Name ____ block_____ date____________________

Atomic Mass of Beanium Lab

based on a concept by *Kathleen Davies*

PROBLEM

How is the average mass of isotopes determined?

INTRODUCTION

Imagine a new element has been discovered, and has been given the name “beanium”. Students at local high schools have been given the job of determining the number of isotopes of this new element, the mass of each isotope, the abundance of each isotope and the “atomic weight” of the new element. Fortunately, beanium atoms are very large, so you will be able to sort and weigh them easily. In this laboratory investigation, you will determine the abundance of each "isotope" of beanium, and determine the average mass (atomic weight) of the element in much the same way the average mass of other elements is determined. Then you will compare your result to a standard measurement of average mass.

MATERIALS (*per group*)

a bag of atoms of the new element, a weigh boat, balance

PROCEDURE

Method 1

1. Determine the number of isotopes of beanium based upon the appearance (size, color, etc.).
2. Sort the beanium atoms into groups based on appearance. Each group represents a different isotope. Count the total number of atoms of each isotope and record the result in column (a) of the data table, *Method 1,* on the next page. Add those numbers to get the total number of atoms in your sample. Record the total in the data table.
3. Determine the abundance of each isotope using the formula below:

$$\textit{Abundance} = \frac{\textit{number of atoms of each isotope}}{\textit{total number of atoms}}$$

   Record the results in column (b) of the data table, *Method 1*, on the next page.

4. Using a balance, measure the total mass of **all** the atoms of each isotope. Record the total mass in column (c) of the data table, *Method 1*, on the next page.
5. Find the typical mass of ONE atom of each isotope by ***dividing the total mass by the number of atoms of that isotope***. ((c) ÷ (a)) Record the result in column (d) of the data table, *Method 1*, on the next page.
6. Multiply the abundance of each isotope by its mass to find the product ((b) x (d)), and record the result in the last column of the data table, *Method 1*, on the next page.
7. Add the products in the last column to find the "atomic mass" of the element beanium. Record the result in the data table, *Method 1*, on the next page.

Method 2

8. Put ALL the beanium atoms on the balance at once. Measure their mass. Record the results in the data table, *Method 2*, on the next page.
9. Count the number of beanium atoms on the balance. Record the results in the data table, *Method 2*, below.
10. Find the average mass of beanium by dividing the mass of all the beanium atoms by the number of beanium atoms. Record the results in the data table, *Method 2*, below

OBSERVATIONS

Method 1 Data Table

Beanium Isotope	(a) Number of atoms (beans)	(b) Abundance	(c) Total mass (g)	(d) Mass of Isotope (g)	(e) Product
1					
2					
3					
total				Atomic Mass of "Beanium"	

Method 2 Data Table

Mass of all "beanium" atoms	Total number of "beanium" atoms	Average Mass of "beanium"

CONCLUSIONS

1. What do the three kinds of beans represent in this exercise?

2. How does the atomic mass of beanium (*Method 1*) compare to the average mass of beanium (*Method 2*)? Explain.

3. Why isn't the atomic mass of most of the elements on the *Periodic Table* an integer (why do they contain decimals)?

4. Which method, *Method 1* or *Method 2*, is most like the procedure for calculating the average atomic mass of an element?

5. What do isotopes have in common? How do isotopes differ?

6. What is the difference between mass number and atomic number?

7. Copper (atomic mass 63.5 amu) has two known isotopes, copper-63 and copper-65. Explain why the atomic mass of copper is not exactly 64. (In other words, why isn't it midway between the mass numbers for the two isotopes?)

8. Calculate the atomic mass of the element described below. Then use the periodic table to identify the element.

Isotope	Mass (amu)	Percent Abundance (%)
Element-35	34.97	75.77
Element-37	36.97	24.23

9. (extra credit) Because isotopes have identical chemical properties, radioactive isotopes can be used for medical use. Based on where the following elements are likely found in the body, match each radioisotope with its medical use.

____________Sodium-24	a. study of bone formation
____________Calcium-47	b. red blood cell studies
____________Iodine-131	c. diagnose thyroid disorders
____________Iron-55	d measure extracellular fluid
____________Phosphorus- 32	e. genetic (DNA) research