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1125 - section 1
Desk # 7
Sep. 7th, 2010

Properly label heading with the title, your name, partner's name, course/section #, desk #, and date

Density of a Cylinder

Describe the purpose of the lab in a form that can be answered in the conclusion

Purpose Find the density of a metal cylinder.

List all apparatus used along with the identifying numbers

Apparatus metal cylinder # 115, 2 pan balance # 4, vernier calipers # 15

Data

Record data with units and uncertainties in tables with descriptive titles

Table 1: Mass of the cylinder m (g)

Uncertainty	± 0.1
Reading	38.6

Note: zero reading was zero.

Table 2: Dimensions of the cylinder (cm)

	Length L	Diameter d
Precision of calipers	± 0.01	± 0.01
Zero Reading	- 0.01	- 0.01
Reading 1	3.23	1.31
Reading 2	3.26	1.31
Reading 3	3.24	1.30
Average Reading	3.2433	1.3067
Corrected Reading	3.2533	1.3167
Uncertainty	0.015	0.01

Briefly explain how you get the value of the uncertainty

Note: for the length L, the scatter is (3.26-3.23)/2=0.015 cm, bigger than the precision of the calipers, so we use 0.015 cm for the uncertainty.

While for the diameter d, the scatter is (1.31-1.30)/2=0.005 cm, smaller than the precision of the calipers, so we use 0.01 cm.

Calculations

$m=38.6\ g=38.6\times10^{-3}\ kg$,
$L=3.2533\ cm=3.2533\times10^{-2}\ m$,
$d=1.3167\ cm=1.3167\times10^{-2}\ m$

$$\rho=\frac{4m}{\pi d^2 l}$$

$$=\frac{4(38.6\times10^{-3}kg)}{\pi(1.3167\times10^{-2}m)^2(3.2533\times10^{-2}m)}$$

$$=8.7136\times10^{3}kg/m^3$$

Uncertainty Analysis

$$\frac{\delta\rho}{\rho}=\frac{\delta m}{m}+2\frac{\delta d}{d}+\frac{\delta l}{l}$$

$$=\frac{0.1}{38.6}+2\frac{0.015}{1.3167}+\frac{0.01}{3.2533}$$

$$=0.028449 \text{ or } 2.8449\%$$

This is the relative uncertainty. The absolute uncertainty is:

$$\delta\rho=\frac{\delta\rho}{\rho}\rho=0.028449\times8.7136\times10^{3}kg/m^3=0.24789\times10^{3}kg/m^3$$

Conclusion

The density of cylinder #115 was found to be $(8.7 \pm 0.2) \times 10^3$ kg/m^3 (±2.8%).

Discussion

The reference value according to list W in the lab was $(8.69 \pm 0.01) \times 10^3$ kg/m^3. It is well within the range of our result (8.5 to 8.9) × 10^3 kg/m^3, therefore they agree.

However, our result has a large uncertainty. It was dominated by the uncertainty in the diameter measurement: it contributes about 2.3% out of the total 2.8% uncertainty. Using a larger and more uniform cylinder may reduce the final uncertainty in the result.

In this experiment, we have neglected the temperature effect, which may affect the density.

Convert units first

Show equations in symbols before substituting in the numbers

Keep units

Calculate the relative uncertainty in the final result based on the propagation rules, symbols first

Formulate conclusions that answer to the purpose of the lab

Express final result(s) with the correct number of decimal places for the value and the uncertainty

Compare result with alternate or previous results while considering the uncertainty

Discuss major factors that contribute to the final uncertainty

Discuss physical factors that have been neglected in the calculations, but can affect the result