Recording data with correct significant figures and using it in calculations.

All collected data should be in Data Tables, with title, units and uncertainties. Qualitative Data should also be recorded.

**Collected Data**

|  |  |  |  |
| --- | --- | --- | --- |
| Trial | 1 | 2 | 3 |
| Mass of Beaker g  +/- 0.01 | 20.00 | 20.02 | 20.05 |
| Mass of Beaker + cube  +/- 0.01 | 25.35 | 25.12 | 26.12 |
| Length  cm  +/- 0.1 | 2.0 | 1.9 | 2.2 |
| Width  cm  +/- 0.1 | 1.5 | 1.4 | 1.8 |
| Height  cm  +/- 0.1 | 12.1 | 11.9 | 12.5 |

Qualitative Data: The solid is a cube in shape, silver in color, smooth surfaces. Does not have a smell.

Calculations:

Mass of Object

Trial 1: (25.35 +/- 0.01) – (20.00 +/- 0.01) = 5.35 +/ 0.02

Trial 2: (25.12 +/- 0.01) – (20.02+/- 0.01) = 5.10 +/- 0.02

Trial 3: (26.12 +/- 0.01) – (20.05 +/- 0.01) = 6.07 +/- 0.02

Change it into % uncertainties

Trial 1 (.02/5.35) x 100= +/- 0.37%

Trial 2 (.02/5.10) x 100= +/- 0.39%

Trial 3 (0.02/6.07) x100= +/- 0.33%

Volume of Object: Volume of a cube= LxWxH

Trial 1 2.0x 1.5x 12.1= 36 cm3

Trial 2 1.9x 1.4x 11.9= 32 cm3

Trial 3 2.2x 1.8x 12.5= 50. cm3

% Uncertainties for volume

Trial 1:

(.1/2.0)x 100 + (.1/1.5)x100 + (.1/12.1)x100

5%+ 7%+ .83%= 12.83% higher than 2% 1S.F= 10%

Trial 2:

(.1/1.9)x100 + (.1/1.4)x100 + (.1/11.9) x100

5% + 7% + .84%= 12.84%= 10%

Trial 3

(.1/2.2)x100 + (.1/1.8)x100 + (.1/12.5)x100

5% + 6% + .80%= 11.80%= 10%

Calculating Density: D= M/V

Trial 1

D= (5.35 +/- .37%) / 36 +/- 10%

= 0.15 g/cm3 +/- 10.37% 🡪 0.15 g/cm3 +/- 10%

Trial 2

D= (5.10 +/- .39%)/ (32+/- 10%)

= 0.16 g/cm3 +/- 10.39% 🡪 0.16 g/cm3 +/- 10%

Trial 3

D= (6.07 +/- .33%)/ (50. +/- 10%)

= 0.12 g/cm3 +/- 10.33% 🡪 0.12 g/cm3 +/- 10%

Table of calculated Data:

|  |  |  |  |
| --- | --- | --- | --- |
| Trial | 1 | 2 | 3 |
| Density g/cm3 | 0.15 +/-10% | 0.16 +/- 10% | 0.12 +/- 10% |

Average Density: (0.15 + 0.16+ 0.12)/3= 0.14 g/cm3 +/-10%

If percent uncertainties of trials were different, use the largest value for the avg.

Analysis:

10% is what is called: Random Error- This is equipment error, as you can see from your calculations that error came from measuring mass (scale) and volume (graduated cylinder). Notice that is the volume that impacted that % error so if you are going to try to lower Random error you can use a more precise graduated cylinder and more trials.

If you are given a theoretical value for Density. Lets say it should be 0.15g/cm3. You can then calculate a % error.

% error= [(Theoretical- Lab)/ Theoretical] x100

% error= [(.15-.14)/ .15] x100= 66.7%

Systematic error = % error- random

= 66.7-10= 56.7%

Systematic error is procedural error, so you would need to go back to your procedures and see what you would change. As you can see your avg. density was lower than it should had been. Notice trial #3 had a big negative effect on your avg. So you might want to do another trial to replace it. You can also look at trial #3 and discuss what could have occurred mass and volume wise that gave you a lower value than exp[ected.