HW#1 MSEG 302 Spring 2018 Answer Key

**a.  Indium (In) has two naturally occurring isotopes: 113In, with an atomic weight of 112.904 amu, and 115In, with an atomic weight of 114.904 amu.  If the average experimentally observed atomic weight of In is 114.818 amu, calculate the fraction-of-occurences of these two isotopes.**

Since there are only two isotopes, the fractions of each must add to 1; so f113 + f115 = 1. The observed average is 114.818 amu, which is equal to f113(112.904) + f115(114.904). Substituting f115 = 1-f113, gives f113(112.904) + (1-f113)114.904 = 114.818 amu. Solving for f113 gives f113 = (114.904-114.818)/(114.904-112.904) = 0.043. So f115 = 0.957.

Similar to example problem 2.1 in the Callister text and as discussed in lecture

**b.  What do each of the four quantum numbers n, l, ml and ms stand for?   For an electron in a state with quantum number n=4, what are possible values that l, ml, and ms can have?**

n: principal quantum number

l: subshell, ranges from l=0 to l=n-1

ml: magnetic, ranges -l to +l

ms: spin, can be +1/2 or -1/2

For n=4, l ranges from 0 to 4, ml ranges from -3 to +3, and ms is +1/2 or -1/2

Discussed in text (Chapter 2.3) and in lecture

**c.  Compute the percent ionic character of the interatomic bond in each of the following compounds: MgO, GaP, CsF, CdS, and FeO.**

Percent ionic chararacter of a bond between atoms A and B with electronegativities XA and XB is given by %IC = {1-exp[-0.25(XA – XB)2]}, as discussed in class and chapter 2.8 of the text.

Electronegativities of various elements are given in Figure 2.9.

MgO: XMg = 1.3, XO = 3.5, %IC = 70.2%

GaP: XGa = 1.8, XP= 2.1, %IC = 2.2%

CsF: XCs = 0.9, XF = 4.1, %IC = 92.3%

CdS: XCd = 1.5, XS = 2.4, %IC = 18.3%

FeO: XFe = 1.7, XO = 3.5, %IC = 55.5%

Note that the larger the difference in electronegativities, the higher the ionic character, as expected from the equation.

**d.  The chemical composition of the repeat unit for the polymer known as nylon 6,6 is given by the formula C12H22N2O2.  Approximate atomic weights for the constituent elements are AC = 12, AH= 1, AN=14, and AO = 16 amu.  Using these values, estimate the weight fraction of carbon in a nylon 6,6 repeat unit.**

Total weight of nylon 6,6 repeat unit:

12 (12) + 22 (1) + 2 (14) + 2(16) = 226 amu

Total weight of carbon: 12(12) = 144 amu

Total weight fraction of carbon: 144/226 = 63.7 %