Name _____

Drops on a coin lab

Pre-lab

Purpose

You will practice science process skills including following procedures, making observations, recording data, calculating error, and making graphs.

Materials

3 pennies	3 nickels	1 quarter
50 mL beaker	calculator	disposable pipette
ruler		

Safety

- There should not be any horseplay in the lab. Horseplay can result in broken glass and injuries

Questions

- Read through the procedure and identify the variables involved in this lab. List them below.

- Which of these variable is being varied?

- Explain how you will attempt to control at least four of the other variables.

- Do you think that we can predict the number of drops on a quarter by measuring the number of drops on a penny and a nickel?

Procedure

Part 1 - Initial Measurements

1. Obtain a ruler, a disposable pipette, 3 pennies, 3 nickels, and a quarter from the front desk.
2. Use the ruler to measure the diameter of a penny, a nickel, and a quarter in millimeters. Record these measurements on the data section.
3. Complete the calculations for the area of a penny, a nickel, and a quarter on the data sheet.

Part 2 - Drops on a Coin

1. Use the pipette to place drops of water on a penny until you can't get anymore on top.
2. Make observations about the water on top of the penny and record the number of drops you were able to place on the penny.
3. Repeat steps 1 and 2 two more times with the dry pennies.
4. Repeat steps 1 through 3 with the three nickels.
5. Repeat steps 1 through 2 with the one quarter.
6. Use paper towels to dry off your area and coins, and dispose of the paper towels in the trash can.
7. Return your materials to the front desk.

Data & Analysis

Part 1 - Data Section

Penny

Diameter = _____

Area ($A=\pi*r^2$) = _____

Nickel

Diameter = _____

Area ($A= \pi*r^2$) = _____

Quarter

Diameter = _____

Area ($A=\pi*r^2$) = _____

Drops on the Coins

Coin	Trial #1	Trial #2	Trial #3
Penny			
Nickel			
Quarter			

- What does the water on top of the penny look like? (use words or drawings)

- What does the water on top of the nickel look like?

Part 2 - Analysis

1. Determine the mean number of drops for the pennies and nickels.

   Penny = _____

   Nickel = _____

2. Determine the percent error for trial. Use the equation below for calculating percent error.

$$\text{percent error} = \frac{|measurement - mean|}{mean} \cdot 100$$

Coin	Trial #1	Trial #2	Trial #3
Penny			
Nickel			

3. What would be some possible explanations for any error you found?

4. Using Microsoft Excel or Google Sheets, create a graph of drops of water vs. area of the coin by using the data for the pennies and nickels. The graph should be clearly labeled and have a grid. The graph should also be extended to include the area of the quarter. For detailed instructions, see the Excel Instructions section.

5. Use Excel to add a linear trendline. Extend the trendline forward far enough to include the area of the quarter.

6. Are there any data points that are "outliers" that adversely affect the trendline?

7. Use the trendline to extrapolate the number of drops that should be able to fit on a quarter. How does this number compare with how many you actually got on the quarter? Was the trendline a good approximation? How can you tell?

Excel Instructions

Instructions for Google Sheet are similar, but a few differences when making the graph.

1. Open Excel
2. In cell A1, put a label for the dependent variable (drops of water).
3. In cell B1, put a label for the independent variable (area of coin).
4. In column A, type in the corresponding data without the units, starting in cell A2.
5. In column B, type in the corresponding data without the units, starting in cell B2.
6. Highlight columns A and B, then press the Chart Wizard button (blue-yellow-red bar graph)
7. Select the XY (Scatter) chart type, then press *Next >*.
8. Make sure the graph looks OK, then press *Next >*.
9. Add a title, labels for the x-axis and y-axis, turn on the major x-axis grid lines, and turn off the legend, then press *Next >*.
10. Select to place the chart as a new sheet, then press Finish.
11. Double-click on the x-axis and adjust the Scale to have a minimum value of just below your area for the penny and a maximum value of just above your area for the quarter. Try to use even numbers for your scale like 125, 350, or 525.
12. Right-click on one of the data points and select Add Trendline.
13. Choose a linear trendline and then on the options tab set the Forecast Forward, so that it is greater than the difference in the area between the quarter and the nickel. This will allow us to use the trendline to see how many drops could have fit on a quarter.
14. You may adjust the aspects of the graph and spreadsheet to make them more ascetically pleasing.
15. Print out your spreadsheet and graph with a header, then turn them in to your teacher.

