Experimentally Determining the Density of Pennies

Significant Figures, Accuracy, Precision and Data Analysis

A group of General Chemistry students at Purdue University applied four different experimental methods to identify "new" and "old" pennies by the difference in their respective densities. (NOTE: Both the "new" and "old" pennies that they used in the experiment were in public circulation and not in mint condition.)

The students followed four different Methods, which follow. Their experimental data is on the back of this page. The data provided provides densities calculated for all but one of the ten trials. The reported experimental, "working" densities came from the students' calculator displays. You are to calculate the density for tenth trial, whose experimental data is listed first.

Method 1:
The mass, height and diameter of a stack of ten pennies were measured respectively using an analytical balance and calipers.

Method 2:
The mass, and volume of a stack of ten pennies were measured respectively using an analytical balance and 100 mL graduated cylinder.

Method 3:
The mass, height and diameter of a single penny were measured respectively using an analytical balance and calipers.

Method 4:
The masss, and volume of a single penny were measured respectively using an analytical balance and 10 mL graduated cylinder.

However, unlike diligent and meticulous DVC Chem 120 students, the Purdue students failed to record whether the data they obtained was for "new" or "old" pennies.

1. **In your group select one of the four Methods to individually be responsible for and to analyze.**

2. **You will then meet with members from the other DVC Lab Groups, who have the same Method. You are to complete the portion of the data form for only your Method with your sub Group, but complete it entirely. Consider the measured data's significant figures and correctly report the density, average deviation, and standard deviation for this Method with the correct number of significant digits. Then using the average reported density determine if the data set that you've analyzed is for "new" or "old" pennies, and calculate the % error (accuracy) for the method. % = [(Method's Value – Known Value) / Known Value] x 100.**

3. **Return to your parent lab group. As a group, compare the four Methods. Select one of the four methods as being the best experimental approach in obtaining the most precise and accurate results. Circle your choice and then rank the four methods respectively in increasing order of 1) precision and 2) accuracy.**

4. **Complete one form with all data for all four Methods, and provide your Group's precision & accuracy rankings with everyone's name on the form and turn-in.**

NAMES: _____

DENSITY of the U.S. Penny

METHOD 1:

Stack of 10 Pennies		NEW or OLD?		
Height (mm)	Diameter (mm)	Mass (g)	Density g/cm3	DEV
13.1	17.1	19.7483		
			6.0215	
			6.6985	
			6.6905	
			6.3495	
			6.6806	
			6.0294	
			6.8811	
			6.3789	
			6.0800	
	Working Calculated Average			
	REPORTED	AVERAGE		*Correct # of*
		AVG DEV.		*significant*
		STD DEV		*digits*
		ACCURACY		%

METHOD 3:

Indivdual Penny		NEW or OLD?		
Height (mm)	Diameter (mm)	Mass (g)	Density g/cm3	DEV
1.2	18.9	2.0085		
			6.3016	
			6.8984	
			7.0055	
			7.7045	
			5.7002	
			6.1998	
			6.0008	
			5.7992	
			7.5000	
	Working Calculated Average			
	REPORTED	AVERAGE		*Correct # of*
		AVG DEV.		*significant*
		STD DEV		*digits*
		ACCURACY		%

METHOD 2:

Stack of 10 Pennies		NEW or OLD?		
	Volume (mL)	Mass (g)	Density g/cm3	DEV
	4.1	29.5854		
			7.6015	
			7.0585	
			7.9802	
			7.7998	
			7.3600	
			7.1006	
			7.0100	
			7.0194	
			7.8600	
	Working Calculated Average			
	REPORTED	AVERAGE		*Correct # of*
		AVG DEV.		*significant*
		STD DEV		*digits*
		ACCURACY		%

METHOD 4:

Indivdual Penny		NEW or OLD?		
	Volume (mL)	Mass (g)	Density g/cm3	DEV
	0.35	2.6525		
			9.2008	
			6.8992	
			7.9805	
			7.1995	
			6.7122	
			6.1878	
			7.0100	
			6.3005	
			8.8995	
	Working Calculated Average			
	REPORTED	AVERAGE		*Correct # of*
		AVG DEV.		*significant*
		STD DEV		*digits*
		ACCURACY		%