Archimedes-Cup 1021647

Operating instructions

01/25 ALF/UD

1 Handle
2 Bucket
3 Cylinder

1. Description

The device is used to demonstrate Archimedes' Principle of buoyancy in liquids. It can also be used to determine the density of an unknown fluid.

It consists of a bucket with a handle and a hook, as well as a precisely fitted solid cylinder with a ring.

2. Basic principles

According to Archimedes' Principle, if an object with the weight F_G is immersed in a fluid, the force F_B exerted on the object by the fluid is equal to the weight of the fluid F_G' displaced by the object, $F_B = F_G'$.

Archimedes' Principle is valid in fluids as well as in gases.

Since the volume of fluid V_F displaced by the object is just equal to the volume V_K of the object, i.e. $V_F = V_K = V$, the following applies to the mass m_F of the fluid with the density ρ:

$$m_F = \rho \cdot V \quad (1)$$

The weight of the displaced fluid F_G' is this mass m_F multiplied by the acceleration due to gravity g:

$$F_G' = g \cdot m_F \quad (2)$$

Therefore, the buoyant force F_B is given by the following formula:

$$F_B = \rho \cdot g \cdot V \quad (3)$$

The density ρ of an unknown fluid can therefore be calculated by the formula:

$$\rho = \frac{F_B}{V} \quad (4)$$

3. Technical data

Cylinder:

Dimensions:	approx. 44 mm x 38 mm Ø
Volume:	approx. 50 cm^3
Total dimensions:	approx. 54 x 191 mm^2

4. Operation

4.1 Verification of Archimedes' Principle

Additionally required:

1	Dynamometer 250 g / 2.5 N	1003370
1	Vessel with Overflow, Transparent	1003518
1	Beaker 500 ml low form	1025691
1	Stand Base, A-Shaped 195 mm	1001044
1	Stainless Steel Rod 750 mm	1002935
1	Clamp with Hook	1002828

- Set up the stand and suspend the dynamometer from the hook.
- Attach the cylinder to the bucket and suspend both from the dynamometer.
- Read and write down the weight.
- Fill the vessel with overflow to such an extent with water that it just stops to overflow.
- Place the beaker next to the vessel with overflow so that the overflowing water can be collected.
- Lower the dynamometer until the cylinder is completely immersed in the water. Collect the overflowing water in the beaker.
- Read the new value on the dynamometer.

The difference between the two readings is the buoyant force F_B on the cylinder.

- Carefully pour the water from the beaker into the bucket. Make sure no water is left in the beaker.

The dynamometer displays the initial value. Thus, Archimedes' Principle is confirmed.

4.2 Determination of the density of an unknown fluid

- Calculate the volume of the cylinder from its dimensions (see 3.). Alternatively, measure the diameter d and height h of the cylinder with a ruler and calculate its volume according to $V = \pi \cdot r^2 \cdot h$.
- Determine the buoyant force F_B with the unknown fluid in place of water.
- Use formula (4) to determine the density ρ of the unknown fluid.

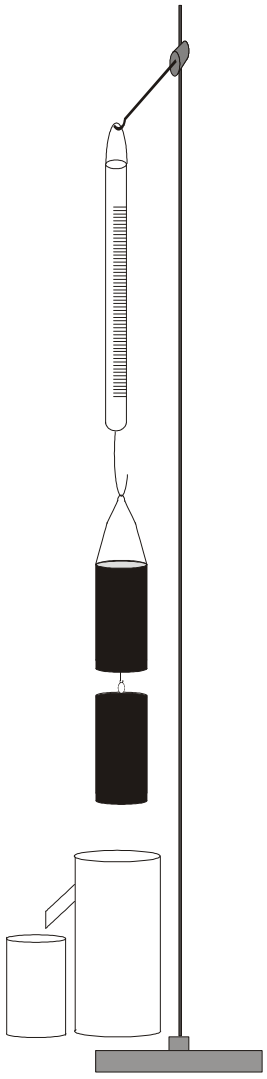

Fig. 1: Experimental set-up