Archimedes' Principle Apparatus

Instruction Manual

Model P61102

1. Archimedes' Principle Apparatus

2. Instructions:
   - Place the apparatus on the laboratory bench.
   - Fill the bucket with water and place it on the scale.
   - Invert the cylinder and immerse it in the water.
   - Record the initial reading on the scale.
   - Remove the cylinder from the water and record the new reading.
   - Calculate the change in weight, which equals the weight of the displaced water.

3. Determination of the density of an unknown fluid:
   - Use a glass or plastic cylinder of known density.
   - Fill the cylinder with the fluid and place it on the scale.
   - Subtract the reading of the empty cylinder from the reading of the filled cylinder.
   - This difference gives the weight of the displaced fluid.

4. Calculation of the density of an unknown fluid:
   - Place the cylinder in a container filled with a known density fluid.
   - Record the new reading on the scale.
   - Subtract the original reading from the new reading to find the weight of the displaced fluid.
   - Divide the weight of the displaced fluid by the volume of the cylinder to find the density.

5. Volume measurement:
   - Place the cylinder in a container filled with water.
   - Record the initial reading on the scale.
   - Invert the cylinder and immerse it in the water.
   - Record the new reading on the scale.
   - Subtract the initial reading from the new reading to find the buoyant force.
   - Divide the buoyant force by the acceleration due to gravity to find the volume of the displaced fluid.

Note:
- Archimedes' Principle:
  - The buoyant force is equal to the weight of the displaced fluid.
  - The volume of the displaced fluid is equal to the volume of the object submerged.

Reference:
- Archimedes' Principle: A Principle for All Seasons.
Instruction Manual
for
Archimede’s Principle Apparatus
Model P61102

1. Applications

The Archimede’s Principle Apparatus (Model P61102), also known as Bucket and Plummet, is a traditional instrument to verify one of the most important physics principles in physics. It can also be used to investigate the buoyant force on an object immersed in a fluid, and to determine the density of an unknown fluid.

2. Identification

Fig. 1

1 Bucket
2 Plummet
3 Handle
4 Hook
5 Ring
6 Division Mark

3. Specifications

1. Volume of Plummet: 100cm³
2. Mass of Plummet: ≥ 120g
3. Volume of Cavity in Bucket: 100ml
4. Dimensions: 5.5cm x 5.5cm x 5.5cm
5. Net Weight: 150g

4. Theory

According to Archimede’s Principle, if an object is immersed in a fluid, the force exerted on the object by the fluid is equal to the weight of the fluid displaced by the object.

Since the volume of fluid displaced by the object is just equal to the volume of the object, the mass of fluid displaced is the volume of the object multiplied by the density of the fluid. The weight of the displaced fluid is this mass multiplied by the acceleration due to gravity. Therefore, the buoyant force is given by the formula \( F_B = d \cdot g \cdot V \), where \( d \) is the density of the fluid, \( g \) the acceleration due to gravity, and \( V \) the volume of the object.

If the force is measured in the unit of grams, the above formula can be rewritten as

\[
F_B = d \cdot V
\]

5. Operation

The following experiments require a ruler, a 200g spring scale, an overflow can and a 250ml beaker.

A. Verification of Archimede’s Principle
1. Fill the overflow can with water.
2. Place the beaker next to the overflow can so that water can be collected.
3. Insert the plummet in the bucket to verify that the volume of the plummet is equal to the volume of the cylindrical cavity of the bucket.
4. Take the plummet out of the bucket and hang it on the bucket.
5. Measure the mass of the bucket and plummet with the spring scale.
6. Move the bucket with plummet over the overflow can. Lower the set until the plummet is immersed in the water.