

# Report for experiment

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**ASSIGN  
BUSTER**

REPORT FOR EXPERIMENT 1 MEASUREMENT Group 5 Name: Tien Pham PHYS 2125 Class number 35818 Day: 1/14/1013 Instructor: Dilipkumar Mehta

**OBJECTIVES** The purpose of the experiment is to determine the diameters and lengths of the three metal cylinders and the copper wire, the mass of the metal cylinders and calculate the densities of the cylinders and

comparison with the acceptable values. **MATERIALS** 1. Triple- beam balance 2. Micrometer 3. A ruler (inches and centimeters) 4. A roll of copper wire 5. Wire Cutter 6. Vernier Caliper 7. Electronic balance (to measure mass of copper wire) 8. Graduated Cylinder 9. Three cylindrical metals (brass, aluminum, copper, zinc, etc) 10. Irregular object (lead, steel, zinc, etc)

**THEORY** Density is one of the useful quantities scientists use to identify different materials with, given by:  $\text{Density} = \text{Mass}/\text{Volume}$  The volume of a cylinder is:  $V = \pi r^2 h$  To find the volume of an irregular solid, we submerge it in a graduated cylinder and measure the volume of water it displaces.

**PROCEDURE** 1) Determine the mass of each cylinder, the copper wire and the irregular solid. 2) Determine the zero reading of the vernier caliper. This is when the jaws are in contact with each other. Record the values in centimeters. Make sure to open and close the jaws before each measurement. 3) Measure the length and diameter of each cylinder with the vernier caliper. Record them in centimeters to two decimal places. 4) Measure the length of the copper wire with the metric ruler 5) Determine the zero reading of the micrometer by allowing the anvil and the screw to approach each other very slowly. Record the values in centimeters. Make sure to open and close the micrometer before each measurement. 6) Measure the diameter of the wire with the micrometer by gripping the wire between the anvil and the screw. Try to change the location of the

measurement on the wire in order to get different diameters. 7) Determine the volume of the irregular solid by submerging it in a graduated cylinder and measuring the volume of the liquid that is displaced. REPORT FORM Part

I. Length and Diameter of Metal Cylinders with Vernier Caliper | | 1 | 2 | 3 | 4 |

Average | | Zero reading | 0 | 0 | 0 | 0 | 0 | | Length of Aluminum cylinder | 5.

09 | 5. 08 | 4. 97 | 5. 09 | 5. 05 | | Length of Brass cylinder | 4. 99 | 5. 00 | 4.

99 | 5. 01 | 4. 99 | | Length of copper cylinder | 2. 25 | 2. 23 | 2. 27 | 2. 22 | 2.

24 | | Diameter of Aluminum cylinder | 1. 32 | 1. 36 | 1. 27 | 1. 32 | 1. 32 | |

Diameter of Brass cylinder | 1. 26 | 1. 24 | 1. 29 | 1. 28 | 1. 27 | | Diameter of

copper cylinder | 1. 36 | 1. 35 | 1. 35 | 1. 37 | 1. 36 | | Length of copper wire

with | 100 | 100 | 100 | 100 | 100 | | metric ruler | | | | | Part II Diameter of

Copper Wire with the micrometer | | 1 | 2 | 3 | 4 | Average | | Zero reading | -

0. 03 | -0. 04 | -0. 04 | -0. 04 | -0. 375 | | Reading with wire | 0. 25 | 0. 23 | 0. 25

| 0. 26 | 0. 2475 | | Diameter of wire | 0. 28 | 0. 27 | 0. 29 | 0. 30 | 0. 285 |

Part III Determination of Density | Material | Mass, | Length, cm | Radius, |

Volume, | Accepted | Computed | Percent error | | | G | | cm | cm<sup>3</sup> | density |

density | | Aluminum cylinder | 17. 4 | 5. 05 | 0. 66 | 6. 91 | 2. 7 g/cm<sup>3</sup> | 2. 5

|-7. 4% | | Brass cylinder | 53. 6 | 4. 99 | 0. 64 | 6. 42 | 8. 4 g/cm<sup>3</sup> | 8. 3 |- 1.

2% | | Copper cylinder | 30. 6 | 2. 24 | 0. 68 | 3. 25 | 8. 9 g/cm<sup>3</sup> | 9. 4 | 5. 6% |

| Copper wire | 0. 7 | 100 | 0. 014 | 0. 062 | 8. 9 g/cm<sup>3</sup> | 11. 3 | 26. 9% | |

Irregular solid (lead) | 136. 2 | | | 13. 0 | 11. 3 g/cm<sup>3</sup> | 10. 5 |-7. 1% | |

Irregular solid (steel) | 86. 7 | | | 10. 7 | 7. 8 g/ cm<sup>3</sup> | 8. 1 | 3. 7% |

CALCULATION 1) Calculate the volume of each object.  $V = \pi r^2 h$  V of

aluminum cylinder =  $\pi (0. 66)^2 (5. 05) = 6. 91 \text{ cm}^3$  V of brass cylinder =  $\pi$

$(0. 64)^2 (4. 99) = 6. 42 \text{ cm}^3$  V of copper cylinder =  $\pi (0. 68)^2 (2. 24) = 3. 25$

