Experiment(1): techniques and measurements

The goal of this experiment

→ Determine the density of liquids and irregular solid

Density:

→ is asubstances mass per unit volume

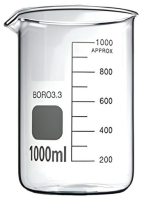
→ depend on the temperature

Intensive property: is a characteristic of a substance that **dose not** depend on the amount of matter.

Extensive property: is acharacteristic of substance that **depend** on the amount of matter.

$$Density = \frac{mass}{Volume} \quad g/ml, g/cm^3$$

Finding density for liquids



Empty beaker

ml = 20.45 g

Beaker filled with water or any liquid (10.00ml)

mass of beaker and liquid

m2 = 29.20 g

mass of liquid m = m2 - ml

m = 29.20 - 20.45

8.75 g

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

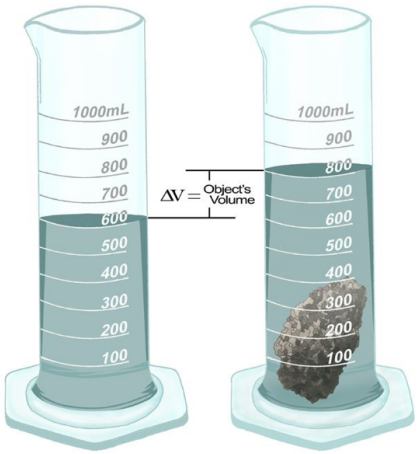
$$= \frac{8.75\ g}{10.00\ ml} = \frac{0.875\ g/ml}{3\ s.f}$$

Density for irregular solid

DETERMINATION OF UNKNOWN DENSITY

$$\text{DENSITY} = \frac{\text{MASS}}{\text{VOLUME}}$$

$$\rho\ (g/cm^3) = \frac{m\ (g)}{\Delta V (cm^3 = mL)}$$



V1 V2

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

$$= \frac{482.63}{800 - 600} = \frac{482.63}{200}$$

$$= 2.41\ g/ml \approx 2\ g/ml$$

Error in calculations

1) Error in addition and subtraction

$$\text{Error} = \sqrt{(\text{Error 1})^2 + (\text{Error 2})^2}$$

example

→ m1 = 5.02 ± 0.01

→ m2 = 9.43 ± 0.01

→ m3 = m2 - m1

$= 9.43 - 5.02 = 4.41 \pm \sqrt{(0.01)^2 + (0.01)^2}$

$= 4.41 \pm 0.01$

2) Error in multiplication and division

→ $R = XY$

→ $\text{Error} = R * \sqrt{\left(\frac{\Delta x}{x}\right)^2 + \left(\frac{\Delta y}{y}\right)^2}$

Example

$X = 12.8 \pm 0.1$, $Y = 11.4 \pm 0.5$

$R = X / Y$

$R = \frac{12.8}{11.4} = 1.12$

$\Delta r = 1.12 \sqrt{\left(\frac{0.1}{12.8}\right)^2 + \left(\frac{0.5}{11.4}\right)^2}$

$= 0.07$

$R = 1.12 \pm 0.07$

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Lab report 1: Techniques and Measurements

Name:..... Section:.....
Students' ID:..... Date:.....

Pre-Laboratory Questions

1. A piece of an unknown metal weighing 15.32 g is placed into a graduated cylinder containing 30.50 mL of water. After adding the metal, the water level rises to 36.75 mL. Calculate the density of the metal.

$D = \frac{m}{V}$ | $V = V_2 - V_1$ | $d = \frac{15.32}{6.25}$

$= 36.75 - 30.50$ | $= 2.4512$

$= 6.25\ ml$ | $2.45\ g/ml$

2. An empty beaker weighs 25.3623 g. A 20.00 mL sample of unknown liquid is added to the beaker, and the total mass of the beaker and liquid sample is 45.2154 g. Calculate the density of the unknown liquid.

$D = \frac{m}{V}$ | $m = m_2 - m_1$ | $d = \frac{19.8531}{20.00}$

$= 45.2154 - 25.3623$ | $= 0.992655$

$= 19.8531$ | $= 0.9927\ g/ml$

3. Define the following terms.

a) Specific gravity → is a measure of the density of substance in compasition to the density of water.

b) Intensive properties . Dont depend on the amount of matter.

c) Extensive prosperity.. Depend on the amount of matter

Results and Calculation

A. Determination of the Density of Pure Liquid

	Result	Error
Mass of beaker	50.30	± 0.01
Mass of beaker + water	53.43	± 0.01
Mass of water (2 - 1)	2.87	$\sqrt{(0.01)^2 + (0.01)^2} = 0.01$
Volume of water	10.00	± 0.05
Temperature	23	
Density (3/4)	2.87 / 10.00 = 0.287	$0.287 \sqrt{\left(\frac{0.01}{2.87}\right)^2 + \left(\frac{0.05}{10.00}\right)^2}$

B. Density of Solutions

Term	Result	Error
Mass of beaker		
Mass of beaker + solution		
Mass of solution		
Volume of solution		
Temperature		
Density		

C. Density of Solids

	Result	Error
Mass of beaker		
Mass of beaker + solid pieces		
Mass of solid pieces		
Initial water level in the graduated cylinder		
Final water level in the graduated cylinder		
Volume of solid pieces		
Density of the solid substance		

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Questions

1. Why is it important to avoid air bubbles when measuring the volume of a liquid in a pipette?

- The air bubbles causes the measured volume to be inaccurate
- The liquid volume level appear higher than it should be

↓ $D = \frac{m}{V\uparrow}$, so the density will be lower

2. How Temperature Affects the Density of a Substance?

T ↑ D ↓ , T ↑ D ↓

a. The density of copper is 8.92 g/cm3 and the density of iron is 7.87 g/cm^3. if equal masses of copper and iron were transferred to equal volumes of water in graduated cylinders, which graduated cylinder would have the highest volume reading? Why?

	copper	iron
↓	8.92	7.87

For equal masses, the substance with the lower density occupies a large volume

→ so iron less dense than copper

iron will displace more water and show a higher volume.