Required Practical Review

Physics Practical - Density

Free science lessons: https://www.youtube.com/watch?v=ScXOp8Zph28
GCSEpod: https://members.gcsepod.com/shared/podcasts/title/10976

Know it

Activity 1: you will determine the density of a regular shaped object using a ruler and balance.

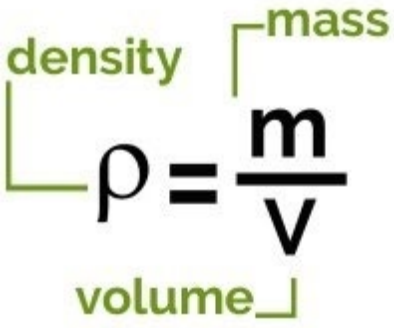
Activity 2: you will measure the mass of an object in the same way as activity 1. You will also measure its volume from the amount of water it displaces.

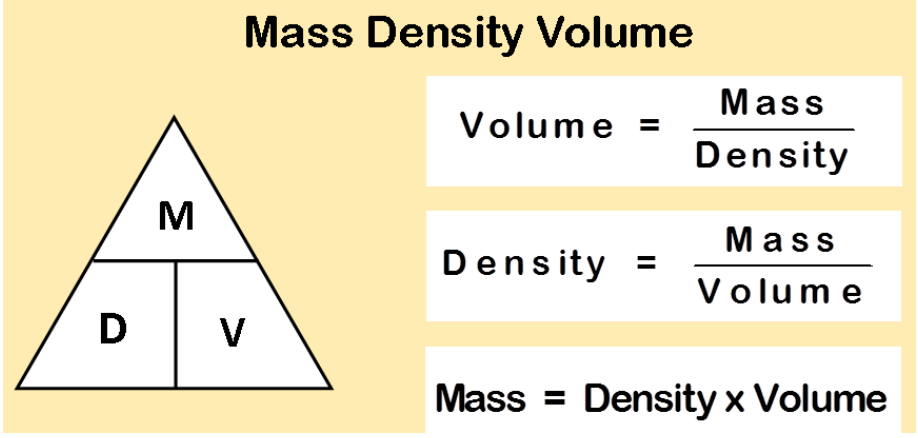
Activity 3: you will find the density of a liquid.

You are provided with the following:

- 30 cm ruler marked off in mm
- digital balance
- regular shaped objects.

Formula to calculate density:





Read these instructions carefully before you start work.

1. For each object measure the:
   - length
   - width
   - height.

2. Record your results in a table.

   Include columns for volume, mass, density and substance.
   - volume
   - mass
   - density
   - substance.

3. Measure the mass of each object using the digital balance. Record the results.

4. Calculate and record the volumes (length $\times$ width $\times$ height).

5. Calculate and record the densities (mass $\div$ volume).

6. Use the table below to identify the substance each object is made from.

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

Activity 2: Irregular shaped objects.

You are provided with the following:

- digital balance
- displacement can and something to stand it on (eg a brick)
- various measuring cylinders
- beaker of water and an extra empty beaker
- paper towels
- cotton or thin string
- irregularly shaped objects.

Read these instructions carefully before you start work.

