LAB SHEET · SIMULACIENCIA

Lab sheet: density of a solid

Name	Class	Date	Sample number

Aim

To measure the mass and volume of an unknown sample, calculate its density and identify what material it is made of.

Background

The **density** (ρ) of a material is the mass of each unit of volume. It is calculated by dividing the mass by the volume:

$$\rho = m / V$$

Each material has its own density, so measuring it tells you what an object is made of. Here the mass is measured in grams (g) and the volume in cubic centimetres (cm^3), so the density comes out in g/cm^3.

The mass is measured with a balance. As the sample has an irregular shape, its volume cannot be worked out with a ruler: it is measured **by displacement**. You pour water into a measuring cylinder and read its volume; then you put the sample in and read it again. The rise in the water level is the volume of the sample:

$$V = V_f - V_i$$

Remember that 1 mL = 1 cm^3.

Equipment

The practical is done in the simulated lab at simulaciencia.es/en/simulations/practica-densidad, at the **Open** level.

- Electronic balance reading to 0.1 g.
- 50 mL and 100 mL measuring cylinders (each mark is 1 mL) and a 250 mL one (each mark is 2 mL).
- Wash bottle with water.
- Magnifier to read the scale of the measuring cylinder.
- The unknown sample your teacher gives you.

Before you start

Answer these before measuring.

1. Which measuring cylinder will you use and why? Think about two things: the sample must fit, and the measurement should be as precise as possible.
2. Why must you weigh the sample before putting it in the water and not afterwards?

3. How much water will you pour into the cylinder? It must cover the sample, but the water must not go past the top mark when you put the sample in.

Answers

Method

1. Choose your sample number and the measuring cylinder in the panel.
2. Switch the balance on with its **ON** button and, with the pan empty, press **TARE** to zero it.
3. Drag the sample onto the balance pan. Write the mass in the results table.
4. Put the sample back on its tray. Bring the wash bottle over the mouth of the cylinder and add water.
5. Take the magnifier to the water and read the initial volume (V_i). Keep your eyes level with the water (the yellow line on the magnifier) and read the **bottom of the meniscus**. Write it down.
6. Predict how far the water will rise. Then lower the sample **carefully** into the cylinder down to the water and let go of it there. If you drop it from the top, it will splash and you will have to start again.
7. Read the final volume (V_f) with the magnifier and write it down.
8. Take the sample out and put it on its tray. Empty the cylinder with **EMPTY**, fill it again with **a different amount of water** and repeat the volume measurements. Take three measurements in total. Do not weigh the sample again: it is wet now.

Results table

Mass of the sample: m = ... g

Measurement	Initial volume V_i (mL)	Final volume V_f (mL)	Volume of the sample $V = V_f - V_i$ (cm^3)
1			
2			
3			
Mean			

Calculations

Write each calculation with its numbers and units.

Calculation	Working and result
Mean volume of the sample (V)	
Density of the sample (ρ = m / V)	

Identifying the material

Find the material in the table whose density is closest to yours.

Material	Density (g/cm³)
PVC	1.40
Magnesium	1.74
Teflon	2.20
Aluminium	2.70
Titanium	4.51
Iron	7.87
Copper	8.96
Lead	11.34

Material of my sample	Density from the table (g/cm³)	Percentage error = $\lvert\rho - \rho_{table}\rvert / \rho_{table} \times 100$ (%)

Questions

1. Before putting the sample in, how far did you predict the water would rise? Why is the rise in the water level the volume of the sample?
2. Press “Start again” with the same sample: it will have a different mass and volume. Measure its mass and volume again and calculate its density. What has changed and what has not? Why?
3. Which instrument do you think adds more error to your density, the balance or the measuring cylinder? Compare how much 0.1 g is of your mass and how much one mark of the cylinder is of your volume.
4. What would have happened to your density if you had weighed the sample without taring the balance? And if you had weighed it wet?
5. Could you measure the volume of a piece of cork, which floats in water, in this way? What would you do?

Answers

Answers

Conclusion

Explain in a few lines what material your sample is made of, how you found out, and where you think the difference between your density and the one in the table comes from.

Conclusion

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