Problem Set 1 (For January 13)

NOTE: In general, assigned problems will be available on the web site each Friday. Thursday's x-hour recitation will be used to review the assignment. I will also suggest relevant problems from the text (in the format "chapter.problem number"). As you work any problem, try to think of other ways the same question could be asked. Try to imagine other types of questions based on the same physical idea and/or data. It is impossible to cover all potentially relevant and interesting types of questions in these assignments (without assigning so many that you would have nothing but chemistry to do all term). Consequently, you should think of each question as only a starting point for the types of calculations and ideas associated with any one topic. This means that you must strive for an understanding of the concepts behind the question rather than trying to memorize a rote set of steps to take you from "givens" to the answer.

Recommended Text Problems: 2.18, 2.21, 2.33, 2.51, 3.25, 3.27, 3.33, 3.34, 3.39, 3.40

A note about nomenclature: Problems 2.37–2.43 cover nomenclature. While we will build our chemical vocabulary during the course, these problems give you some early practice and/or review. Don't ignore nomenclature!

1 . During World War II, a German scientist, who was not sympathetic to the Nazi regime but was nevertheless trapped in it, was working on mass spectroscopy. When visited by the SS, who demanded to know what he was doing for the war effort, he showed them a mass spectrum of iron and pointed out the isotope of mass 53.9396 u, the lightest of iron's naturally occurring isotopes. He said, "I'm trying to isolate this lighter form of iron so that our tanks can be lighter and thus faster." This, however, was an impossible task, and he knew it, but the SS bought his story, funded his research, and left him alone! Iron has the following natural isotopes and abundances:

mass/amu	fractional abundance
53.9396	0.058
55.9499	0.918
56.9354	0.021
57.9333	0.003

Your text lists the atomic mass of iron as 55.85 amu. Do these data agree with that entry? Note: this is as much an exercise in significant figures as it is in the concept behind average atomic masses! (See also problem 3.21.)

2 . Three different oxides of manganese (Mn) contain 63.2%, 69.6%, and 77.4% Mn by mass. Given the atomic mass of oxygen (O), 16.00 amu, deduce *two* possible atomic masses for Mn from these data and the corresponding molecular formulas of the oxides, i.e., x and y in Mn_xO_y. Finally, look up the true atomic mass of Mn and decide which set of oxide molecular formulas is the correct one.

3 . In class, we discussed the nonstoichiometric oxide of iron called wüstite with composition ranging roughly from $Fe_{0.85}O_{1.00}$ to $Fe_{0.95}O_{1.00}$ depending on how it is synthesized. We pointed out that oxygen is always in the form of ions with a minus-two charge: O^{2-}, and that iron appears in two charge states, iron(II), Fe^{2+}, and iron(III), Fe^{3+}. Because the compound is electrically neutral, the total negative charge from oxygen must equal the total positive charge from all the iron ions in both charge states. Use this conservation of charge condition to calculate the percentage of iron in the iron(III) form in a sample of wüstite of composition $Fe_{0.930}O_{1.000}$. Hint: for each mole of O, there are 0.930 moles of Fe. Let x represent the number of moles of Fe in the iron(III) state, then use charge balance to find x, and from x, calculate the percentage we seek.