Earth Science Name: _____ Period :_____

Lab: Money Trouble – Determining Density of Pennies - Abbreviated

Background:

Density is a measure of the amount of Mass in a given Volume. A pound of feathers and a pound of lead have the same mass, but the feathers can occupy significantly more space than the lead.

Historically pennies have been made of copper with an imprint of Abraham Lincoln on one side. At some point in time a change was made to the manufacturing process so that the penny today is made of a zinc core with a copper coating so that is will retain its historic appearance. Because copper and zinc have different densities, we can determine the year the changes were made to the manufacturing process.

Your Task:

~~Part A~~ ~~Follow the procedure below to determine the minimum number of pennies necessary to **accurately** calculate the density of a penny.~~

Part B ~~Use the results of Part A to calculate the density of pennies made in the 60's, 70's, 80's, 90's and 00's.~~ Identify the decade in which the manufacturing process change was made. Note: pennies from the 60's and 70's are more rare, so it may not be possible to use the optimal number of pennies for these decades.

Materials

- Triple beam balance or electronic balance
- 100 ml graduated cylinders
- Pennies
- Water
- Reference materials to explore the minting of coins and density of metals

Procedure

Part B: Pennies for different decades

1. Sort pennies by decade.
2. **If using glass graduated cylinders - Put on your safety goggles!** Pour 30 to 40 mL of water into a 100 mL graduated cylinder. Record the volume of the water in the cylinder on the data table on page 2. This is the Starting Volume. Leave the water in the cylinder.
3. Using the balance, determine and record the mass of eight pennies from a single decade.
4. Slide the eight (8) pennies into the graduated cylinder, being careful not to splash any water. Record the volume of the water plus pennies.
5. Subtract the Starting Volume to determine the amount by which the volume changed when you added the four pennies. Record this amount as the volume of the four pennies. This is known as ***displacement volume.***
6. Use the formula **Density = Mass/Volume** (D=m / V) to determine the density of the eight pennies.
7. Complete the procedure for each decade.

Table B: Data for Pennies made in Different Decades

Quantity	# of Pennies	Mass of pennies (g)	Starting volume in cylinder (mL)	Volume of water and pennies (mL)	Volume of pennies (mL)	Density of pennies (g/mL)
1960's						
1970's						
1980's						
1990's						
2000's						

Part B Analysis:

Independent variable: _____

Dependent variable: _____

Constants: _____

Control: _____

Problem Statement: (How does...)

Hypothesis (If..., then ....)

1. Create a results graph (correct graph type, properly labeled)
2. Write a conclusion.
3. Answer the following questions.
   a. Why did your teacher require you to use 8 pennies, and not 2 or 4 pennies?
   b. Why wasn't volume measured before mass?
   c. Look at the graph for Part B. Is it possible to determine what decade the production change took place? How would you go about determining this?

BONUS QUESTION:

Assuming that pennies are made from copper and zinc; based upon your data what percent of each type of penny (1995 or later) is copper and what percent is zinc

(Hint: density of penny = x [density of copper] + y [density of zinc] and x + y = 1 or y = 1 - x; in other words, this is an algebra problem with 2 unknowns and 2 equations.) Look up the density of copper and zinc for this. **You must show your work.**