CHEM131 HOMEWORK #2 KEY

2-35. Familiarity with the periodic table is very useful for this problem, and now might be a good time to look at these atoms in the periodic table available from the Chem131MWF home page on the web. In particular, each element has a list of binary compounds available from the menu on the left of the screen. Na and Cs are in group 1A, are metals, and normally loses 1 e^-. Sr and Ba are group 2A alkaline earth metals that usually loose 2 e^-. Aluminum is a group 3A metal that usually losses 3 e^-. N is in group 5A and usually gains 3 e^-. S and Se are in group 6A and normally gain 2 e^-. As a halogen in Group 7A, I gains 1 e^-.

2-40. Acetic acid, ammonium nitrite, cobalt(III)sulfide, iodine monochloride, lead(II)phosphate, potassium iodate, sulfuric acid, strontium nitride, aluminum sulfite, tin dioxide, sodium chromate, hypochlorous acid.

2-42. Na_2O, Na_2O_2, KCN, $Cu(NO_3)_2$, $SiCl_4$, PbO, PbO_2, CuCl, GaAs, CdSe, ZnS, Hg_2Cl_2, HNO_2, P_2O_5.

3-24. x = fraction of ^{151}Eu and y = fraction of ^{153}Eu. We know that x + y = 1 (there are only 2 isotopes of Eu). We also know that 150.9196x + 152.9209y = 151.96. Eliminate y from this equation by substituting y = 1 - x to get

$$150.9196x + 152.9209(1 - x) = 151.96$$

$$(150.9196 - 152.9209)x = 151.96 - 152.92$$

$$2.001x = 0.96; \quad x = 0.48 \text{ (or 48\%) and } y = 0.52 \text{ (or 52\%)}.$$

3-26. The three peaks in the mass spectrum, each differing by 2 amu, means that there are two different isotopes of Br. We can label them ^{L}Br and ^{H}Br, temporarily, where the superscripts stand for Light and Heavy. Three different kinds of Br_2 molecule will than exist: ^{L}Br-^{L}Br, ^{L}Br-^{H}Br, and ^{H}Br-^{H}Br. Since 157.84 is approximately twice 79 and 161.84 is about twice 81, ^{L}Br = ^{79}Br and ^{H}Br = ^{81}Br. If the relative peak intensities had intensity ratios of .25:.5:.25 the natural abundance of the two isotopes would be exaclty equal. The lighter ^{79}Br is slightly more abundant. The situation with chlorine is quite different, where about 3/4 of the Cl atoms are ^{35}Cl and 1/4 are ^{37}Cl. When Cl_2 is formed the 75% of the Cl atoms that are ^{35}Cl have a 75% chance of reacting with a ^{35}Cl to make ^{35}Cl-^{35}Cl and a 25% chance to react with ^{37}Cl to make ^{35}Cl-^{37}Cl. Similarly, the 25% of the Cl atoms that are ^{37}Cl have a 25% chance of reacting with ^{37}Cl to form ^{37}Cl-^{37}Cl and a 75% chance to react with ^{35}Cl to form ^{37}Cl-^{35}Cl. Adding up all of the sources of Cl_2 listed here gives 0.75x0.75 (56.25%) ^{35}Cl-^{35}Cl, 2(0.75x0.25) (37.5%) ^{37}Cl-^{35}Cl, and 0.25x0.25 (6.25%) ^{37}Cl-^{37}Cl. It should be clear that if the fractions were each .5 rather than .75 and .25 the relative amounts of the three isotopic species would be 25%, 50%, and 25%, but if the fractions were .9 and .1 the relative amounts would be 81%, 18% and 1%.

3-30. a) 1.27 mmol CO_2 x (1 mol/1000 mmol) x (44.01 g CO_2/mol CO_2) = 5.59 x 10^{-2} g CO_2

b) 2.00 x 10^{22} molecules NCl_3 x (1 mol NCl_3/ 6.022 x 10^{23} molecules) x (120.36 g/mol NCl_3) = 4.00 g NCL_3.

c) 0.00451 mol $(NH_4)_2CO_3$ x (96.09 g $(NH_4)_2CO_3$ / mol $(NH_4)_2CO_3$) = 0.433 g $(NH_4)_2CO_3$

d) 1 molecule N_2 x (1 mol N_2/6.022 x 10^{23} molecules N_2) x (28.02 g N_2/mol N_2) = 4.653 x 10^{-23} g N_2.

e) 62.7 mol $CuSO_4$ x (159.62 g $CuSO_4$/mol $CuSO_4$) = 1.00 x 10^4 g $CuSO_4$.

Home Work 3: Ch.3; 38, 40, 46, 47, 56, 57, 64, 89,99*

*This is an example of a Challenge Problem. In general these problems are harder than the others on the homework since they typically involve several steps of (or more advanced) mathematical reasoning to solve for the answer. You should try these problems after you feel comfortable about your ability to solve for the other problems in the homework. For reference, the students who scored in the "A" range last year typically would get these types of problems largely correct on the exams.