



Set of 5 Density Bodies 1000768

Instruction Sheet

12/24 ALF/UD



1. Description

The set of five density bodies is used to determine the densities of different materials and to demonstrate Archimedes' principle.

The set consists of five sample blocks of different materials with identical dimensions plus a transparent hollow body with internal volume equal to that of the sample blocks and a loop attached for suspending it. The sample blocks are provided with 2 mm holes for suspending them.

2. Technical data

Materials:	Wood, aluminium, iron, brass, copper
Dimensions of each sample block:	10 x 20 x 45 mm ³

3. Experiment procedure

Additionally required apparatus:

1 Electronic Scale 220 g	1022627
1 Precision Dynamometer 1 N	1003104
1 Beaker 800 ml tall form	1025694
1 Stand Base, A-Shaped 195 mm	1001044
1 Stainless Steel Rod 750 mm	1002935
1 Clamp with Hook	1002828
1 Fishing Line, 10 m	4009036

3.1 Determining densities of solid bodies

3.1.1 Determining density by weighing and calculating the volume

- Determine the mass m of the sample blocks by weighing.
- Calculate the volume V from the dimensions of the sample blocks.
- Calculate the densities of the sample blocks according to the equation

$$\rho = \frac{m}{V}$$

Note:

The 2 mm holes introduce an error and for precise determination that must be considered in the calculation.

3.1.2 Determining density by measuring the buoyant force

- Push about 20 cm of fishing line through a hole in the sample block and tie the ends to make a loop.
- Hang the sample block on the dynamometer and read off the weight force F_G and note it down.
- Fill the beaker with water.
- Immerse the sample block completely in the water and read off the weight force F_G' and note it down.

The sample block shows an apparent loss of weight caused by the buoyant force, which is equal to the weight of the volume of liquid that it displaces.

- Determine the weight difference $\Delta F_G = F_G - F_G'$ and calculate the volume of the sample block according to the equation

$$V = \frac{\Delta F_G / g}{\rho_{H_2O}}$$

($\rho_{H_2O} = 998 \text{ kg/m}^3$ (20°C), $g = 9,81 \text{ m/s}^2$).

- Calculate the density of the sample block according to the equation

$$\rho = \frac{m}{V} = \frac{F_G / g}{V} = \frac{\rho_{H_2O}}{(1 - F_G' / F_G)}.$$

- Repeat the measurement with the other sample blocks and compare the results with those from Experiment 3.1.1.

Note:

Because of $\rho < \rho_{H_2O}$, the density for the wooden sample block can only be determined by the method of experiment 3.1.1.

3.2 Confirming Archimedes' principle

Archimedes' principle states that the buoyant force F_A on a body immersed in a medium is exactly equal to the weight (force due to gravity) F_G' of that volume of the medium which is displaced by the body; $F_A = F_G'$.

Archimedes' principle applies to both liquids and gases.

- Set up the stand and clamp and hang the dynamometer on the hook (Fig. 1).
- Fit the sample block into the sample holder to confirm that its volume is equal to the internal volume of the hollow body.
- Calculate the volume of the sample block from its dimensions.
- Suspend the hollow body and the sample block on the dynamometer.
- Note the weight reading on the dynamometer.

- Place the beaker underneath and fill it with water.
- Lower the dynamometer until the sample block is completely immersed in the water.
- Note the new dynamometer reading.

The difference between the two readings is the buoyant force F_A on the sample block.

- Fill the hollow body with water.

As the internal volume of the hollow body is equal to the volume of the sample block, the quantity of water in it is equal to the quantity of water displaced by the sample block.

The dynamometer now shows the same reading as at the beginning. This confirms Archimedes' principle.

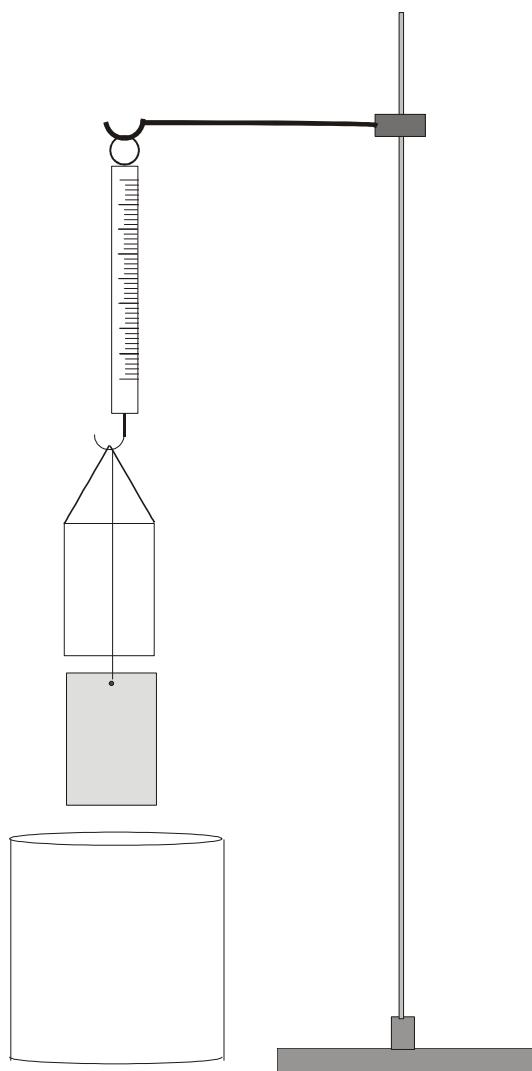


Fig. 1: Experiment setup