**Isotopes of “Pennium” Lab**

* **Question:** What are atoms, ions and isotopes?
* **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.

* **Safety**: Please be careful with electrical equipment so that you do not receive an electrical shock.

**Data Table**

*(Copy into your lab notebook before lab day.)*

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

* **Procedure:** (✓ *each of the steps as you complete them. )*

*Important:* **Do not mix or exchange your pennies with another group!**

* 1. Count your pennies to make sure that there are 20.
* 2. Sort your pennies by date from oldest to newest.
* 3. Using an electronic balance, measure and record the mass of each penny separately. Record the date of each penny as well.
* 4. Replace your pennies into the vial.
* **Calculations:**
1. Inspect your data carefully. Based on your data, sort your pennies into two isotopes of Pe - Isotope I & Isotope II. Label them Isotope I or Isotope II on the data table.
2. Calculate the **average atomic mass of each isotope**.

Divide the total mass of pennies (of each isotope) by the total number of pennies.

*Average atomic mass = total mass of pennies of each isotope*

 *total number of pennies in that isotope*

1. Calculate the **fractional abundance of each isotope** in your sample.

Divide the number of pennies (for each isotope) by the total number of pennies.

*Fractional abundance = # of pennies for each isotope*

*total number of pennies*

1. Using the fractional abundance and the average atomic mass of each isotope, calculate the **average atomic mass of Pe.** Multiply the average mass of Isotope I by the fractional abundance of Isotope I. Then, multiply the average mass of Isotope II by the fractional abundance of Isotope II. Finally, add these two products together.

*Average atomic mass of Pe = (average mass of Isotope I ) (fractional abundance of Isotope I) +*

 *(average mass of Isotope II ) (fractional abundance of Isotope II)*

* **Conclusion:**

*“The average atomic mass of the imaginary element Pennium is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .”*

# EXTRA CREDIT: Not all pennies are made from copper. In 1943, our pennies were steel! This was because copper was so valuable for the war effort. Calculate the atomic mass of Pe if *in addition* to your pennies you have one (1) more for a total of 21 pennies. This additional penny is a 1943 steel penny with a mass of 2.70 g.