1. Measure the mass of one of the irregular shaped objects.

2. Record your result in a table.

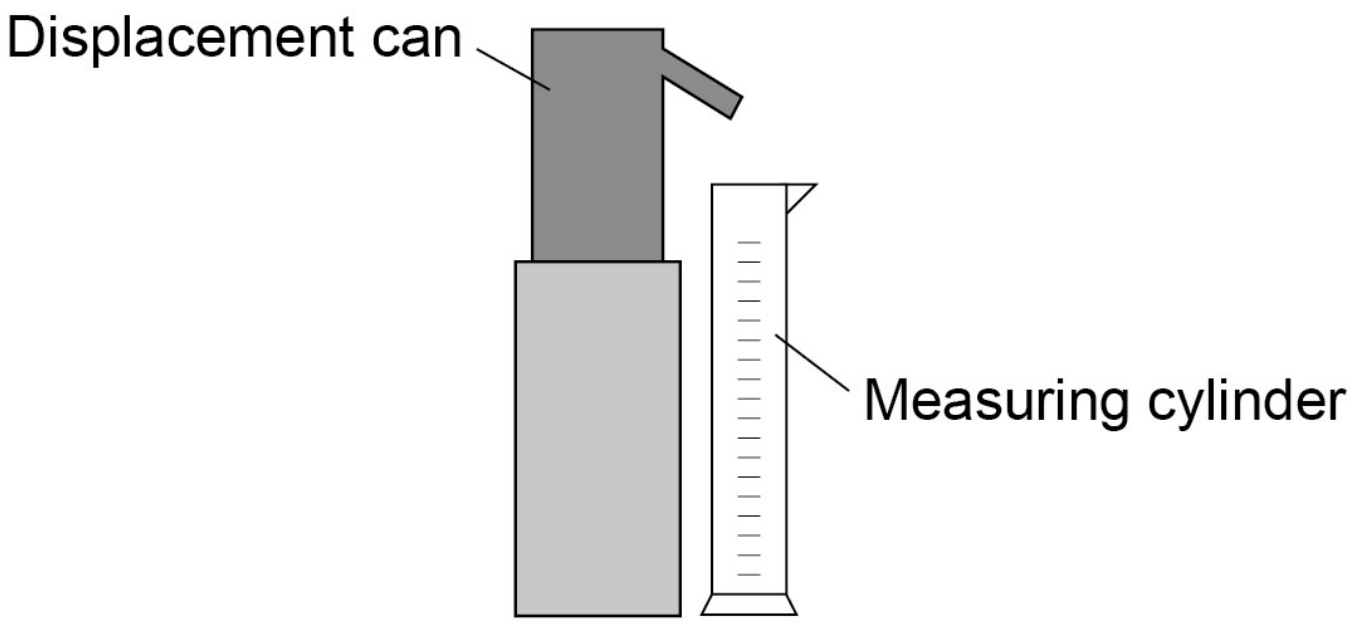
   It will need columns for:

   - volume
   - density
   - mass
   - substance.

3. Place a displacement can on a brick. Put an empty beaker under the spout and fill the can with water. Water should be dripping from the spout.

4. Wait until the water stops dripping. Then place a measuring cylinder under the spout instead of the beaker.

   Choose the measuring cylinder you think will give the most precise reading.



5. Tie the object to a piece of cotton. Very carefully lower it 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 and record 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.
   Try to find out what substance it is made from.

8. Repeat steps **1–7** for some other objects.

   Remember to refill the can each time.

Activity 3 – liquids

You are provided with the following:

- digital balance
- 250 ml beaker
- 100 ml measuring cylinder
- suitable liquid eg sugar solution.

Read these instructions carefully before you start work.

1. Measure the mass of the empty beaker.

2. Record your results in a table. Your table will need columns for the:
   - mass of the empty beaker
   - mass of the beaker with the liquid in
   - mass of the liquid
   - volume of the liquid
   - density of the liquid.

3. Pour about 100 ml of liquid into the measuring cylinder.
   Measure and record the volume.

4. Pour this liquid into the beaker.
   Measure and record the mass of the beaker and liquid.

5. Calculate and record the volume of the liquid.

6. Calculate the density of the liquid.

7. The density of water is 1 g/cm^3.

8. Determine the mass of sugar per cm^3 dissolved in the water. Assume the sugar does **not** affect the volume of the water.

Review it

Complete the tasks below into your book.

Up to grade 4

1. Name the independent and dependent variables and state what equipment is needed to measure them.

2. State the equation for density.

3. How could you check that your results are reproducible?

Grade 5-7

4. Suggest the biggest source of uncertainty or error in your experiment. Explain your answer.

5. Describe how you find out the volume of an irregular object. (Make sure you use the word **'displaced'**).

Grade 7+

6. Suggest a method someone may use to calculate the density of the following object.

Test it

Answer the exam questions below into your book.

Q1 A student wanted to determine the density of a small piece of rock.

(a) Describe how the student could measure the volume of the piece of rock.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) The volume of the piece of rock was 18.0 cm^3.

The student measured the mass of the piece of rock as 48.6 g.

Calculate the density of the rock in g/cm^3.

