Experiment: Using and Applying Density

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OBJECTIVE:
This activity involves measuring and solving for the density of a variety of materials. In addition, it gives good practice in manipulation of the density equation by solving for other variables. Pre-knowledge and use of geometry, significant figures, unit conversions, unit labels, percent error calculations and choice and use of appropriate measuring techniques, devices and standard laboratory equipment are also reinforced.

The Density of known materials can be obtained from any handbook or the Periodic Table. Students are to collect all measurable quantities in laboratory and then solve the mathematical computations as homework, including percent error calculations. The Table below is provided simply as a suggested format and includes the task required for each experimental object. All data collected is to be put into a table format which is properly and clearly labeled and completed in your Laboratory Comp Book identified by the above title. As indicated, all formulas and calculations must be shown ***in detail*** in an organized and concise manner appropriately labeled for credit. Each item listed without a specific unit label will cause a reduction in credit. (See Lab Credit Notes)

MATERIALS:
Water Marble Pb Brick Aluminum foil Copper wire UNK #____

EQUIPMENT PROVIDED:
Metric rulers Analytic or Electronic Balance Digital Calipers or Micrometer
Graduated Cylinder, 10 mL, 50 mL Pasteur Pipets 50 mL beaker

OBJECT/ TASK	DENSITY	MASS	VOLUME (formula)	Caliper/Micrometer Reading *(if applicable)*
I. Water **Task: Find the Density** **Equation =**	D=	m=	V=	
II. Marble **Task: Find the Density** **Equation =**	D=	m=	V=	
III. Lead Brick **Task: Find the Mass (lbs)** **Final Equation:** **Mass =**	11.35g/cm^3	m=	V=	
IV. Aluminum foil **Task: Find the Thickness** **Final Equation:** **Thickness =**	2.70 g/cm^3	m=	V=	For % Error Calculation Actual Thickness=
V. Copper wire **Task: Find the Diameter** **Final Equation:** **Diameter =**	8.96 g/cm^3	m=	V=	For % Error Calculation Actual Diameter=
VI. Unknown Metal **Sample #___** **Task: Find the Density and Determine the Identity**	D=	m=	V=	% Error (based on actual Density once metal is known):
Probable Identity of UNK #_____ based on the Periodic Table density values: _____				

TASK to be accomplished for each item:

1. What equipment is appropriate for measuring this particular object's mass, volume, density or other necessary measurement?
2. What is the geometric shape of this object (if applicable)? (Draw a diagram and indicate the measured dimensions)
3. What is the formula for solving for the volume of this geometric shape (if applicable)?
4. Write the equation for Density, substitute the appropriate formula for volume and rearrange the equation solving for the ***task-appropriate variable.***
5. Use the micrometer to measure the actual diameter of any solid for determination of the Percent Error of the Aluminum Foil thickness and the Copper Wire diameter. What units does this equipment register?
6. Find the % error of your calculated diameter and thickness utilizing the micrometer reading as the *"Theoretical Value."*
   Note: Use the Micrometer reading ONLY as the "Theoretical Value." It is not intended for use in other measurements.

$$\% \text{ error} = \left| \frac{\text{Actual value - Theoretical value}}{\text{Theoretical value}} \right| \times 100\%$$ (note the absolute value brackets!)

UNKNOWN METAL SAMPLE: Obtain an unknown metal sample from the instructor. Record all measurements and calculate the density. Compare this density with the known densities ***metals*** listed on the Periodic Table to determine the identity of this sample. Confer with the instructor to verify the actual identity and calculate the percent error of your hypothetical value versus the real value (should there be a difference).

Geometric formulas:	$V_{block} = L \times W \times H$ $V_{cylinder} = \pi r^2 h$ $V_{sphere} = 4/3\ \pi r^3$
Conversions:	454 grams/1 pound 1 cm = 10 mm 1 mL = 1 cm^3 Density = mass/volume

CONCLUSION QUESTIONS:

1. Describe the different methods that are used to determine density (e.g. liquid, irregular solid vs. regular solid)
2. How does one choose an appropriate measuring device such as an analytic balance or an electronic scale?
3. Explain in detail how you determined the appropriate number of significant digits to report in both calculated answers.
4. What error would be introduced into the determination of a regularly shaped solid if the solid were hollow? Would the apparent volume of the solid be larger or smaller than the actual volume? Would the density calculated be too high or too low? Why?
5. What error would be introduced into the determination of the density of an irregularly shaped object such as a quantity of metal pellets if there were air bubbles adhering to the sample? Would the density be too high or too low? Why?

DATED AND LABELED JOURNAL ENTRY: Describe in full and complete sentences any difficulties you encountered while completing this activity. Try to be as explicit as possible in your reflection as to what you did or did not know, remember or be able to do without assistance. Summarize all the chemistry skills and concepts that were needed to complete this task.

LAB CREDIT NOTES:

In doing Tasks be sure to show the following in your Lab Book for FULL CREDIT:

a) A**LL** units and unit conversions. **NOTE: Points will be deducted for incorrect or missing units***.**
b) **ALL** measurements taken with the appropriate measuring device identified and recorded with the proper number of significant digits allowed. **NOTE: Points will be deducted for recording and calculating with an improper number of significant digits based on the precision of the measuring device. Remember the rules for the use, calculation and proper allowable recording of significant digits as well as rounding off.*
c) Box **ALL** your answers that **satisfy the task identified**.
d) Use a table similar to the following to display your work in your Lab Book
e) Check ***again*** that all numbers contain unit labels!