General Physics Experiment Report

Experimental Data Processing and Analysis

Class Code : PHYS1010AE

Group : B
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1. **Purpose:**
   The purpose of the experiment was to practice and analyze the fundamentals of measurements. It was purposely on learning how to use the laboratory tools and equipment to provide data with less error as compared to standard results. The purpose was aimed on learning how to use a micrometer, digital scale and micro caliper scale, then being able to analyze the collected data after the experiment. The focus of this experiment was also based on getting accurate and reliable results by using the right tools and methods of measurements
2. **Introduction**
   Physics in centralized in measurements, findings and experiment to provide a justified decision. Measurement is a process of computing the amount of an unknown physical quantity by using a standard known reference. In this lab experiment we focused on measuring the diameter, height and mass of a ball, wire and a cylinder and collecting the data and measurements. We used three different lab tools for each

quantity namely; the digital scale, micrometer and Vernier Caliper scale. We used the vernier caliper to measure the diameter of the ball, hollow cylinder(tube) and copper wire, we also used the same tool to measure the height of the tube and the copper wire. We used the micrometer to measure the diameter of the ball. We finally used the digital scale to measure mass of the three objects.

3. **Materials/methods**

The experiment was a successful measure because we had the right materials to measure and analyze the data. For the direct experiment we used the vernier caliper scale micrometer and digital scale to measure the diameter, height and mass of the objects. For data analysis we used the laptop and using a software of Microsoft excel to analyze the results. In an attempt of measuring the objects accurately we measure each object five times, recorded the data and analyzed as to the average data. We first measured the mass of the three objects using the digital scale five times and also measured the diameter of the ball recorded the results. We then measured the cylinder's height, inner and outer diameter using the vernier caliper scale. We finally measured the height of the copper wire using the vernier caliper and we used the micrometer to measure the diameter. The following are calculation methods and mathematical operations used to calculate the results:

Average;

= Sum of observations/number of observations

Standard deviation:

$$\sigma = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

For standard deviation of the mean;

$$\bar{\sigma} = \frac{\sigma}{\sqrt{n}} = \sqrt{\frac{1}{n\ (n-1)} \sum_{i=1}^{n} (x_i - \bar{x})^2}$$

For volume: V= (PI/5)*d^2*t

For density: Density= Mass/Volume

4. Results

Below is the data of the recorded data after measuring the diameter, mass and height.

Cylinder

cylinder	Inner Diameter(mm)	Inner Radius(mm)	Outer Diameter(mm)	Outer radius(mm)	Height (mm)	Mass(g)
1	14,40		22,10		46,50	25,20
2	14,40		22,10		46,50	25,20
3	14,40		22,10		46,50	25,20
4	14,40		22,10		46,50	25,21
5	14,40		22,10		46,50	25,19
average	14,40	7,20	22,10	11,05	46,50	25,20
standard deviation	0,0000		0,0000		0,0000	0,006325
Average standard deviation	0,0000		0,0000		0,0000	0,004000

Ball

Ball	Diameter(mm)	Radius(mm)	Zero error (mm)	TURE radius (mm)	Mass(g)	Volume(mm^3)
1	9,460				3,51	
2	9,456				3,52	
3	9,449				3,51	
4	9,460				3,52	
5	9,460				3,52	
average	9,457	4,729			3,52	4,429E+02
standard deviation	0,00	0,00			0,00	0,00
Average standard deviation	0,002	0,000			0,002	0,000

Wire

Wire	Diameter(mm)	Radius(mm)	Mass(g)	Height(mm)	volume(mm^3)	Density(g/mm^3)	Theorical density(g/mm^3)
1	2,310		3,55	96,00		8,37E-03	8,65E-03
2	2,460		3,55	96,40			
3	2,300		3,55	96,30			
4	2,330		3,55	96,30			
5	2,440		3,55	96,40			
Average	2,368	1,184	3,55	96,28	4,240E+02		
Standard Deviation	6,202E-02	0,00E+00	4,44E-16	1,342E-01	0,00E+00		
Average Standard	5,467E-02	0,00E+00	4,44E-16	9,333E-02	0,00E+00		

5. Discussion

The principle of this experiment was to analyze, collect the data and record the data using proper ways of recording data. In any measurement, there are two factors that need to be controlled-accuracy and precision. Precision refers to the closeness of the multiple measurements. Accuracy refers to the closeness of the measured value with the actual value. Therefore, in the experiments taking the average of the five measurements in each of the quantities measured was to give us a value very close to the true value of mass, diameter and height.

The Venier scale is divided into equal divisions and thus the count is 0.1mm. both the main and Vernier scale readings are taken into account while making a measurement. The main scale reading is the first reading on the main scale immediately to the left of the zero of the Venier scale(3mm), while the Venier scale reading is the mark on the Vernier scale.

The micrometer screw gauge is used to measure even smaller dimensions than the Vernier calipers. The micrometer screw gauge also uses an auxiliary scale (measuring hundredths of a millimeter) which is marked on a rotary thimble. Basically, it is a screw with an accurately constant pitch (the amount by which the thimble moves forward or backward for one complete revolution, thimble must be rotated through two revolutions to open the jaws by 1 mm.

For each object, measurements were taken and recorded in a spreadsheet (Excel). Different results were recorded, and this could have been caused by errors while taking measurements. The results that were produced were provided in form of tables above.

6. Conclusion

The main aim of the research was to practice the fundamentals of measurements and data analysis. It was to learn how to use a micrometer, digital scale and a Vernier scale and be able to

analyze the collected data after the measurement was done properly. As presented in the table and graph above we have measured the diameter, height and mass of the three objects. The results presented indicates that the experiment was carried out successfully. Inconsistency in the results was caused by experimental errors thus affecting the results.

7. Reference

1. http://www.phy.uct.ac.za/phy/courses/phylab1/vernier
2. https://collegedunia.com/exams/vernier-caliper-physics-articleid-876
3. http://scce.ac.in/noticeboard/10969_12092017METROLOGY_MANUAL_3YR.pdf
4. https://www.keyence.com/ss/products/measure-sys/measurementselection/type/micrometer.js
5. https://dictionary.cambridge.org/dictionary/english/measurement

Questions

1. To achieve an accuracy of 1/100mm with a Vernier caliper, you'd want the divisions on the main scale to be 1/100mm apart. The Vernier scale, being the fine-tuning hero, would then have 100 divisions that match up with 99 divisions on the main scale. Each Vernier division would cover the same distance as 99 main scale divisions, making it a tight competition between precision and patience.
2. It's not an error in the sense of something going wrong, but it does introduce a systematic error in measurements. To handle this, you should always check and note any zero error before making measurements. In this case, you'd account for the -0.05mm by adding it

to your readings. So, if the Vernier scale reads 5mm, you'd actually record it as 5.05mm.

3. When measuring the height and diameter of a cylinder, it's generally a good practice to measure at different places. This helps account for any irregularities or imperfections in the shape of the cylinder. If you measure at the same spot each time, you might introduce a systematic error if there's an anomaly in that particular region.So, vary your measurement spots to get a more comprehensive understanding of the cylinder's dimensions. It's like giving your cylinder a thorough check-up!

4. In the context of calculating the volume of a cylinder, we should first calculate the average of the height and diameter and then use that average in our volume formula.