Use the equation:

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

_____

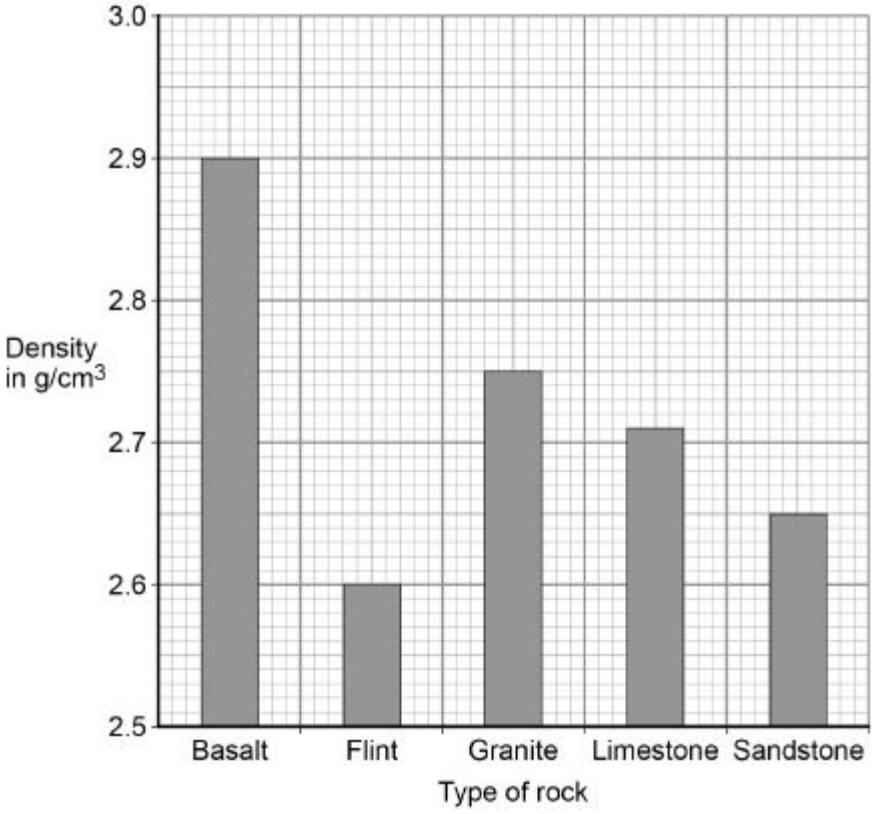
_____

_____

Density = _____ g/cm^3

(2)

The graph below shows the densities of different types of rock.



(c) What is the most likely type of rock that the student had?

Tick **one** box.

- Basalt ☐
- Flint ☐
- Granite ☐
- Limestone ☐
- Sandstone ☐

(1)

(d) Give **one** source of error that may have occurred when the student measured the volume of the rock.

_____

_____

(1)

(e) How would the error you described in part **(d)** affect the measured volume of the rock?

_____

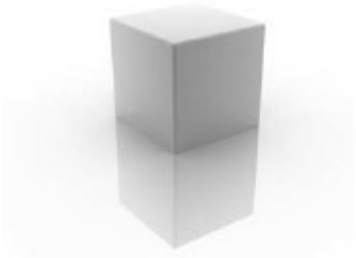
_____

(1)

(Total 9 marks)

Q2.

A student wants to calculate the density of the two objects shown in the figure below.



Metal cube

Small statue

Describe the methods that the student should use to calculate the densities of the two objects.

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Mark it

Q1.

(a) **Level 2:** The method would lead to the production of a valid outcome. Key steps are identified and logically sequenced.

3–4

Level 1: The method would not necessarily lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- part fill a measuring cylinder with water
- measure initial volume
- place object in water
- measure final volume
- volume of object = final volume − initial volume

- fill a displacement / eureka can with water
- water level with spout
- place object in water
- collect displaced water
- measuring cylinder used to determine volume of displaced water

(b) $\text{density} = \frac{48.6}{18.0}$

1

density = 2.70 (g/cm^3)

1

*an answer of 2.70 (g/cm^3) scores **2** marks*

(c) limestone

1

(d) eye position when using measuring cylinder
or
water level in can (at start) not at level of spout
or
not all water displaced by stone is collected in container

1

(e) volume would be lower / higher

1

[9]

Q2.

Level 3 (5–6 marks):
Clear and coherent description of both methods including equation needed to calculate density. Steps are logically ordered and could be followed by someone else to obtain valid results.

Level 2 (3–4 marks):
Clear description of one method to measure density or partial description of both methods. Steps may not be logically ordered.

Level 1 (1–2 marks):
Basic description of measurements needed with no indication of how to use them.

0 marks:
No relevant content.

Indicative content

For both:
- measure mass using a balance
- calculate density using $\rho = m / V$

Metal cube:
- measure length of cube's sides using a ruler
- calculate volume

Small statue:
- immerse in water
- measure volume / mass of water displaced
- volume of water displaced = volume of small statue

[6]