Chemistry 120
Rio Hondo College
Fall 2017 Exam 3

Name Key

Exam #3 – 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 (**with states**), then balance the chemical equation. **Provide the name of the specific reaction type.** Write "No Reaction" if you do not expect a reaction to occur. For reactions that do occur, assume the reaction will go to completion.

a. _____$CaCl_2(aq)$ + _____$Li_2SO_4(aq)$ → $CaSO_4(s) + 2LiCl(aq)$
ppt rxn

b. _____$Pb(C_2H_3O_2)_2(aq)$ + _____$Na_2SO_4(aq)$ → $PbSO_4(s) + 2NaC_2H_3O_2(aq)$
ppt rxn

c. _____$H_3PO_4(aq)$ + _____ $NaNO_3(aq)$ → no rxn

d. _____$Cu(s) + MgCl_2(aq)$ → no rxn

e. _____$NH_4Cl(aq)$ + _____$KOH(aq)$ → $NH_3(g) + H_2O(l) + KCl(aq)$
gas-evolution

f. 4 $Al(s)$ + 3 $O_2(g)$ → $2Al_2O_3$
combination/redox

g. _____$C_7H_{16}(l)$ + 11 $O_2(g)$ → $7CO_2(g) + 8H_2O(g)$
combustion

h. _____$HBrO_4(aq)$ + _____$NaOH(aq)$ → $H_2O(l) + NaBrO_4(aq)$
acid/base

i. _____$H_2SO_4(aq)$ + 2 $NaHCO_3(aq)$ → $Na_2SO_4(aq) + 2H_2O(l) + 2CO_2(g)$
gas evolution

2. (12) Write balanced chemical equations for each of the following reactions. Indicate all states. If a reaction does 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.

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

   b. Solid magnesium reacts with aqueous copper (I) nitrate

$Mg(s) + 2CuNO_3(aq) \longrightarrow 2Cu(s) + Mg(NO_3)_2(aq)$

   c. Solid magnesium chloride reacts with bromine liquid

no rxn

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. If a reaction does not occur write "No Reaction".
   a. Solutions of barium hydroxide and ammonium phosphate are mixed together

$3Ba(OH)_2(aq) + 2(NH_4)_3PO_4(aq) \longrightarrow 6NH_4OH + 6NH_3(g) + 6H_2O(l) + Ba_3(PO_4)_2(s)$

   b. Complete ionic equation:

$3Ba^{+2} + 2OH^- + 6NH_4^+ + 2PO_4^{-3} \longrightarrow 6NH_4^+ + 6OH^- + Ba_3(PO_4)_2(s)$
$\longrightarrow 6NH_3(g) + 6H_2O(l) + Ba_3(PO_4)_2(s)$

   c. Net ionic equation:

$* \; 3Ba^{+2} + 2PO_4^{-3} \longrightarrow Ba_3(PO_4)_2(s)$ (Before NH_4OH decomposed)

* no net ionic eq after decomposed NH_4OH

   a. Solid magnesium is added to liquid water yielding soluble magnesium hydroxide and a gas

$Mg(s) + 2H_2O(l) \longrightarrow Mg(OH)_2(aq) + H_2(g)$

   b. Complete ionic equation:

$Mg(s) + H_2O(l) \longrightarrow Mg^{+2} + 2OH^- + H_2(g)$

Dissolved* $Mg^{+2} + 2H^+ + 2OH^- \longrightarrow Mg^{+2} + 2OH^- + H_2(g)$

   c. Net ionic equation:

$2H^+ \longrightarrow H_2(g)$

4. (3) Circle the least reactive metal:

   Zinc or Copper

5. (6) Pure oxygen gas can be prepared in the laboratory by the decomposition of solid potassium chlorate to form solid potassium chloride and oxygen gas. How much oxygen gas in micrograms can be prepared from 85.4 g of potassium chlorate?

