

Density, pressure and pressure in liquids

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab

Name: _____ Date: _____ Class: _____

How can you find the density of a block, a stone or a liquid with a ruler, a balance and a measuring cylinder? In this lab you measure mass and volume for four samples, calculate their densities and decide which would float. You also compare the reliability of different volume measurements.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE P3, IGCSE 1.8

Aim

To determine the density of a regular solid, two irregular solids and a liquid, and to decide which float in water.

Equipment

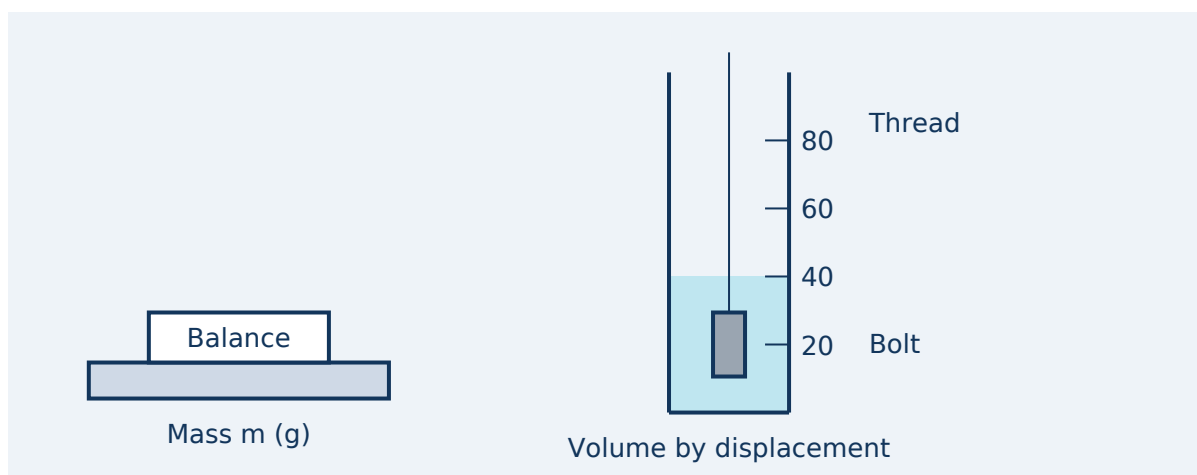
- Digital balance (0.1 g)
- 100 cm³ measuring cylinder, water, thread
- Ruler, wooden cube, steel bolt, small stone
- Cooking oil, small beaker

Safety

Safety

Wipe up any spilled water or oil at once because the floor becomes slippery. Lower solids gently into the cylinder so that glass does not break. Do not taste the oil.

Method



Mass is measured on a balance and the volume of an irregular solid by the rise of water in a measuring cylinder.

1. Measure the mass of the wooden cube on the balance. Measure its edge with the ruler and calculate the volume.
2. Measure the mass of the bolt. Fill the measuring cylinder to 40.0 cm³, tie the bolt to the thread, lower it in slowly and read the new level. The volume is the rise.
3. Repeat step 2 for the stone, using a level of 40.0 cm³ again.
4. For the oil, measure the mass of the empty beaker, pour exactly 50.0 cm³ into the beaker using the cylinder, then measure the mass of the beaker with oil. Subtract to find the mass of oil.
5. Calculate the density of each sample using $\rho = m \div V$.

Results

Sample results (readings at the bottom of the meniscus):

Sample	Mass m (g)	Volume V (cm ³)	Density ρ (g/cm ³)
Wooden cube (4.00 cm edge)	38.4	64.0	0.60
Steel bolt	31.2	4.0	7.80
Stone	43.5	15.0	2.90
Cooking oil	46.0	50.0	0.92

The stone raised the water level from 40.0 cm³ to 55.0 cm³, and the bolt from 40.0 cm³ to 44.0 cm³.

Analysis questions

Question 1 Wooden cube

Show that the volume of the cube is 64.0 cm³ and calculate its density.

Question 2 Convert the stone

Calculate the density of the stone in kg/m^3 .

Question 3 Identify the bolt

Compare the density of the bolt with the table of the lesson and identify the metal. Give the density in kg/m^3 .

Question 4 Float or sink

State whether each of the four samples floats or sinks in water (1.00 g/cm^3), giving a reason.

Question 5 Fraction under water

The wooden cube floats. Use its density to calculate the fraction of its volume below the water surface.

Question 6 Reading uncertainty

Each level reading in the cylinder has an uncertainty of $\pm 0.5 \text{ cm}^3$. Calculate the percentage uncertainty in the volume of the bolt and of the stone, and state which density is more reliable.

Question 7 Improve the lab

Suggest two ways of improving the accuracy of the densities.