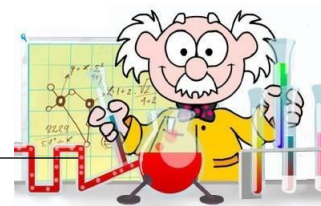| Abdelhafid Boussouf University Center - Mila | Academic year 2024–2025 |
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Practical Work N°5

Measurement of Volumic Mass (Density) of a substance

I- Definition

Density, also known as volumic mass, is a measure of how much mass is contained in a given volume. It tells us how tightly matter is packed together in a substance, if you take a piece of lead and a piece of wood of the same size, the lead feels much heavier because it has a higher density it has more mass packed into the same volume.

The formula for calculating density is:

$$\text{Density}(\rho)= \frac{\text{Mass(m)}}{\text{Volume(V)}}$$

Where:

- **Mass (m)** is the amount of matter in the object, usually measured in grams (g) or kilograms (kg).

- **Volume (V)** is the amount of space the object occupies, usually measured in cubic centimeters (cm^3) or cubic meters (m^3).

So, density is expressed in units like grams per cubic centimeter (g/cm^3) or kilograms per cubic meter (kg/m^3). For example, water has a density of about 1 g/cm^3, meaning that 1 cubic centimeter of water has a mass of 1 gram.

The reference body for liquids and solids is water, for gases it is air.

- When you say the value of d (density) equals that of ρ solution, it means you're comparing the density of a solution to the density of water (since ρ water=$1g/cm^3$).

- If the density of the solution is greater than 1 g/cm^3, it's denser than water and will sink. If it's less than 1 g/cm^3, it's less dense and will float.

For example, oil floats on water because its density is less than 1. Similarly, a rock will sink because its density is greater.

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II- Measurement of Volumic Mass (Density) of a Solid

Objective:

To determine the volumic mass (density) of a solid object using the displacement method.

Materials Needed:

- Solid object (a metal block, a stone)
- Balance (for measuring mass)
- Measuring cylinder (graduated cylinder)
- Water

Theory:

The density (ρ) of a solid is defined as its mass (m) per unit volume (V):

$$\rho = \frac{Mass(m)}{Volume(V)}$$

Where:

- ρ = density of the solid (kg/m^3 or g/cm^3)
- m = mass of the solid (kg or g)
- V = volume of the solid (m^3 or cm^3)

Procedure:

1. **Measurement of Mass:**

- Weigh the solid object using the balance and record the mass m.

2. **Measurement of Volume by Displacement:**

- Fill the measuring cylinder with a known volume of water and record this volume Vinitial.

- Carefully immerse the solid object into the water in the measuring cylinder.

- Ensure that the solid is fully submerged without touching the sides of the cylinder.

- Record the new volume of water with the solid submerged, Vfinal.

- Calculate the volume of the solid object by subtracting the initial volume from the final volume:

$$V_{solid} = V_{final} - V_{initial}$$

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🔸 For a solid of defined shape (sphere), wrap a string around the solid to determine its circumference (perimeter), then determine its radius and apply the formulas to calculate its volume. The calculation of the volume is necessary to determine the volumic mass of a sample.

3. **Calculation of Density:**

- Calculate the density of the solid using the formula:

$$\rho_{solid} = \frac{m}{V_{Solid}}$$

Results:

Record your measurements and calculations in a table:

Solid Object	Mass (g)	Initial Volume of Water (cm³)	Final Volume of Water (cm³)	Volume of Solid (cm³)	Density (g/cm³)
Solid A					
Solid B					

III- Measurement of Volumic Mass (Density) of a Liquid

Objective :

To determine the volumic mass (density) of a given liquid using a graduated cylinder and a balance.

Materials:

- A graduated cylinder (50 mL or 100 mL)

- Balance.

- Liquid sample (e.g., water, alcohol, oil)

- Dropper or pipette

- Distilled water.

Procedure:

- Calibrate the Balance:

- Turn on the balance and calibrate it.

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- Ensure the balance reads zero before starting the experiment.

- Measure the Mass of the Graduated Cylinder:

- Place the empty graduated cylinder on the balance and record its mass (M_1).

- Add the Liquid to the Graduated Cylinder:

- Using the dropper or pipette, carefully add the liquid to the graduated cylinder until it reaches a specific volume (V) marked on the cylinder. Record the volume.

- Typical volumes to use are 10 mL, 20 mL, or 50 mL, depending on the size of your graduated cylinder.

Measure the Combined Mass:

- Place the graduated cylinder with the liquid on the balance and record the new mass (M_2).

- Calculate the Mass of the Liquid:

- Subtract the mass of the empty graduated cylinder (M_1) from the combined mass (M_2) to find the mass of the liquid (M). Mass of liquid (M) = $M_2 - M_1$

Calculate the Density:

Use the formula for density: Density (ρ) = Mass of liquid (M)/ Volume of liquid (V)

Ensure the units are consistent (e.g., grams for mass and milliliters for volume).

Results:

Record your measurements and calculations in a table:

Sample	Mass of Liquid (g)	Volume of Liquid (cm³)	Density (g/cm³)
Liquid A			
Liquid B			

Safety Precautions:

Handle all equipment with care to avoid breakage.

Clean up any spills immediately to prevent slips.

Follow all safety guidelines for handling the liquid sample.