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Experiment 1 Lab Report

Purpose:

- Compare densities of 2 samples composed of the same material
- Learn uncertainty analysis techniques and gain proficiency in Excel



Figure 1. Cylinder Sample Set A. d refers to the diameter of the cylinders which averaged to 25.36mm and 19.04mm respectively. l refers to the length of the cylinders which averaged to 76.25mm and 50.82mm respectively.

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

Figure 2. Density Formula. D refers to the density, m refers to the mass, d refers to the diameter, and l refers to the length.

The relative uncertainty was calculated by dividing the absolute uncertainty of each variable by the by the mean of that variable.

$\delta m / |m|$ = absolute uncertainty of m

For example, the relative uncertainty of the mass of cylinder 3A was 0.010g/345.50g, or 0.0029%.

Sample #	3
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	A	A	A	B	B	B
Parameter	Mass (g)	Length (mm)	Diameter (mm)	Mass (g)	Length (mm)	Diameter (mm)
Trial 1	345.50	76.24	25.34	129.84	50.84	19.04
Trial 2	345.50	76.30	25.34	129.84	50.83	19.02
Trial 3	345.50	76.24	25.35	129.84	50.83	19.05
Trial 4	345.50	76.22	25.39	129.84	50.82	19.05
Trial 5	345.50	76.27	25.39	129.84	50.85	19.05
Mean	345.50	76.25	25.36	129.84	50.83	19.04
Sample Standard Deviation	0	0.031	0.026	0	0.011	0.013
Least Count Uncertainty	0.01	0.01	0.01	0.01	0.01	0.01
Absolute Uncertainty	0.010	0.031	0.026	0.010	0.011	0.013
Relative Uncertainty (%) (no units)	0.0029%	0.041%	0.10%	0.0077%	0.022%	0.068%

	Sample A	Sample B
Density (g/mm ³)	0.008969	0.008969
Density (g/cm ³)	8.969	8.969

Density Relative Uncertainty	0.25%	0.17%
Density Absolute Uncertainty (g/cm ³)	0.022	0.015

Ratio test comparing the two densities	0.0059
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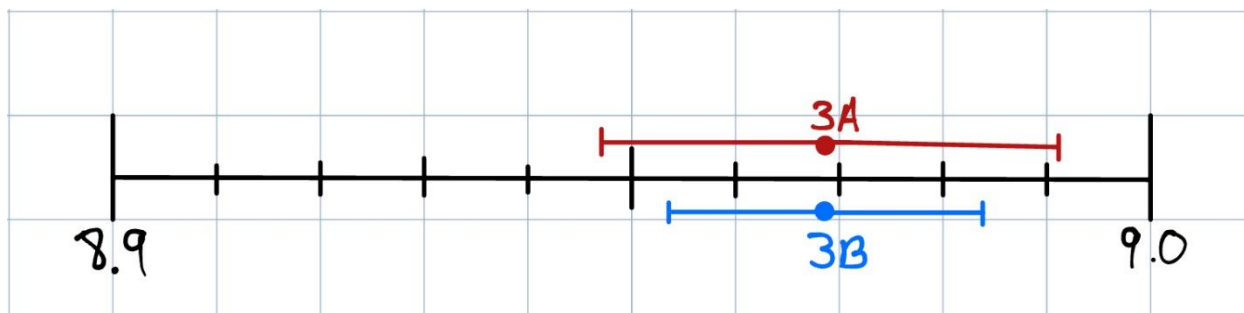


Figure 3. Density (g/cm³) Number Line. The red line represents cylinder 3A and the blue line represents cylinder 3B.

Results:

The result from the ratio test supports the idea that the cylinders have a similar density.

The diameter of the cylinders had the largest uncertainties. This may be because it is difficult to line the calipers up with the exact diameter. There may have also been error from when the calipers were zeroed.

Conclusion:

Cylinder 3A has a density of 8.969 ± 0.022 g/cm³ and cylinder 3B has a density of 8.960 ± 0.015 g/cm³. 3A has a relative uncertainty of 0.25% and 3B has a relative uncertainty of 0.17%. Based on the ratio test result being 0.0059, a number less than 2, the densities agree with each other.

Measuring the mass of different balances rather than the same lab may show more uncertainties in the mass of the cylinders. It would also be fun to see the compare with results from other sample sets and see an example of a ration test that disagrees or is inconclusive.