EXPERIMENT: PENNIUM

Part A. Average atomic mass

Until 1982, US pennies had been made from pure copper. But in 1982, for economic reasons, the composition was changed and pennies were made from zinc, with a thin coating of copper on the exterior to preserve their appearance. As a result, although all pennies are the same size, there is a significant difference in weight between pre-82 pennies and post-82 pennies.

If pennies were a chemical element (let’s say “pennium”), it would have two isotopes (pre-82 and post-82). Both would look the same and behave in the same way, but would differ in their weight, just like ordinary isotopes. In this case, both isotopes would be stable. As with all atomic elements, we would need to know its atomic mass, which is an averaging of all the available isotopes.

Your first task is to determine the “atomic mass” of pennium. In the course, of this determination, it is important to use good scientific method. For example, weighing a single penny will give an erroneous result, since the true atomic mass of pennium is an average of two isotopes. Furthermore, weighing one pre-82 penny and one post-82 penny will also give a false result since it assumes that 50% of all pennies are pre-82, and 50% are post-82, which may not be the case. Talk this over with your lab partner, and devise a method to get an accurate and realistic atomic mass of pennium. As a secondary task, try to determine the relative abundance of each isotope.

1. Describe your method:

2. Data Collected and Calculations:

3. Atomic mass of pennium: ______
4. Relative abundance of pre-82 penny: ______
5. Relative abundance of post-82 penny: _____
Part B. Alchemy

PLEASE USE THE POST 82 PENNIES FOR THIS PART OF THE EXPERIMENT

Select three of your cleanest pennies and put them aside. If you can't find some relatively shiny pennies, you can also clean your pennies prior to the experiment by putting them in a salt/vinegar mixture. Rinse them with water before proceeding with the experiment. One of these pennies will serve as a control. Prepare a cauldron of approximately 3mL of 1.5 M sodium hydroxide (NaOH). Into this place a sprinkling of zinc powder and two of your pennies. Heat the cauldron over a Bunsen burner as demonstrated by the instructor (turn the Bunsen burner off if the solution starts to boil vigorously). Occasionally turn the pennies over with a pair of tongs. After a couple of minutes, they will turn silver. When the transformation is complete, remove the pennies with a set of tongs, and place them in a beaker of ordinary tap water to wash them.

Take one of the silver pennies and hold it (by its edge) with a set of tongs in a Bunsen burner flame. (BE CAREFUL; IF YOU HEAT STRONGLY, YOU MAY MELT YOUR PENNY!) The silver penny will gradually turn to gold. When this is complete, dunk the now gold penny in your beaker of ordinary tap water to cool it to room temperature. Of your three pennies, one should now be copper, one silver, and one gold. Dispose of the NaOH in the provided waste jar.

If you want to take your pennies home and you have small children in your family, please enclose all three of them in contact paper and keep in a secure place.

1. Review the terms chemical and physical changes. Does the first step (copper to zinc) accomplish a chemical change or a physical change? Explain.

2. Does the second step (zinc to brass) appear to be a chemical or physical change? Describe what you think might be happening at the atomic level.