UNIVERSIDADE da MADEIRA

Experimental Science
P8: Archimedes principle

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1. Purpose

- Determine the buoyant force value when an object is completely immersed in a fluid.
- Establish the relation between the buoyant force and the fluid's displaced volume.
- Make measurements with the calliper and micrometer.

2. Introduction

The Archimedes Principle can be stated the following way: any object immersed in a fluid will be subject to a buoyant force (upward force) with a magnitude equal to the weight of the fluid displaced by the object.

According to this principle the buoyant force value I will be given by:

$$I = \rho\, g\, V$$

where ρ is the fluid's specific mass, g is the gravitational acceleration and V is the object's immersed volume (coincides with the fluid's displaced volume). Another way of calculating the buoyant force I consists of measuring the object's weight P_R in air and when immersed in fluid P_A.

The difference between these two weights will be an estimate of the buoyant force:

$$I = P_R - P_A$$

On this experiment the buoyant force will be measured by the previous method.

3. Previous questions

1. A lead bar has a 10 cm^3 volume and a 114 g mass. What is the buoyant force to which it is subject when completely submerged in water?

2. An aluminium bar has a 10 cm^3 volume and a 27 g mass. What is the buoyant force to which it is subject when completely submerged in water?

4. Experimental activity

4.1 Material

28 aluminium bars with the same nominal volume, 7 water recipients, 7 spring scales (three 1 N and four 2 N), 7 callipers, 7 micrometers, 7 clamps, 7 multi clamps, 7 rods, 7 towels.

4.2 Procedure

1. At the white board there is a table that identifies the 28 bars distributed throughout the lab counters. In front of each there is an indication of whether it has been measured or not. Choose on that hasn't been measured yet (register its number and ask the teacher to check it on the board). Measure the longest bar length with a calliper and the remaining two lengths with the micrometer (when using the calliper, always use the inner jaws tips). Make each length measurement at least four times. Record you measurements in a table with the following header:

Height (cm)	Side 1 (cm)	Side 2 (cm)

2. Calculate the object's volume.
3. Draw another table with the following header:

V (cm^3)	P_R (N)	P_A (N)	I (N)	I/V (N/cm^3)

4. Verify the characteristics do of the spring scale you will be using (e.g., smallest division). If necessary adjust the scale's zero.
5. Measure the bars set weight P_R by suspending them on the spring scale. Record the force value.
6. Measure the bars set apparent weight P_A by suspending them on the spring scale while completely submerged in water. Record the force value. Wipe clean the bars with the towel.
7. Repeat steps 4 to 6 for every (1 to 7) bar sets in the lab. You will have to go around the lab measuring in all the 7 experiment setups.
8. Complete the last 2 table columns.

ATENTION: The bars are numbered and should stay in the same order (not switched between the different sets). If a nylon wire sets loose ask the teacher to fix it and rejoin it to the original set.