Penny Density Lab

Name:_____ 80/1200

Objective: To discover the unknown metal inside of the new pennies, which changed from being ALL COPPER before 1982, to just 2% copper plated over an "unknown" metal inside since 1983. You will measure the old pennies to sharpen our skills, and then carefully measure the new ones to discover what this unknown metal is.

Required reading:

The government now makes pennies that are different from the ones made before 1983. The older pennies were made of almost pure copper (about 99.5%). Since 1983, they have been made with a very thin outer coating of copper (approximately 2% of the metal in the coin) wrapped over a core of a different metal (which is our unknown metal).

The pennies are identical in size and volume but they have a different mass that you just never noticed. We have some high quality electronic balances that will measure the mass for you.

We will carefully measure the mass of old pennies in sets as marked in the data tables. Then we will use the displacement method for measuring volume of each set of pennies. These measurements will let us (later) get an average density measurement for the old pennies, which we can compare to the density of copper. Dry off the pennies before returning them to the big pile of pennies.

We will repeat the measures with the NEW pennies, also in numbers indicated in the data table. The measured average density for those will be very close to the density of the unknown metal inside them. When we discover the density of the metal, we can try to figure out the name of that metal by comparing our measured density to the known densities in table S. Dry off the coins when you are done

Sig Figs Matter

When measuring with the electronic balances, the measures go to the 100th gram, we do not round when using electronic devices. The graduated cylinders have lines for each mL, so you will ROUND or ESTIMATE then to the nearest 10th mL. When calculating your measured densities, significant figures of the answer will be limited to the <u>lowest number of SF</u> in the numbers you multiply in the calculations.

Indicate that you read all of this page with your initials _____

Data 1. OLD PENNIES		Start water volume in cylinder:
# of pennies in set	dry mass of pennies in grams	volume of pennies only in cm^3
9		
12		
15		
18		
21		
24		
27		
30		

Data 2. NEW PENNIES		Start water volume in cylinder:
# of pennies in set	dry mass of pennies in grams	volume of pennies only in cm^3
9		
12		
15		
18		
21		
24		
27		
30		

Graphing - Each student will create 2 large graphs plotting mass as a function of volume (mass on the vertical scale or Y-axis, volume on the horizontal scale or X-axis). It is imperative that you set the graph up correctly.

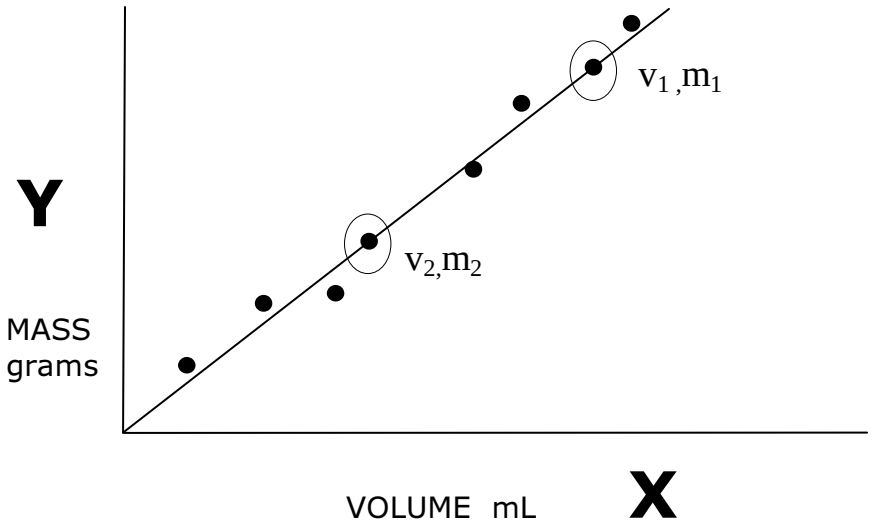
Since density is equal to mass over volume, and the fact that the slope of our graph is equal to the change in Y over the change in X, and since on this graph Y is mass and X is volume, the slope of the lines will be equal to your measured density of the pennies.

USING your data, you will draw the BEST FIT straight line to represent your data points. Your line might not touch a single point you just drew. Your line is your mind's best "average" of the data. Once the line is drawn, the only points that matter are ON THE LINE. Your line must go through the point 0 grams and 0 mL on the graph, and it must be straight because it represents the constant of density. Do not just "connect the dots" on your graph. The dots are not in an exactly straight line because your measurements aren't.

By calculating the slope of each line, you will actually be calculating the AVERAGE measured density of the pennies. The slope IS THE SAME THING as average measured density.

Put the 8 points of data for the old pennies on the old penny graph first, then draw the BEST FIT LINE, don't just connect the dots. This line must be straight! The line is your AVERAGE (by eye) of the data points. Then put the second set of eight dots of data on the second graph and draw ANOTHER BEST FIT STRAIGHT LINE. Give your graph a sensible title and be sure each axis has a label with units. (It starts at 0,0, no mass = no volume)

$\text{slope} = \frac{\Delta Y}{\Delta X}$	$\text{Density} = \frac{\Delta \text{ mass}}{\Delta \text{ volume}}$	$\text{Density} = \frac{m_1 - m_2 \text{ gm}}{v_1 - v_2 \text{ cm}^3}$



Circle and label (v_1, m_1) as well as (v_2, m_2) on BOTH of your graph lines.

To calculate slope, use data points FROM YOUR BEST FIT LINE, which do not necessarily come from your actual data tables. The best fit line MUST be straight, it represents the CONSTANT called density.

We will NOT use the density equals mass over volume formula for any reason during this experiment. The calculations of slope will be our "average density" for our 5 measurements.

CALCULATIONS and QUESTIONS for this lab report, SHOW THE MATH!!!

1. Calculate the slope (which is the measured density) for the "old" pennies ON THE GRAPH.

2. Calculate the slope (which is the measured density) for the "new" pennies ON THE GRAPH.

3. We assume that the old pennies are pure copper. What is your %E for your measured density? (formula, math)

4. Using table S, fill in a short list of the 6 metals with a density close to your measured density of the new pennies.

5. Indicate which metal on this list is closest to your data, or, what metal does your data say is inside the coins?

6. The metal inside of the new pennies is zinc. Calculate your density % Error.

	Symbol	Name	Element Density g/cm^3
A			
B			
C			
D			
E			
F			
5. The element closest to your measure:			

7. Why is it important to put the pennies into the cylinders slowly, without splashing?

8. If you found a small hunk of nickel metal, and measured the volume to be 84.00 mL, what would be its mass? Show all work. Watch your SF!

This lab report	Includes	grading/points
cover page	Title, intro sentence about why we are doing this lab	1 + 1 = 2
page 3	large graph, proper labels, titles, best fit lines, etc.	3 + 3 = 6
page 4	problems from above, two on the graphs, most on loose leaf, fill in that table just above.	12
page 5	Conclusion - every lab report should have these 4 parts: • What did you measure • What did you calculate • What is your % error (and why) • What can you conclude or decide from this lab work? • All conclusions MUST include YOUR numbers, not just words.	5
deduct 5 points if late	this lab is due on:	25 points