Density

Investigating density of regularly and irregularly shaped solids and liquids using a range of appropriate apparatus.

In this practical you will:

- use a ruler and a balance to determine the density of a regularly shaped object
- use a displacement method to determine the density of an irregularly shaped object
- use measurements of volume and mass to determine the density of a liquid.

Activity 1: Determine the density of a regularly shaped object

Apparatus

- 30 cm ruler marked off in mm
- digital balance
- a selection of regularly shaped objects.

Method

1. For each of your selected objects measure and record the:
   - length
   - width
   - height.
2. Calculate the volume of each object.
3. Record your results in a table like this:

Regular shaped object	**Length in cm**	**Width in cm**	**Height in cm**	**Volume in cm^3**	**M ass in g**	**Density in g/cm^3**

4. Measure the mass of each object using the digital balance. Record the results in your table.
5. Calculate and record the density of each object using:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

6. Standard units of density are kg/m^3. Use the data above to calculate the density of the object in these units.

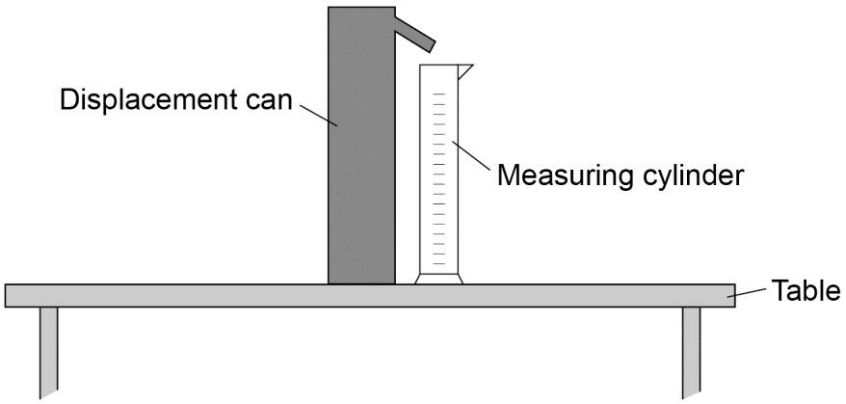
Activity 2: Determining the density of an irregularly shaped object

Apparatus

- a digital balance
- a displacement can
- various measuring cylinders
- a beaker of water and an extra empty beaker
- paper towels
- a selection of irregularly shaped objects.

Method

1. Measure the mass of one of the irregular shaped objects.
2. Record your results in a simple table.
3. Put the displacement can on your desk. Put an empty beaker under the spout and fill the can with water. Water should be dripping from the spout and you should wait until you see this stop.
4. Then put a measuring cylinder that you think will give the most accurate reading under the spout instead of the beaker.



5. Very carefully lower the object into the displacement can so that it is completely submerged.

   Collect all of the water that comes out of the spout in the measuring cylinder.
6. Measure the volume of the collected water. This volume is equal to the volume of the object.
7. Calculate and record the density of the object.
8. Repeat the activity for some other objects.

   Remember to refill the can with water each time.

Activity 3: Determining the density of a liquid

Apparatus

- a digital balance
- a 100 cm^3 measuring cylinder
- a sugar solution of unknown concentration.

Method

1. Measure the mass of the empty measuring cylinder.
2. Record your results in a table like this:

M ass of the empty cylinder in g	**Volume of liquid in cm^3**	**M ass of cylinder plus liquid in g**	**M ass of liquid in g**	**Density of liquid in g/cm^3**

3. Pour **about** 100 cm^3 of the sugar solution into the measuring cylinder.

   Record the volume accurately.
4. Measure and record the mass of the measuring cylinder and liquid. From this calculate and record the mass of just the liquid.
5. Calculate the density of the liquid.
6. Standard units of density are kg/m^3. Use the data above to calculate the density of the liquid in these units.

Task

a) Write a paragraph to describe and explain the differences in density you have seen between solids and liquids. You might consider how particles are arranged in the different states of matter.

b) Use the table below to identify some of the samples of regular shaped object you use d in activity 1.

Substance	**Aluminium**	**Zinc**	**Iron**	**Copper**	**Gold**
Density in g/cm^3	2.7	7.1	7.9	8.9	19.3

c) Using your results from activity 3, determine the mass of sugar per cm^3 dissolved in the water.

The density of water is 1 g/cm^3. Assume the sugar does not affect the volume of the water.