Chem 130 **Name**_____
Exam 1, Ch 1-4 **September 21, 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. Which of the following aspects of Dalton's atomic theory remains unchanged in our current understanding:
   a. Atoms are indivisible.
   b. All atoms of a particular element are identical.
   c. Compounds are the result of a combination of two or more different kinds of atoms in fixed ratios. Answer _____
   d. None of the above.

2. A reaction mixture contains 1.0 mol $CaCN_2$ and 1.0 mol H_2O. The maximum number of moles NH_3 produced in the reaction below is

$$CaCN_2(s) + 3H_2O(l) \rightarrow CaCO_3(s) + 2NH_3(g)$$

   a. 3.0
   b. 2.0
   c. Between 1.0 and 2.0 Answer _____
   d. Less than 1.0

Part I: Complete all of problems 3-10

3. Identify four elements that exist naturally as diatomic molecules. (4 points)

4. Gallium is solid at 20^{o}C. There are 1.16 x 10^{21} atoms in 134 mg of gallium at this temperature. Above 30^{o}C, gallium melts (it melts in your hand!). How many atoms are there in 134 mg of gallium at 40^{o}C? Briefly justify your answer. (4 points)

5. Does calcium tend to form anions or cations? What is the charge on the ion? Briefly justify your answer. (4 points)

6. Complete the following table. (12 points)

Symbol		$^{133}Cs^{+}$	
# of protons	34		48
# of neutrons	45		64
# of electrons			48
Charge	-2		
Name			

7. Name the following compounds or provide the correct formula for the given names. (16 points)

   a. $Mo(NO_3)_4$ _____

   b. B_2Br_4 _____

   c. $Sr(OH)_2$ _____

   d. $(NH_4)_2S$ _____

   e. xenon hexafluoride _____

   f. magnesium perchlorate _____

   g. chromium (VI) cyanide _____

   h. sulfuric acid _____

8. The atomic mass of gold (Au) is 196.97 amu and all gold atoms in a naturally occurring sample of gold have this mass. The atomic mass of silver (Ag) is 107.87 amu, but no silver atoms in a naturally occurring sample of silver have this mass. Explain this observation. (8 points)

9. Write balanced reactions, specifying the state for all reactants and products. (8 points)

   a. Solid barium hydroxide octahydrate reacts with solid ammonium chloride to produce aqueous barium chloride, aqueous ammonium hydroxide and liquid water.

   b. Aqueous potassium sulfide reacts with aqueous iron (III) nitrate to produce aqueous potassium nitrate and solid iron (III) sulfide.

10. A brand new penny is 19.05 mm in diameter and 1.52 mm thick and is 97.5% zinc and 2.5% copper by mass. Assuming the penny has the same density as zinc (7.13 g/cm^3), how many copper atoms are in a new penny? You may assume the penny is a cylinder with a volume of $\pi r^2 h$, where π = 3.14159, r is the radius and h is the thickness.(8 points)

Answer_____

Part II. Answer three (3) of problems 11-14. Clearly mark the problem you do not want graded. 10 points each.

11. Nitrogen gas can be prepared by passing gaseous ammonia (NH_3) over solid copper (II) oxide at high temperatures. The other products of the reaction are solid copper and water vapor. In a certain experiment, a reaction mixture containing 18.1 g ammonia and 90.4 g copper oxide produces 6.63 g nitrogen gas. What is the percent yield for the reaction?

Answer_____

12. The Ostwald process, used for the commercial production of nitric acid, involves the three steps below. How many kilograms of ammonia (NH_3) are required to produce 1.00 kilograms of nitric acid if the percent yield for the entire process is 73.2%?

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$
$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$
$$3NO_2(g) + H_2O(\ell) \rightarrow 2HNO_3(aq) + NO(g)$$

Answer_____

13. Isobutylene contains only carbon and hydrogen and is an important industrial chemical used in the production of a variety of products, ranging from antioxidants to polymers. Combustion of 1.00 grams of isobutylene results in the production of 3.14 grams of carbon dioxide and 1.28 grams of water. If the molar mass of isobutylene is 56.106 g/mol, what is its molecular formula?

Answer_____

14. A compound that contains only potassium, chromium and oxygen was analyzed. If was found that the compound contained 26.58% potassium and 35.45% chromium by mass. What is the formula for this compound?

Answer_____

Possibly Useful Information

$N_A = 6.022 \times 10^{23}$

$d = m/v$

$$\% \text{ by mass} = \frac{\text{g component}}{\text{100 g sample}}$$

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											5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	2 He 4.00260
3 Li 6.941	4 Be 9.01218											13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	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	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
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	49 In 114.818	50 Sn 118.710	51 Sb 121.757	52 Te 127.60	53 I 126.904	54 Xe 131.29
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	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
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						
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)							

	58	59	60	61	62	63	64	65	66	67	68	69	70	71
*Lanthanide series	Ce 140.115	Pr 140.908	Nd 144.24	Pm (145)	Sm 150.36	Eu 151.965	Gd 157.25	Tb 158.925	Dy 162.50	Ho 164.930	Er 167.26	Tm 168.934	Yb 173.04	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)