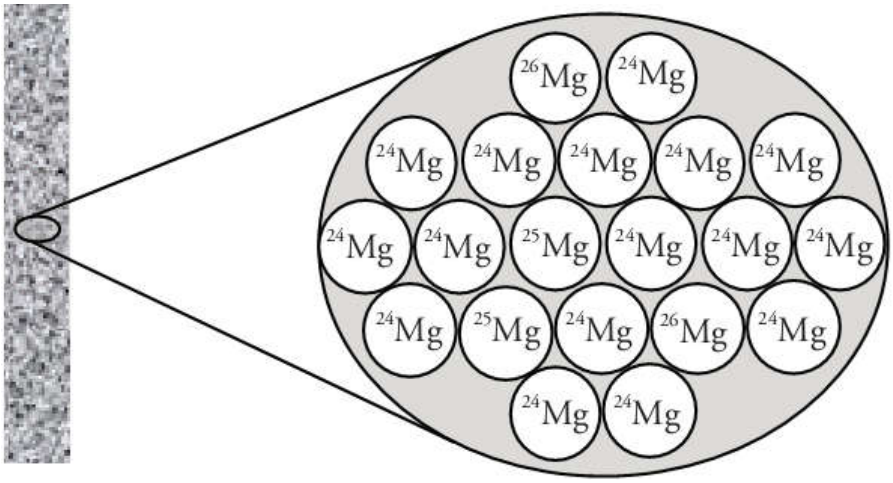
Chemistry
Ms. Ye

Name _____
Date _____Block _____

Average Atomic Mass: *How are the masses on the periodic table determined?*

Most elements have more than one naturally occurring isotope. As you learned previously, the atoms of those isotopes have the same atomic number (number of protons), making them belong to the same element, but they have different mass numbers (total number of protons and neutrons) giving them different atomic masses. So which mass is put on the periodic table for each element? Is it the most common isotope's mass? The heaviest mass? This activity will help answer that question.

Model 1 – A Strip of Magnesium Metal



1. Even though the Mg atoms above have different masses (24, 25, or 26), what is the atomic number for each Mg atom in Model 1? Why?

2. Since the mass number is equal to the total number of protons and neutrons, if each Mg atom has the same atomic number, what causes them to have a different mass (i.e. 24, 25, or 26)?

3. For the sample of 20 atoms of magnesium shown in Model 1, complete the table indicating the mass numbers of the three isotopes and the number of atoms of each isotope present.

mass number	**number of atoms present**
24	
25	
26	

4. Which isotope of magnesium is the most common in Model 1?

Model 2 – Natural Abundance Information for Magnesium

Isotope	Natural Abundance on Earth (%)	Atomic Mass (amu)
^{24}Mg	78.99	23.9850
^{25}Mg	10.00	24.9858
^{26}Mg	11.01	25.9826

Note: The **natural (percent) abundance** of an element is a measure of how much of a particular isotope exists. For example, if the natural abundance for Mg-24 is 78.99%, that means 78.99% of all naturally occurring magnesium atoms have a mass of 24 amu.

5. If you could pick up a single atom of magnesium and put it on a balance, the mass of that atom would most likely be _____ amu. Why?

6. Refer to a periodic table and find the box for magnesium.
   a. Write down the atomic mass decimal number shown in that box _____
   b. Does the decimal number shown on the periodic table for magnesium match any of the atomic masses listed in Model 2?

Model 3 – Proposed Average Atomic Mass of Magnesium Calculations

Jack's Method

$(0.7899)(23.9850\ \text{amu}) + (0.1000)(24.9858\ \text{amu}) + (0.1101)(25.9826\ \text{amu}) =$ _____

Alan's Method

$$\frac{23.9850\ \text{amu} + 24.9858\ \text{amu} + 25.9826\ \text{amu}}{3} =$$ _____

7. Complete the 2 proposed calculations for the average atomic mass of Mg in Model 3 and put your answers in the blanks above.

8. Consider the calculations in Model 3.
   a. Which method shown in Model 3 gives an answer for average atomic mass that matches the mass of magnesium on the periodic table?

   b. Why do you think the other method did not give the correct answer for average atomic mass (the one on the periodic table)?

