**Number of Copper Atoms in a Penny**

* **Lab Question:** How what is the relationship between mass, moles and Avogadro’s number?
* **Introduction:** As you know, the United States’ one-cent coin, or the penny, is a unit of currency equaling one one-hundredth of a United States dollar. However, you may not know that the composition of the penny has changed dramatically over the years. In 1943, at the peak of World War II, cents of zinc-coated steel were made for a short time due to war demands for copper. During the early 1970s, the price of copper rose to a point where the cent almost contained more than one cent’s worth of copper. This led the Mint to test alternate metals, including aluminum and bronze-clad steel, though neither were adopted. Because the value of the copper in the coin finally rose above one cent, the cent’s composition was finally changed in 1982 to its current make-up of an inside zinc core and a thin copper coating.

In this lab, we will determine the number of atoms of copper in a modern (post-1982) penny by using a strong acid to react and dissolve the zinc core, leaving only the copper coating.

* **Safety:** Goggles, gloves and aprons must be worn. Hydrochloric acid is a strong acid, do not smell the fumes and be careful not to spill. If you spill any, let your teacher know immediately.

**Data Table**

|  |  |
| --- | --- |
| ***Date of Penny*** |  |
| ***Copper Shell Mass (g)*** |  |

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

Day1

* 1. Obtain a post-1982 penny. Each member of the group gets their own penny to work with. Record the date of the penny.
* 2. Using a metal file, file four oppositely-placed small grooves into the edge of the penny. The grooves must be only deep enough so that the zinc is exposed.
* 4. Obtain a small beaker and label it with your name and your period.
* 5. Now, put on your gloves and pour ~20mL of 6M HCl into the beaker.
* 6. Carefully place the penny in the acid. Observe for about a minute.
* 7. Place your labeled beaker in the area indicated by your teacher to react overnight.

Day 2

* 8. Using your forceps, carefully remove the fragile copper shell that is left from the penny. Rinse it gently with distilled water over your beaker.
* 9. Pat the penny dry with a paper towel.
* 10. Put the penny on a small watch glass and place it in the oven for 10 minutes to allow it to dry completely.
* 11. While waiting for your penny to dry, dispose of the acid into the waste container indicated by your teacher and rinse your beaker in the sink.
* 12. After ten minutes, remove the penny from the oven.
* 13. Measure and record the mass of the copper shell.
* 14. Clean your lab station.
* **Calculations:**
1. **Moles of Copper** Convert the mass of the copper into moles of copper by using the atomic mass of copper

$$Moles of Cu= mass of copper x \frac{1 mole of Cu}{63.55g Cu}$$

1. **Number of Atoms of Copper** Convert the mole of copper into number of atoms of copper by using Avogadro’s number. Express your answer in correct scientific notation.

$$\# of atoms of Cu= moles of copper x \frac{6.022 x 10^{23}atoms of Cu}{1 mole Cu}$$

* **Conclusion:**

*“By obtaining the mass of the copper shell of a post-1982 penny, the number of copper atoms in a penny was calculated to be \_\_\_\_\_\_\_\_.”*

EXTRA CREDIT: Write your answer out in expanded form.