CHM 4, PAL – atomic mass Student name:

This worksheet will provide you with the necessary background and practice to be a pro at working on atomic mass calculations (textbook section 4.9)

Part A: Background information for atomic mass calculations

1) Write down the equation from your textbook or lecture notes for calculating atomic mass from isotope masses and natural abundances.

2) Like your college GPA (where a 5-unit course is weighted more heavily than a 3-unit course), finding an element's atomic mass involves using the equation you just wrote to calculate a weighted average of its isotope masses.

   a. Use the equation in question 1 to calculate the atomic mass of an element that has two isotopes, each with 50.00% abundance. One isotope has a mass of 63.00 amu and the other has a mass of 68.00 amu.

   b. Recalculate the atomic mass if instead there is 80.00% of the 63.00 amu isotope and 20.00% of the 68.00 amu isotope.

   c. Compare your answers from questions 2a and 2b. Do the results make sense? Explain.

3) There are two naturally occurring isotopes of gallium: Ga-69 with a mass of 68.93 amu and Ga-71 with a mass of 70.92 amu. Without doing any calculations, look at the periodic table and determine which isotope of gallium has the higher natural abundance. Briefly explain your answer.

Part B: Atomic mass calculations

4) Naturally occurring lithium consists of two isotopes, Li-6 with a mass of 6.015 amu and an abundance of 7.42% and Li-7 with a mass of 7.016 amu. Start by filling out the table below and then calculate the atomic mass of lithium. Show all your work and then compare your answer with the value given on the periodic table.

Fraction of Li-6 =	Mass of Li-6 =
Fraction of Li-7 =	Mass of Li-7 =

5) Mg has three naturally occurring isotopes: Mg-25 (10.03% abundance with a mass of 24.9858 amu) and Mg-26 (11.70% abundance with a mass of 25.9826 amu).

a. Fill in the following table with any of the information you are given. [Hints: Even though you aren't given the "fraction of Mg-24", how can you figure it out? Where can you get the "Atomic mass of Mg"?]

Fraction of Mg-25 =	Mass of Mg-25 =
Fraction of Mg-26 =	Mass of Mg-26 =
Fraction of Mg-24 =	Atomic mass of Mg =

b. Use the information in the above table to calculate the mass of Mg-24.

Part C: A challenging atomic mass calculation

6) The previous problems all had only one unknown. Some atomic mass calculations have more than one unknown. Since mathematically we can't solve for a single answer if there is one equation with two unknowns, we'll need to get rid of one of the unknowns by coming up with a second equation. Here is an example of this type of question:

Boron has two naturally occurring isotopes: B-10 with the mass of 10.013 amu and B-11 with the mass of 11.009 amu. What is the percent abundance of the heavier isotope?

a. Plug the provided isotope masses and the atomic mass of boron (from the periodic table) into the equation for calculating the atomic mass of boron:

Note that you still have two variables in the equation above.

b. Write a second equation that relates these two missing variables. [Hint: If the two natural abundances must add up to 100%, what is true about the sum of the two isotope fractions?]

c. Use the information in question 8b to replace one of your variables in question 8a and then solve for the fraction of each isotope.

d. What is the percent abundance of the heavier isotope?

Part D: Extra practice if your PAL team has time

7) Chlorine has two naturally occurring isotopes. The lighter isotope, Cl-35 has a mass of 34.969 amu and a natural abundance of 76.0%, what is the mass of the heavier isotope, Cl-37? Show all of the work involved in your calculation.

8) Nitrogen contains two naturally occurring isotopes, N-14 with a mass of 14.003 amu and N-15 with a mass of 15.000 amu. What are the percentages of the two isotopes in naturally occurring nitrogen?

9) Silicon has 3 naturally occurring isotopes, Si-28 (mass = 27.977 amu, natural abundance = 92.230%), Si-29 (mass = 28.976 amu, natural abundance = 4.683%). Find the mass of the third isotope, Si-30.