Honors Chemistry Lab #6- Candium Isotopes

ASK: How can I determine the average atomic mass of isotopes using candy as a model?

Isotopes are different forms of the same element. Therefore, they have the same number of protons and electrons, but they each have a different number of neutrons. For example, think of the three isotopes of hydrogen: H-1 is “regular” hydrogen; H-2 is called deuterium and H-3 is known as tritium. They are all types of hydrogen with only one proton in the nucleus and one electron in the electron cloud, but all three have different numbers of neutrons in their nuclei. In this lab, the “element” is called Candium. The three types of candy you will use are M&Ms, Skittles, and Reese’s Pieces. You will call the three forms (isotopes) of Candium “M&Mium,” “Skittlium,” and “Reesium.” Each isotope of an element has a mass with a natural percent abundance. The atomic mass of the element listed on the periodic table represents the masses of each isotope and their *percent abundances.* The relative abundance and mass of small atomic particles are measured in the laboratory by an instrument called a mass spectrometer. The mass spectrometer separates particles by mass and measures the mass and relative abundance of each. From these data a weighted average is calculated to determine the atomic mass of the element. For every element, each atom of a given isotope has the same mass; however, you know that each M&M does not have the same mass just like each skittle does not have the same mass. Thus, in this lab you have to determine the average mass of one atom of each isotope of Candium. The purpose of this lab is to use the Candium model to explain the concept of atomic mass and to analyze the “isotopes of Candium” in order to calculate its average atomic mass.

Safety Requirements: Do not eat the candies before, during, or after the experiment. Contamination has occurred in this lab. You must return the samples with the exact number of “atoms” that you received.

RESEARCH: 1). Obtain a sample of Candium. 2). Separate the three isotopes and count. Obtain the total mass for each group of isotopes 3). Complete the data table using the instructions found under the “Data Analysis Questions” section. The large X’s in the table indicate cells that do not require data.

Data: Please see the next page if you need help with the calculations for the data table.

	Isotope: M&Mium	**Isotope: Skittlium**	**Isotope: Reesesium**	**Total**
Total Mass of Atoms (g)				
Total Number of Atoms				
Average Mass (g)				X
Percent Abundance (%)				X
Relative Abundance				X
Relative Mass				

Average Atomic Mass of Candium

Data Analysis (for data table calculations in table above; show all work):

Calculate the average mass for each isotope

$$\text{Average Mass} = \frac{\text{total mass of atoms}}{\text{total number of atoms}}$$

Calculate the percent abundance of each isotope

$$\%\ \text{Abundance} = \frac{\#\text{of atoms for each isotope}}{\#\ \text{of atoms for all isotopes}} \times 100$$

Calculate the relative abundance of each isotope

$$\text{Relative Abundance} = \frac{\text{Percent abundance}}{100}$$ *(basically the % expressed as a decimal)*

Calculate the relative mass for each isotope.

Relative Mass = Relative Abundance x Average mass

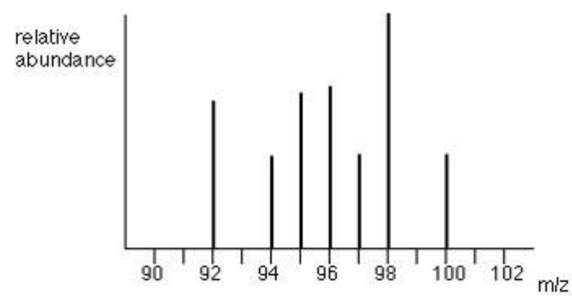
Finally, calculate the average atomic mass of this element, Candium (bold box in data table)

Average atomic mass of Candium = Sum of all relative masses

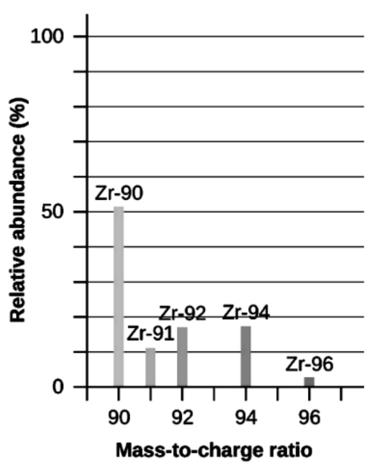
MAKE your claim and write your SUMMARIZE. Incorporate the two questions below into your summary.

Post-Lab Questions: (complete all questions in STEM journals)

Q1. The mass spectrum to the right is generated through mass spectrometry. In a mass spectrum, each bar represents an ion having a specific mass-to-charge ratio (m/z) and the length of the bar indicates the relative abundance of the ion. Analyze the spectrum, determine which element is represented, and propose an explanation based on the spectrum data.



Q2. Examine the mass spectrum for Zr^{4+}. Predict how the spectrum peaks would change if Zr^{3+} were run in the mass spectrometer instead of Zr^{4+}.



Please self-assess your STEM journal using the rubric/checklist.