Core practical 9: Measuring Density

5.4 Core practical: Investigate density using direct measurements of mass and volume

Links to the specification content

1.2	Know and use the relationship between density, mass and volume

Introducing the practical

There are three key investigations of density:

Measurement of density of regular-shaped mass

This works best when a range of different materials of different sizes can be obtained (as well as different sizes of the same material if possible). The data are best recorded in a table with all raw results as the students are measuring volume or height, length and breadth, rather than directly measuring the volume.

Measurement of density of irregular mass

This is most readily achieved by using a displacement technique, either with a eureka / displacement can (taking care to fill the can up to the spout) or with a measuring cylinder that is broad enough to take the object and have enough water for the object to be fully submerged.

Taking a measurement of the mass before finding volume will mean that the object is dry when it is placed on the balance, therefore not giving a false reading for the mass with any extra water.

Measurement of density of a liquid.

Put measuring cylinder on balance first and either record the mass of the cylinder or press the "zero" or "tare" button on the balance. Add the liquid and read off both the volume and the new mass. The mass of the liquid is the difference between the two mass readings.

If the volume is found first, then the cylinder will need to be dried completely to find its mass.

Measuring density

Questions you could ask to enhance learning and focus your students on important aspects of the practical:

Skills that are covered in the practical:

- Measurements of dimensions of a regular shape leading to calculation of a volume
- Measurement of the volume of an irregular shape using a displacement technique
- Measurement of volumes of liquids using a measuring cylinder
- Measurement of mass using a balance
- Consideration of the order of following instructions
- Tabulation of data

Maths skills:

1A Recognise and use numbers in decimal form

1B Recognise and use numbers in standard form

1D Make estimates of the results of simple calculations, without using a calculator

2A Use an appropriate number of significant figures

2B Understand and find the arithmetic mean (average)

2I Make order of magnitude calculations

3B Change the subject of an equation

3C Substitute numerical values into algebraic equations using appropriate units for physical quantities

3D Solve simple algebraic equations

5B Visualise and represent 2D and 3D objects, including two dimensional representations of 3D objects

5C Calculate areas of triangles and rectangles, surface areas and volumes of cubes.

Questions

This example is taken from the 4PH0/1P paper, January 2017, Question 2. The commentary below outlines how the skills students will have gained by carrying out the practical may be shown in the final exams.

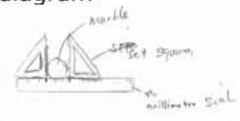
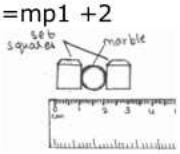
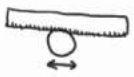
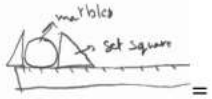
2 Marbles is a game played with small balls of coloured glass.

Each ball is known as a marble.

(a) Describe how a millimetre scale and two set squares can be used to measure the diameter of a marble.

You may draw a diagram to help your answer.

(3)

Question number	Answer	Notes	Marks
2 (a)	MP1. set squares used correctly to mark diameter of marble; MP2. Set squares measured against ruler; MP3. EITHER repeat and find average (mean); OR measure 2 or more marbles (in a line);	allow labelled diagram  =mp1 +2  =mp1 +2  =mp2  =0  = mp1 +2	3

In this previous papers, the volume of liquids or irregular shapes has been required. In this paper, the measurement of the dimensions of a regular object which wasn't cuboidal proved challenging, showing that candidates did not recall having used set squares frequently.

b) Describe an experiment to find the density of a marble.

You may draw a diagram to help your answer. **(5)**

(b)	Any 5 from MP1. mass measured; MP2. suitable device for measuring mass; MP3. suitable container named e.g. measuring cylinder, displacement can; MP4. displacement method described (can be shown on diagram); MP5. volume determined e.g.=volume after-volume before or volume displaced;	Allow labelled/annotated diagram uses diameter to calculate the volume states $V= 4/3\ \pi\ r^3$	5