Penny Density Lab

Name:_____ 80/1200

Objective: To discover the unknown metal inside of the the new pennies, which changed from being ALL COPPER before 1982, to just 2% copper plated over this "unknown" metal inside since 1983. You will measure the old pennies to sharpen your skills, and then carefully measure the new ones to try and 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. In 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 this 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 scales that will highlight this difference.

Procedure: Carefully measure the mass of old pennies in sets as marked in the data tables. Then use the water displacement method for measuring volume of each set of pennies. These measurements will be used to calculate an average density measurement for the pennies, which should be equal to the density of copper. Dry off the pennies before returning them to the big pile of pennies.

Repeat the measures with the NEW pennies. The calculated average density for those will be very close to the density of the unknown metal inside them. That density should be close to a metal on table S, you will attempt to figure out which metal is inside the new pennies. Dry off the coins when you are done

Sig Figs Matter

When measuring with the electronic balances, do not round away any significant figures (SF). There is NO estimating on a device like this. The graduated cylinders have lines for each mL, so you must ESTIMATE 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.

Read the rubric at the end of the lab.

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

Data 1. OLD PENNIES		Volume of water in cylinder to start:		
# of pennies	dry mass of pennies in grams	Volume of water And pennies	— Start water volume in cylinder:	= Volume of just the pennies
9				
12				
15				
18				
21				
24				
27				
30				

Data 2. NEW PENNIES		Volume of water in cylinder to start:		
# of pennies	dry mass of pennies in grams	Volume of water And pennies	— Start water volume in cylinder:	= Volume of just the pennies
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 or Y-axis, volume on the horizontal X-axis). It is imperative that you set the graph up correctly. Make your scales consistent, and no breaks are allowed. Mass 0 to 100 grams, volume 0 to or 12 cm^3.

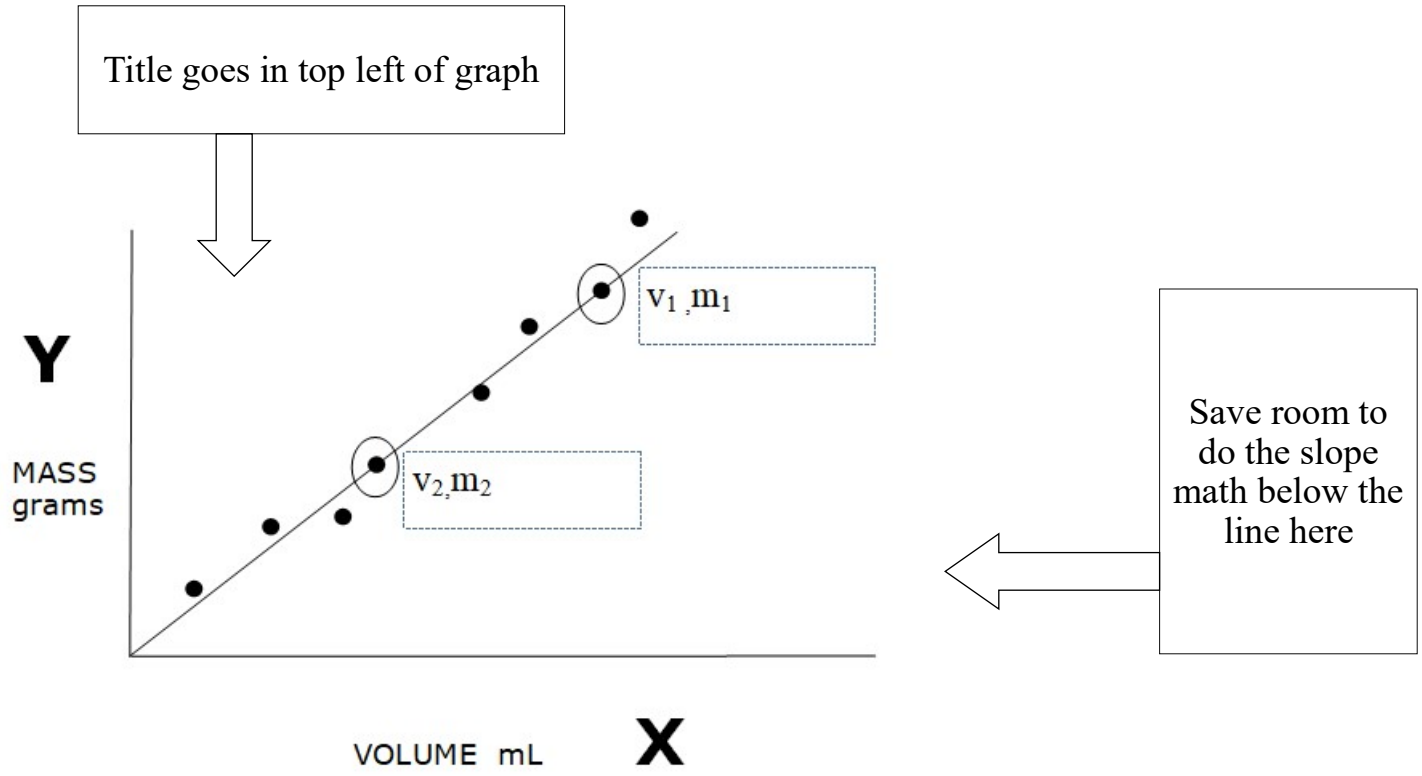
Title should be MASS and VOLUME of Old Pennies (or new). Axis labels will be mass in grams, and volume in cm^3.

Since density is equal to mass over volume, the slope of this line will equal you average measured density. The slope of the "old penny" graph should be close to the density of copper. The slope of the new penny line should be close to the density of the mystery metal inside the new pennies.

Do NOT connect the dots. Use the data points to draw the BEST FIT straight line to "average" your data. Your line might touch some of your data points, or not touch any of your data dots. This best fit line is your mind's "average" of the data. Once the line is drawn, the only points that matter are ON THE LINE.
Your line must start at 0 grams and 0 cm^3. It must be straight because it represents the constant called density. The dots are not in an exactly straight line because your measurements aren't exactly perfect.

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 measured density.

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



Circle and label (v_1 ,m_1) as well as (v_2 ,m_2) on BOTH of your graph lines. These are the points you are using in your slope calculation. Only use points that are ON THE LINE.

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.

Lab QUESTIONS for this lab report, SHOW THE MATH!!! ON Separate paper except 1 and 2.

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, SF)
4. Using table S, fill in a short list of the 6 metals with a density close to your measured density for the new pennies.
5. Indicate which metal on this list is closest to your data. Your data says that this is the mystery metal in the new pennies.

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

Redraw a small table like this onto your white paper.

6. The metal inside of the new pennies is zinc. Calculate your % Error for density. (formula, math, SF)
7. Why is it important to not splash water out of the graduated cylinders when you put the pennies into it?
8. If you found a small hunk of platinum metal, and you carefully measured the volume to be 73.58 mL, what would be the mass of this metal? (formula, math, 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