Average Mass Practice: ***Show all work for the following problems.***

1. What is the average atomic mass for element X?

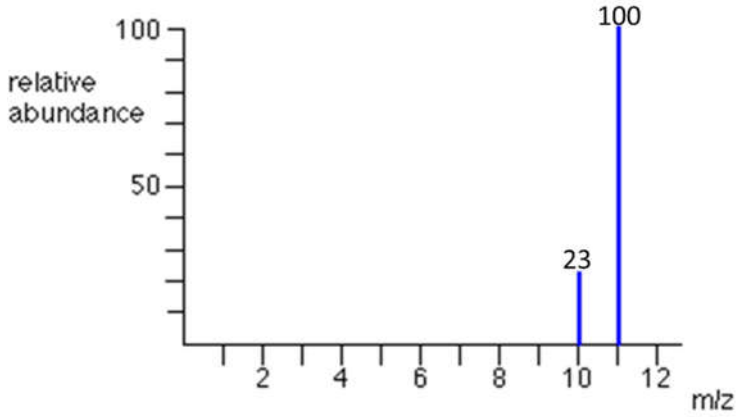
Isotope	Atomic Mass (amu)	Natural Abundance (%)
X-22	22.03256	78.33
X-23	22.99893	2.56
X-24	24.04562	19.11

2. An unknown element has the following atomic masses for three isotopes. Determine the average atomic mass and identify the element (write in standard nuclear notation).

Isotope	Atomic Mass (amu)	Natural Abundance (%)
1	27.9769271	92.2297
2	28.9764949	4.6832
3	29.9737707	3.0872

3. An unknown element exists in nature as two isotopes: Isotope 1 has a mass of 150.9196 amu in a 47.81% abundance and Isotope 2 has a mass of 152.9209 amu in 52.19%. What is the identity and average atomic mass of the unknown element?

4. The following is the mass spectrum for the stable isotopes of Boron. Determine the average atomic mass of Boron from the information provided. (note: you need to calculate the percent abundance first)



Candium (Cn) ***Name _____***
Average Atomic Mass Lab

Background:
Any naturally occurring sample of an element will contain different isotopes of that element, or atoms of the same element that have different numbers of neutrons and therefore different masses. For example, a naturally occurring sample of Hydrogen will contain Hydrogen-1, Hydrogen-2 (Deuterium), and Hydrogen-3 (Tritium). The average atomic mass of any element is a weighted average. You must consider not only the mass of each isotope, but also how abundant that isotope is in nature.

The purpose of today's activity is to determine the average atomic mass of a new substance, *Candium*, represented by the symbol Cn. **Each piece of candy** will represent **an atom** of *Candium*, and **each type of candy** will represent **an isotope** of *Candium*.

Procedure:
1. Count how many total atoms of *Candium* you have in your sample and record the number in your data section
2. Sort the *Candium* atoms into groups representing the different isotopes.
3. Record the number of atoms of each isotope of Cn in the data table.
4. Find the mass of each isotope and record this value in your data table.
5. Determine the **percent abundance** of each isotope by dividing the number of atoms of the isotope by the total number of atoms in the sample and multiplying by 100. Show your work in the calculations section.
6. Calculate the average atomic mass of *Candium* by using your calculated percent abundances and atomic masses. Show your work in the calculations section.

Data:
Total number of atoms in your sample _____

Isotope Description and Drawing	**# atoms of this isotope**	**Atomic mass of this isotope (a.m.u.)**	**Percent abundance (%)** (show work below)

Calculations:

Average atomic mass: (*use the appropriate method*). *Show all work*!

Post Activity Questions:

1. Which type of candy represents the greatest percent abundance? Was your average atomic mass of *Candium* close to the atomic mass of this type of candy? Why or why not?

2. A sample of element X contains 90% ^{35}X atoms, 8% ^{37}X atoms, and 2% ^{38}X atoms.
   a. Will the average isotopic mass be closest to 35, 37, or 38? Why?

   b. What is the average isotopic mass of element X? Show all work.

3. Chlorine has two major isotopes: ^{35}Cl and ^{37}Cl. The average isotopic mass of chlorine is 35.5.
   a. Given that the average isotopic mass is 35.5, which isotope should be more prevalent (has a greater percent abundance), ^{35}Cl or ^{37}Cl? Why?

   b. Which mixture of isotopes (shown as percentages) produces this average mass (35.5)? (Show your work for calculating average mass for both choices)
      A. 50% ^{35}Cl and 50% ^{37}Cl B. 75% ^{35}Cl and 25% ^{37}Cl