CHEM 107 (Spring-2004)
Exam 2 (100 pts)

Name: --, SSN -------------------------------

      LAST NAME, First

(Circle the alphabet segment of your LAST NAME): A,B   C-H   I-L   M-R   S-Z

Please answer the following questions:

Part I: Multiple Choices (48 pts: 12 @ 4 pts each). Circle the **_ONE_** best answer:

1. The number of ions formed when $Al(NO_3)_3$ is dissolved in water is:

    a) 13   b) 3   c) 2   d) 4

2. For the reaction: $\underline{a}$ $Al(OH)_3$ (s) $+$ $\underline{b}$ H_2SO_4 (aq) $\longrightarrow$ $\underline{c}$ $Al_2(SO_4)_3$ (aq) $+$ $\underline{d}$ H_2O

    The corresponding order for the coefficients a, b, c and d is:

    a) 2, 3, 1 and 6   b) 1, 1, 1 and 3   c) 2, 1, 2 and 6   d) 2, 3, 1 and 3

3. In dilute nitric acid, HNO_3, copper metal dissolves according to the following equation:

    3 Cu (s) $+$ 8 HNO_3 (aq) $\longrightarrow$ 3 $Cu(NO_3)_2$ (aq) $+$ 2 NO_2 (g) $+ 4$ H_2O (l)

    How many grams of HNO_3 are needed to dissolve 11.45 g of Cu

    a) 30.27 g   b) 0.4805 g   c) 1.441g   d) 0.1802

4. For the reaction: 2 Al (s) $+$ 6 HCl (aq) $\longrightarrow$ 2 $AlCl_3$ (aq) $+ 3$ H_2 (g)
    the spectator ion(s) are:

    a) only Cl^- b) Al^{3+} and H^+ c) H^+ and Cl^- d) Al^{3+} and Cl^-

5. Which of the following salts are expected to be insoluble in water?

    a) $CaBr_2$ b) NiS c) K_3PO_4 d) $CsOH$

6. In the reaction:

    $CaCO_3$ (s) $+ 2$ HCl (aq) $\longrightarrow$ $CaCl_2$ (aq) $+$ H_2O (l) $+$ CO_2 (g)

    What volume of 6.0 M HCl will be needed to react with 0.350 mol of $CaCO_3$?

    a) 42.0 mL   b) 117 mL   c) 1.17 L   d) 583 mL

7. Calculate the molarity of F^- in a 250.0 mL solution containing 18.34 g LiF and 4.32 g NaF?

    a) 0.810   b) 0.202   c) 3.24   d) 4.77

8. Which of the following is a weak electrolyte:

    a) potassium chloride (KCl)   b) hydrobromic acid (HBr)

    c) nitrous acid (HNO_2)   d) Nitric acid (HNO_3)

9. Styrene, the raw material for polystyrene foam plastics, has an empirical formula of CH. Its molecular mass is 104. What is its molecular formula?

    a) 8   b) CH   c) $(CH)_n$ d) C_8H_8

10. A sample of tin (Sn) and chlorine compound with a mass of 2.57 g was found to contain 1.17 g of tin. What is empirical formula of the compound?

    a) $SnCl_2$ b) $SnCl$

    c) Sn_4Cl d) $SnCl_4$

11. Calculate the molarity of 0.105 g of backing soda ($NaHCO_3$, molar mass = 84 g/mol) in 2.5 mL of solution.

    a) 0.5 M   b) 5.0×10^{-4} M   c) 0.042 M   d) 42 M

12. In a titration, 23.25 mL of 0.105 M NaOH was needed to react with 21.45 mL of HCl. What is the molarity of the acid?

    a) 2.44 M   b) 0.114 M

    c) 0.105 M   d) no answer was given

Part II. Equations and formulas (20 pts)

Write <u>balanced chemical equations</u> for each of the following. Including physical states as (s, l, g aq) and be careful about the type of arrow you use as ⟶ or ⇌ (*Use the periodic chart for charges on each ion and reference sheet*). Please write N. R. if there is no reaction.

1. (6 pts) Write the equation (if any) which represents what happened when KNO_3 is mixed with $CuCl_2$ in water:

2. (6 pts) Write the NET IONIC equation for the reaction of Na_2SO_4 (aq) with $BaCl_2$ (aq)

2

3. (**8 pts**) Write the NET IONIC equation for the reaction of a solution of $Pb(NO_3)_2$ with a solution of KI and then identify the spectator ion(s).

Net ionic equation:

Spectator ion(s):

Part III. **Calculations (32 pts)** <u>Show all work for full credit</u>. **Please express all answers with the proper units and correct number of significant figures.**

1. (**20 pts**) A chemist set up a synthesis of phosphorus trichloride by mixing 12.0 g P with 35.0 g Cl_2. The equation for the reaction is:

$$2 \text{ P (s)} \ + \ 3 \text{ Cl}_2 \text{ (g)} \longrightarrow 2 \text{ PCl}_3 \text{ (l)}$$
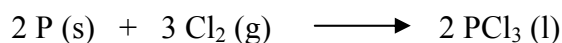
a) Which reagent will be totally consumed (limiting reactant)?

Limiting Reactant:

b) What is the maximum number of grams of PCl_3 that can be produced (theoretical yield)?

Mass of PCl_3 =

c) What is the percent yield of the reaction, if 42.4 g of PCl_3 was obtained?

% yield =

2. (**12 pts**) Gold(III) hydroxide, $Au(OH)_3$, is used for electroplating gold onto other metals. It can be made by the following reaction:

$2 \ KAuCl_4 \ (aq) + 3 \ Na_2CO_3 \ (aq) + 3 \ H_2O \longrightarrow 2 \ Au(OH)_3 \ (aq) + 6 \ NaCl \ (aq) + 2 \ KCl \ (aq) + 3 \ CO_2 \ (g)$

To prepare a fresh supply of $Au(OH)_3$ (247.99 g/mol), a chemist at an electroplating plant has mixed 20.00 g of $KAuCl_4$ (377.88 g/mol) with 500.0 mL of 0.472 M Na_2CO_3 solution. What is the maximum number of grams of $Au(OH)_3$ that can form?

Limiting Reactant:

Maximum mass of $Au(OH)_3$ that can form:

Exam 2 – Spring 2004

You will have **60 minutes** to complete this exam. The exam has **5 pages** plus the Periodic Table and Reference page.

When you are told to do so, **tear off** the Periodic Table cover sheet and use as required during the exam.

General Solubility Guidelines

All nitrates are soluble.
All salts of sodium, potassium and ammonium are soluble.
All chlorides, bromides and iodides are soluble except Ag^+, Hg_2^{2+}, and Pb^{2+}.
All sulfates are soluble except Ba^{2+}, Sr^{2+}, Pb^{2+} and Hg_2^{2+}.
All acetates, chlorates and perchlorates are soluble.
Everything else will be considered insoluble.

Equations and Constants:

Density = Mass/Volume

$K = 273 + °C$

Avogadro's Number $= 6.022 \times 10^{23}$

Periodic Table of the Elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.01																	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.30											13 Al 26.98	14 Si 28.08	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.1	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 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
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 131.1
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 181.0	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	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)
87 Fr (223)	88 Ra 226.0	89 Ac 227.0	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 Uun (269)	111 Uuu (272)	112 Uub (277)						

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 157.2	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 237.0	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 (260)