$\text{cm}^3$  V of copper wire =  $\pi (0. 014)^2 (100) = 0. 062 \text{ cm}^3$  2) Calculate the

density of each object.  $D = m \cdot V$   
 $D$  of aluminum cylinder =  $17.4 \cdot 6.91 = 2.5 \text{ g/cm}^3$   
 $D$  of brass cylinder =  $53.6 \cdot 6.42 = 8.4 \text{ g/cm}^3$   
 $D$  of copper cylinder =  $30.6 \cdot 3.25 \text{ g/cm}^3$   
 $D$  of copper wire =  $0.7 \cdot 0.062 = 11.3 \text{ g/cm}^3$

$D$  of irregular solid (lead) =  $136.2 \cdot 13.0 = 10.5 \text{ g/cm}^3$   
 $D$  of irregular solid (steel) =  $86.7 \cdot 10.7 = 8.1 \text{ g/cm}^3$   
 3) Find the percent error for the density of each object by comparing your findings with the accepted ones. Percent error =  $[(\text{computed value} - \text{accepted value}) / (\text{accepted value})] \times 100\%$   
 Aluminum cylinder:  $[(2.5 - 2.7) / 2.7] \times 100\% = -7.4\%$   
 Brass cylinder =  $[(8.3 - 8.4) / 8.4] \times 100\% = -1.2\%$   
 Copper cylinder =  $[(9.4 - 8.9) / 8.9] \times 100\% = 5.6\%$   
 Copper wire =  $[(11.3 - 8.9) / 8.9] \times 100\% = 26.9\%$   
 Irregular solid (lead) =  $[(10.5 - 11.3) / 11.3] \times 100\% = -7.1\%$   
 Irregular solid (steel) =  $[(8.1 - 7.8) / 7.8] \times 100\% = 3.7\%$

**OBSERVATION** Taking data involves measuring something takes for a certain errors to occur. If we repeat the measurement several times, even with the same meter stick, most likely we will find different results. This is to be expected, since it is impossible to repeat everything the exactly the same way and each time we take a data point we make a random error. One such source of error is the non-alignment of our eye with the marking of the meter stick which we are reading, i. e., the eye is not directly over the marking. The best way to reduce random errors is to average all the measurements. In general, the average value is a more accurate approximation of the true value than any of the individual measurements.

**CONCLUSION** There is a certain inherent inaccuracy or variation in the measurements we make in the laboratory. No physical measurement is completely exact or even completely precise. The apparatus or the skill of the observer always limits accuracy and precision. One way of estimating the precision of our measurements of some quantity

is to measure the quantity many times and then use the data to estimate how precise our measurement is. Review Questions and Exercises: 1) How would you measure the volume of an irregular solid? When an object is completely submerged in water, the change in water level equals the object's volume. Fill the graduated cylinder with water and record the initial water level. Place your irregular object into the beaker. Notice the water level rises. Subtract the initial water level from the final to obtain the volume of the irregularly shaped object. 2) If a cylinder of radius 2 cm and height 4 cm is submerged in a graduated cylinder of radius 3 cm containing a liquid. By how much does the liquid rise? Volume of the cylinder = volume of liquid displaced  $\pi r^2 h = \pi (2)^2 (4) = \pi (32) = 9\pi$  cm<sup>3</sup> So, the liquid would rise by  $\frac{16}{9}$  or 1.78 cm. 3) Find the mass of a solid brass sphere that has a radius of 4 cm. Volume =  $\frac{4}{3} \pi r^3 = \frac{4}{3} \pi (4)^3 = 268.08$  Mass = volume x density = 268.08 x 8.4 = 2251.89g 4) What advantage does a vernier caliper have over a metric ruler? A Vernier caliper has an accuracy of 0.1 mm, The meter stick (ruler) however, has an accuracy of only 1mm. 5) To what decimal point can you estimate the reading on a micrometer? Micrometer gives a decimal point of 3 Post lab QUESTIONS 1) Explain why several measurements were taken for each quantity. A good way to reduce error or increase measurement accuracy is to take several measurements and compute their average. 2) Convert the volume of the aluminum cylinder into cubic millimeters and liters. 3) In measuring the volume of the cylinders, which dimension you should be more accurate about, the length or the diameter. Explain. It is always in three dimensions. To find the volume of an object like a cube or a box, you measure the length, width, and height and then multiply them 4) Why was the micrometer used

instead of the vernier caliper to measure the diameter of the wire. The vernier caliper simply doesn't have enough tolerance for such small diameters, the micrometer requires occasional calibration while the vernier caliper requires it less, and the vernier caliper can be tricky to read tenths of units

5) According to Legend, Archimedes, who was a famous Greek Mathematician, was given a crown, which was supposed to be made of pure gold but contained some silver alloy, by King Hieron II of Sicily. He was asked by the king to prove or disprove his suspicion. (The crown indeed did contain silver). If you were Archimedes, how would have determined experimentally whether or not the crown was pure gold? Archimedes took a piece of pure gold, and submerged it in water, and marked how much water was displaced. Then he weighed it and so determined the density of pure gold. He then performed the same procedure with the crown, and found that the density differed from that of the pure gold piece