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

$$85.4\,g\,KClO_3 \times \frac{1\,mol\,KClO_3}{122.55\,g\,KClO_3} \times \frac{3\,mol\,O_2}{2\,mol\,KClO_3} \times \frac{32.00\,g\,O_2}{1\,mol\,O_2} \times \frac{10^6\,\mu g}{1\,g}$$

$$3.34 \times 10^7\,\mu g\,O_2$$

6. (5) Present a balanced chemical equation of **<u>your choice</u>** (*HINT: use something simple*). For your equation you will have 25.0 g of each reactant, provide a **WRITTEN** explanation of how you would determine which reactant is limiting. You may use a calculation to illustrate your answer, **but a calculation alone is worth ZERO points.**

See text for definition

7. (15) When 30.0 mL of 0.400 M $MgCl_2$ are mixed with 40.0 mL of 0.600 M Na_3PO_4, $Mg_3(PO_4)_2$ is precipitated. Determine the number of moles of $Mg_3(PO_4)_2$ that will be precipitated and the concentration of each ion remaining in solution when the reaction has gone to completion.

$$3MgCl_2(aq) + 2Na_3PO_4(aq) \rightarrow Mg_3(PO_4)_2(s) + 6NaCl(aq)$$

$$0.03L \times \frac{0.400\,mol\,MgCl_2}{1L} \times \frac{1\,mol\,Mg_3(PO_4)_2}{3\,mol\,MgCl_2} = 0.004\,mol\,Mg_3(PO_4)_2$$ (L)

$$0.04L \times \frac{0.600\,mol\,Na_3PO_4}{1L} \times \frac{1\,mol\,Mg_3(PO_4)_2}{2\,mol\,Na_3PO_4} = 0.012\,mol\,Mg_3(PO_4)_2$$

$$[Cl^-]\quad 0.03L \times \frac{0.400\,mol\,MgCl_2}{1L} \times \frac{2\,mol\,Cl^-}{1\,mol\,MgCl_2} = \frac{0.024\,mol}{0.07L} = 0.343\,M$$

$[Mg^{+2}]$ 0M, all consumed

$$[Na^+]\quad 0.04L \times \frac{0.600\,mol\,Na_3PO_4}{1L} \times \frac{3\,mol\,Na^+}{1\,mol\,Na_3PO_4} = \frac{0.072\,mol}{0.07L} = 1.03\,M$$

$$[PO_4^{-3}]\quad 0.012 - 0.004 = 0.008\,mol\,Mg_3PO_4 \times \frac{2\,mol\,Na_3PO_4}{1\,mol\,Mg_3(PO_4)_2} \times \frac{1\,mol\,PO_4^{-3}}{1\,mol\,Na_3PO_4} \times \frac{1}{0.07L}$$

$$= 0.229\,M$$

8. (5) How much of a 6.0 M HNO_3 solution should you use to make 750.0 mL of a 0.250 M HNO_3 solution?

$$M_1V_1 = M_2V_2$$

$$V_1 = \frac{0.250\,M \times 750\,ml}{6M}$$

$$= 31\,ml$$

9. (5) A 10.00 mL sample of unknown H_3PO_4 solution requires 112 mL of 0.100 M KOH to completely react with the H_3PO_4. What was the molarity of the unknown H_3PO_4 solution?

$$H_3PO_4\ (aq) + 3\ KOH\ (aq) \rightarrow 3\ H_2O\ (l) + K_3PO_4\ (aq)$$

$$112\ ml \times \frac{1\ L}{1000\ ml} \times \frac{0.100\ mol\ KOH}{1\ L} \times \frac{1\ mol\ H_3PO_4}{3\ mol\ KOH} \times \frac{1}{0.01\ L} =$$

$$0.373\ M\ H_3PO_4$$

10. (12) What volume in milliliters of 0.0895M potassium hydroxide solution is required to reach the equivalence point in the complete titration of a 15.0 mL sample of 0.130M phosphoric acid?

$$3\ KOH\ (aq) + H_3PO_4\ (aq) \rightarrow 3H_2O\ (l) + K_3PO_4\ (aq)$$

$$15\ ml \times \frac{1\ L}{1000\ ml} \times \frac{0.130\ mol}{1\ L} \times \frac{3\ mol\ KOH}{1\ mol\ H_3PO_4} \times \frac{1\ L}{0.0895\ Mol} \times \frac{1000\ ml}{1\ L} =$$

65.4 ml

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.