Chem 130 **Name**_____
Exam 2, Ch 4-6 **October 12, 2016**
100 Points

Please follow the instructions for each section of the exam. Show your work on all mathematical problems. Provide answers with the correct units and significant figures. Be concise in your answers to discussion questions.

Part 0: Warmup. 4 points each

1. Under what conditions is Cl_2 likely to behave most like an ideal gas?
   a. 100°C and 10.0 atm
   b. 0°C and 0.50 atm
   c. 200°C and 0.50 atm
   d. 400°C and 10.0 atm

   Answer _____

2. To precipitate Zn^{2+} from a solution of $Zn(NO_3)_2$, add
   a. NH_4Cl
   b. $MgBr_2$
   c. K_2CO_3
   d. $(NH_4)_2SO_4$

   Answer _____

Part I: Complete all of problems 3-8

3. The terms **strong electrolyte** and **weak electrolyte** are used in multiple contexts. Discuss how these terms are used in each of the contexts below. Use a maximum of three sentences per context. (8 points)
   a. When describing a compound:

   b. When describing a solution:

4. Complete the following table. (12 points)

Species	Name	Oxidation States			Water Soluble? (Y/N)
$Co(ClO_4)_3$		Co =	Cl =	O =	
$Zn_3(PO_4)_2$		Zn =	O =	P =	

5. Write balanced overall reactions and net ionic equations for each of the following: Indicate the state (s, ℓ, g, aq) of each of the reactants and products. (12 points)

   a. Aqueous sulfuric acid is mixed with aqueous ammonium hydroxide

   Balanced Reaction: (4)

   Net Ionic Equation: (2)

   b. Aqueous lead (II) nitrate is mixed with aqueous lithium sulfiide

   Balanced Reaction: (4)

   Net Ionic Equation: (2)

6. How does the kinetic-molecular theory of gases help explain why a helium-filled balloon shrinks if it is taken outside on a cold winter day? (10 points)

7. A 7.55 g sample of barium hydroxide is added to 125 mL of a 0.762 M nitric acid solution. After any reaction is complete, with the solution still be acidic? (10 points)

Answer_____

8. A 1.27 g sample of an oxide of nitrogen, believed to be either N_2O or NO, occupies a volume of 1.07 L at 25^{o}C and 737 mm Hg. Which oxide is it?(10 points)

Answer_____

Part II. Answer three (3) of problems 9-12. Clearly mark the problem you do not want graded. 12 points each.

9. You can dissolve an aluminum soft drink can in an aqueous base such as potassium hydroxide.

$$2\ Al\ (s) + 2\ KOH\ (aq) + 6\ H_2O\ (\ell) \rightarrow 2\ KAl(OH)_4\ (aq) + 3\ H_2\ (g)$$

   a. If you place 2.05 g of aluminum in a beaker with 125 mL of 1.25 M KOH, will any aluminum remain? Justify your answer with a calculation, no calculation, no credit. (8 points)

   b. After the reaction is complete, what is the concentration of $KAl(OH)_4$ in moles per liter? You may assume a final solution volume of 125 mL. (4 points)

Answer_____

10. At elevated temperatures, solid sodium chlorate ($NaClO_3$, molar mass 106.44 g/mol) decomposes to produce sodium chloride and oxygen gas. In an experiment, a 0.8765 g sample of impure sodium chlorate was heated until the production of oxygen ceased. The O_2 gas was collected over water. The collected gas occupied a volume of 57.2 mL at 23.0^oC and 734 mm Hg. Calculate the mass percentage of sodium chlorate in the original sample. Assume that none of the impurities produce O_2.

Answer_____

11. Redox reactions:
    a. Balance the following reaction in acidic solution. (10 points)

$$BrO_3^-(aq) + H_2O_2(aq) \rightarrow Br_2(\ell) + O_2(g)$$

    b. Permanganate ion can oxidize cyanide ion in acidic solution by the reaction below. Write the corresponding balanced reaction that would occur in basic solution. (2 points)

$$2\ MnO_4^- + 3\ CN^- + 2\ H^+ \rightarrow 2\ MnO_2 + 3\ OCN^- + H_2O$$

12. Answer the following questions related to the combustion of ethanol. Assume the ideal gas law applies.

$$2\ CH_3CH_2OH(\ell) + 6\ O_2(g) \rightarrow 4\ CO_2(g) + 6\ H_2O(g)$$

a. If 5.00 g of ethanol (molar mass 46.07 g/mol) is burned in a 2.00 L container filled with oxygen at 2.08 atm and 100^{o}C, will be the final pressure in the container? (8 points)

Answer_____

b. What volume would the gas produced by this reaction occupy at STP? (4 points)

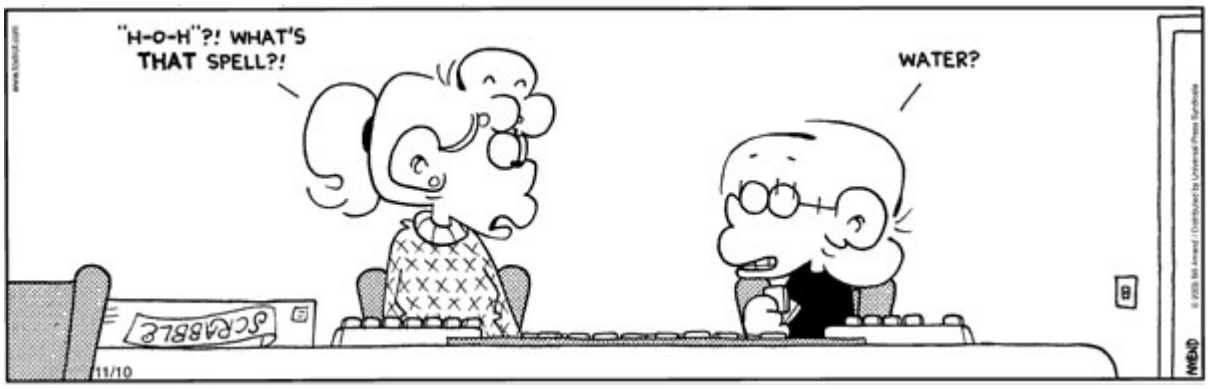
Answer_____

Possibly Useful Information

$R = 0.08206\ \text{L atm mol}^{-1}\ \text{K}^{-1}$	$K = {}^{o}C + 273.15$
1 atmosphere = 760 Torr = 760 mm Hg	$\left(P + a\left(\frac{n}{V}\right)^2\right)(V - bn) = nRT$
$P_{total}V = n_{total}RT$	$P_A = X_a P_{total}$
$N_a = 6.02214 \times 10^{23}\ \text{mol}^{-1}$	$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$
$\%\ \text{by mass} = \frac{\text{g component}}{100\ \text{g sample}}$	$d = m/v$

Vapor Pressure of Water at Various Temperatures

Temperature (°C)	Vapor Pressure (mmHg)
15.0	12.79
17.0	14.53
19.0	16.48
21.0	18.65
23.0	21.07
25.0	23.76
30.0	31.82
50.0	92.51



To save some calculation time, you may round all atomic masses to two (2) decimal points.

1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 H 1.00794	2 2A																2 He 4.00260
3 Li 6.941	4 Be 9.01218											5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
11 Na 22.9898	12 Mg 24.3050	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.9961	25 Mn 54.9381	26 Fe 55.847	27 Co 58.9332	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.757	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.905	56 Ba 137.327	57 *La 138.906	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	89 †Ac 227.028	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Rg (272)							

*Lanthanide series	58 Ce 140.115	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.965	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967
†Actinide series	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	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)