Isotopes of Pennium Lab

Target
Students should be able to determine the masses and relative abundances of isotopes present in a sample of an element (penny) and calculate average atomic mass of an element

Background
Unless you're a coin collector, you probably think all United States pennies are pretty much the same. To the casual observer, all the pennies in circulation do seem to be identical in size, thickness, and composition. But just as elements have one or more isotopes with different masses, the pennies in circulation have different masses. In this investigation, you are going to use pennies with different masses to represent different "isotopes" of an imaginary element called pennium, or Pe. Remember that chemical isotopes are atoms that have the same number of protons, but different number of neutrons. Thus, chemical isotopes have nearly identical chemical properties, bur some different physical properties.
In this investigation, you will determine the relative abundance of the isotopes of pennium and the masses of each isotope. You will them use this information to determine the atomic mass of pennium. Recall that the atomic mass of an element is the weighted average of the masses of the isotopes of the element. This average is based on both the mass and the relative abundance of each isotope as it occurs in nature.

Materials
laboratory balance
Reference envelope
envelope with 10 unknown pennies in it
20 pennies in a resealable Ziploc bag

Procedure
PART 1
1. Remove the pennies from the resealable bag and count them to make sure that there are 20. Determine and record the combined mass of your 20 pennies.
2. Find the mass of each penny separately. In the Data Table, record the year the penny was minted and it's mass to the nearest 0.01 g.
3. Place the 20 pennies in the resealable bag.

PART 2
1. Record the code number of your sealed envelope.
2. Find the mass of the sealed envelope of pennies.
3. Find the mass of the reference envelope.

Data (Part 1) **Mass of the 20 pennies ________________**

Penny	Year	Mass (g)
1		
2		
3		
4		
5		
6		
7		
8		
9		

10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Data Table (Part 2)

Code # on sealed envelope	
Mass of sealed envelope of pennies	
Mass of reference envelope	
Mass of the 10 pennies in the envelope (Mass of envelope minus mass of reference envelope)	
Average atomic mass of $Pe_{Pre1982}$ (from Part 1 Calculation #2)	
Average atomic mass of $Pe_{Post1982}$ (from Part 1 Calculation #2)	

Calculations: (Part 1)

1. You have two isotopes of Pe. They are pre-1982 and post 1982. Calculate the fractional abundance of each isotope in your sample. *(Fractional abundance = number of pennies for each isotope ÷ total number of pennies)*
2. Calculate the average atomic mass of each isotope. *(Average atomic mass = total mass of pennies of each isotope ÷ the number of pennies of that isotope)*
3. Using the fractional abundance and the average atomic mass of each isotope, calculate the atomic mass of Pe. (average mass of isotope 1) x (fractional abundance) + (average mass of isotope 2) x (fractional abundance) = atomic mass

Calculations: (Part 2)

1. Subtract the mass of the reference envelope from the mass of the sealed envelope of pennies to find the total mass of the pennies.
2. Calculate the value X (the number of pre-1982 pennies) and 10-X (the number of post-1982 pennies)
   Solve for X
   Total mass of pennies = (X)(avg mass one pre-1982) + (10-X)(avg mass one post-1982)
   X = # of pre-1982 pennies
   10-X = # of post-1982 pennies
3. Calculate the percent composition of the element "pennium" from your data.
   $\frac{\text{Mass } Pe_{Pre1982}}{\text{Total Mass}} \times 100$ $\frac{\text{Mass } Pe_{Post1982}}{\text{Total Mass}} \times 100$

Analysis and Questions:

1. Was the mass of 20 pennies equal to 20 times the mass of one penny? Explain.
2. In what year(s) did the mass of Pe change? How could you tell?

3. How can you explain the fact that there are different “isotopes” of pennium?
4. Why is the element “pennium” a good analogy or model for actual element isotopes? In what ways is the analogy misleading or incorrect?
5. Name at least one other familiar item that could serve as a model for isotopes
6. Why are the atomic masses for most elements not whole numbers?
7. How are the three isotopes of hydrogen (hydrogen–1, hydrogen-2, and hydrogen-3) alike? How are they different?
8. Copper has two isotopes, copper-63, and copper-65. The relative abundance of copper-63 is 69.1% and copper-65, 30.9%. Calculate the average atomic mass of copper.

Conclusion or Reflection:

Remember in the conclusion you need to have 3 paragraphs.

1st paragraph - you will draw conclusions. Give a valid conclusion based on the correct interpretation of your results and explain your results reflecting back on the target.

2nd paragraph - you will evaluate procedure(s) and results including limitations, weaknesses or errors.

3rd paragraph - you will Identify weaknesses and state realistic suggestions to improve the investigation.