CHEM 130 **Name** _____
Quiz 3 – Sept. 16, 2011

Complete the following problems. You must show your work to receive full credit. Show your answers to the correct number of significant figures with the correct units.

1. Chlorine exits as two isotopes: ^{37}Cl and ^{35}Cl. The atomic mass of chlorine from the periodic table is 35.453 amu. What fraction of all chlorine atoms has a mass of 35.453 amu? Justify your answer in at most three sentences.(9 pts.)

   The value listed on the periodic table is a weighted average of the masses of all of the atoms for a particular element. Each ^{37}Cl atom will have a mass of nearly 37 amu and each ^{35}Cl will have a mass of nearly 35 amu, but no chlorine atom will have a mass of 35.453 amu. Therefore the fraction will be zero or 0%.

2. One common prescription medication for asthma is an inhaler containing albuterol, whose molecular formula is $C_{13}H_{21}NO_3$. Answer the following regarding albuterol. (8 pts.)
   a. What is the mass percent of nitrogen in albuterol? (4 pts.)

   First, you must determine the molar mass of albuterol, which is 239.315 g/mol. Then:

$$\frac{14.0067 \text{ g N}}{239.315 \text{ g albuterol}} \times 100\% = \mathbf{5.85\%}$$

   b. If 100.0 doses of albuterol retail for $85.00 and each dose contains 180 μg of the active ingredient, what is the price of one mole of albuterol? (4 pts.)

$$\frac{\$85}{100 \text{ dose}} \times \frac{1 \text{ dose}}{180 \text{ μg}} \times \frac{10^6 \text{ μg}}{1 \text{ g}} \times \frac{239.315 \text{ g}}{1 \text{ mol}} = \frac{\$1{,}129{,}319}{1 \text{ mol}} = \mathbf{\$1{,}100{,}000 \text{ per mole}}$$

3. Adenine, a component of nucleic acids, has a mass percent composition of 44.45% C, 3.73% H and 51.82% N. Its molecular mass is 135.14 grams per mole. What are the empirical and molecular formulas for adenine? (9 pts.)
   There are at least two approached to this problem. I'll show you two, either approach is fine.

   Approach 1:
   Let's assume we have 100 g of adenine. Then we will have 44.45g C, 3.73g H and 51.82g N. How many moles of each?

$$44.45 \text{ g C} \times \frac{1 \text{ mol C}}{12.011 \text{ g C}} = 3.70 \text{ mol C} \qquad 3.73 \text{ g H} \times \frac{1 \text{ mol H}}{1.00794 \text{ g H}} = 3.70 \text{ mol H}$$

   Similarly, we find we have 3.70 mol N.
   Therefore, our empirical formula is $C_{3.70}H_{3.70}N_{3.70}$, or $C_1H_1N_1$ (or CHO). If this were also the molecular formula, the formula weight would be equal to the molecular mass. For the empirical

formula, the formula weight is 29.02 g/mol, which is one fifth (135.14/27.02 = 5.00) of the molecular mass, therefore, the molecular formula must be $C_5H_5N_5$.

Approach 2:

We know that one mole of adenine has a mass of 135.14 grams and we know the percent composition of adenine, so we can calculate how many moles of each atom must be present in one mole of adenine.

$$\frac{44.45\ \text{g C}}{100\ \text{g adenine}} \times \frac{135.14\ \text{g adenine}}{1\ \text{mol adenine}} \times \frac{1\ \text{mol C}}{12.011\ \text{g C}} = \frac{5.00\ \text{mol C}}{\text{mol adenine}}$$

$$\frac{3.73\ \text{g H}}{100\ \text{g adenine}} \times \frac{135.14\ \text{g adenine}}{1\ \text{mol adenine}} \times \frac{1\ \text{mol H}}{1.00794\ \text{g H}} = \frac{5.00\ \text{mol H}}{\text{mol adenine}}$$

$$\frac{51.82\ \text{g N}}{100\ \text{g adenine}} \times \frac{135.14\ \text{g adenine}}{1\ \text{mol adenine}} \times \frac{1\ \text{mol N}}{14.0067\ \text{g N}} = \frac{5.00\ \text{mol N}}{\text{mol adenine}}$$

Therefore, our molecular formula must be $C_5H_5N_5$ and the empirical formula is $C_1H_1O_1$ or CHO.

Possibly Useful Information

% by mass = $\frac{\text{g component}}{\text{100 g sample}}$	$N_A = 6.02 \times 10^{23}$
Don't walk between parked cars… …or moving ones!	$1\ cm^3 = 1\ mL$ $1000\ cm^3 = 1\ L$

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)

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