Isotopes of "Pennium"

Introduction

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 numbers of neutrons. Thus, chemical isotopes have nearly identical chemical properties, but 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 then 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.

Problem

What are the masses and the relative abundances of pennium and what is the atomic mass of the element?

Materials

Laboratory balance
20 pennies

Procedure

1. Remove 20 pennies from the bag. Make sure you get some old ones some new ones, some crusty ones, some clean ones. You want a good sampling of pennium atoms.
2. Find the mass of each penny separately. In the Data Table, record the year the penny was minted and its mass to the nearest 0.1 g.
3. Place the 20 pennies back in the bag. Clean up your work area and wash your hands before leaving the lab.

Observations

Combined mass (to the nearest 0.1 g) of 20 pennies _____

Data Table

Penny	Year	Mass (g)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Calculations

1. Inspect your data carefully. Determine the number of isotopes of Pe that are present. Group them by mass at ± 0.2 g.

   _____

   _____

   _____

2. Calculate the fractional abundance of each isotope in your sample.

3. Calculate the average atomic mass of each isotope.

4. Using the fractional abundance and the average atomic mass of each isotope, calculate the atomic mass of Pe.

Conclusions

1. What do the 20 pennies in this investigation represent? _____

2. What do the different masses of the pennies represent? _____

3. What information do you need to calculate the average atomic mass of an element? _____

4. Was the mass of 20 pennies equal to 20 times the mass of one penny? Explain. (*Making comparisons*) _____

5. In what year(s) did the mass of Pe change? How could you tell? (*Interpreting Data*) _____

6. How can you explain the fact that there are different "isotopes" of pennium? (*Making Inferences*) _____

7. 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. (*Applying concepts*)