# Density Measurements

## Apparatus

Measuring cylinder (calibrated in $cm^3$ or ml)
Top-pan balance
Water
Empty drinks can
Vernier Callipers

## Theory

The density of a material is given by the relationship

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

In many experiments, as in this one, the units you record are not the standard S.I. ones and you will need to be able to convert measurements to S.I. afterwards for calculations.

Conversion of the volume.

$1ml = 1cm^3$

$1\ cm^3 = 10^{-2}\ m \times 10^{-2}\ m \times 10^{-2}\ m = 10^{-6}\ m^3$

Multiply your value by this factor.

Conversion of the mass.

$1g = 10^{-3}\ kg$

Multiply your value by this factor.

IMPORTANT:
Wherever possible convert before calculating – it leads to fewer errors.

The exam board expects you to be able to do this kind of conversion and to know commonly occurring conversion factors such as these

Volume of a cylinder $= \pi r^2 h = \frac{\pi d^2 h}{4}$

## Method

Determine the mass of the empty measuring cylinder using the balance. Fill the measuring cylinder to the 250 $cm^3$ mark. Determine the mass of the cylinder and the water.

Next measure the external diameter and height of the empty drinks can using vernier callipers. Your teacher will show you how to use these to obtain a value to the nearest 0.02 mm. Repeat each measurement three times in different places.

Finally determine the mass of the empty drinks can and then fill it completely with water and determine the mass of the can and water.

## Results

Copy and complete the following tables in your lab book:

1

| | |
|---|---|
| Volume of water/$cm^3$ | |
| Mass of empty measuring cylinder/g | |
| Mass of measuring cylinder plus water/g | |
| Mass of water/g | |
| Volume of water/$m^3$ | |
| Mass of water/kg | |

2

| | 1 | 2 | 3 | average |
|---|---|---|---|---|
| Diameter of can/mm | | | | |
| Height of can/mm | | | | |
| Average diameter of can /m | | | | |
| Average height of can/m | | | | |

3

| | |
|---|---|
| Mass of empty can/g | |
| Mass of can plus water/g | |
| Mass of water/g | |
| Mass of water/kg | |

## Analysis

Calculate the density of the water from your values in table 1.

Using the average values in table 2, calculate the volume of the cylinder whose diameter and height are the same as that of the can.

Using your density value and the mass of water in the can from table 3, calculate the volume of water in the can.

Calculate the volume of water as a percentage of the cylinder volume.

## Conclusion

Complete the following statements in your conclusion:

The density of water was measured to be……

The cylinder volume was calculated to be …..

The volume of the can was measured to be ……. and was ….% of the cylinder volume.