.88\text{ g}}{1\text{ mol } P_4O_{10}} \right. = 84.8\text{ g}$ X (4)

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 (2)

USED UP: $35.0\text{ g } PH_3 \left| \frac{1\text{ mol } PH_3}{34.00\text{ g } PH_3} \right| \frac{8\text{ mol } O_2}{4\text{ mol } PH_3} \left| \frac{32.00\text{ g } O_2}{1\text{ mol } O_2} \right. = 65.882$ (4) → 65.9 g

REMAINS: $76.5\text{ g} - 65.9\text{ g} = 10.6\text{ g}$ (2)

7. Suppose that a solution contains 100.00 grams of $MgCl_2$ for every 2500. mL of solution.
   a. (5) What is the molarity of the solution?

$$100.00\ g\ MgCl_2 \left| \frac{1\ mol}{95.21\ g} \right. = 1.050\ mol$$ (2)

$$\text{Molarity} : \frac{1.050\ mol}{2.500\ L} = 0.4201\ M$$ (3)

   b. (4) Suppose that 5.00 mL of this solution is added to 55.0 mL of water, forming a new solution. What is the molarity of this new solution?

$$M_1 V_1 = M_2 V_2$$

$$M_2 = \frac{M_1 \cdot V_1}{V_2} = \frac{(0.4201\ M)(5.00\ mL)}{(60.0\ mL)} = 0.0350\ M$$ (2) (2)

   c. (6) How many milliliters of a 0.250 M $AgNO_3$ solution would be needed to completely react with all the magnesium chloride in the solution in part b?

$$2\ AgNO_3 + MgCl_2 \longrightarrow 2\ AgCl + Mg(NO_3)_2$$ (2)

$$60.0\ mL \left| \frac{0.0350\ mol\ MgCl_2}{1000\ mL} \right| \frac{2\ mol\ AgNO_3}{1\ mol\ MgCl_2} \left| \frac{1000\ mL\ AgNO_3}{0.250\ mol\ AgNO_3} \right. = 16.8\ mL$$ (2) (2)

8. (10) To determine the concentration of a sulfuric acid (H_2SO_4) solution, a chemist titrates it using a 0.3555 M potassium hydroxide solution. 22.45 mL of the KOH is required to completely neutralize 10.00 mL of the acid. What is the molarity of the sulfuric acid solution?

$$H_2SO_4 + 2KOH \longrightarrow 2H_2O + K_2SO_4$$ (3)

$$22.45\ mL\ KOH \left| \frac{0.3555\ mol\ KOH}{1000\ mL\ KOH} \right| \frac{1\ mol\ H_2SO_4}{2\ mol\ KOH} = 0.003990\ mol$$ (3)

$$\text{molarity} : \frac{0.003990\ mol}{0.01000\ L} = 0.3990\ M$$ (4)

Periodic Table

	1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1	1 H 1.008	2 2A																2 He 4.003
2	3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 190.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (263)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (269)	109 Mt (268)	110 Ds (272)	111 Rg (272)							

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

Activity Series (shortened)

Most Active	Li K Ca Na	Displaces water from cold water, steam, and acids
	Al Zn Cr Fe	Displaces water from steam, and acids
	Ni Pb	Displaces water from acids
	H_2	
Least Active	Cu Ag Au	Does not displace water from cold water, steam, and acids

Solubility Rules for Selected Anions

chlorates	all are soluble
sulfates	all are soluble <u>except</u> Ag^+, Pb^{2+}, Hg_2^{2+}, Hg^{2+}, Ba^{2+}, Sr^{2+}, and Ca^{2+}
sulfides	none soluble <u>except</u> Group 1A, NH_4^+, and Group 2A
carbonates and phosphates	none soluble <u>except</u> Group 1A NH_4^+

The solubility rules for other ions which you were supposed to memorize are not shown on this table.