

# GCSE Physics

## Worksheet: Density of materials

|                |                   |                       |                            |
|----------------|-------------------|-----------------------|----------------------------|
| TIME<br>30 min | TOTAL<br>30 marks | CALCULATOR<br>Allowed | DIFFICULTY<br>Easy, Medium |
|----------------|-------------------|-----------------------|----------------------------|

Topics: Density of materials

|      |       |      |
|------|-------|------|
| NAME | CLASS | DATE |
|------|-------|------|

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

01

01.1

Which of these is a unit of density?

Tick (✓) **one** box.

|                   |                          |
|-------------------|--------------------------|
| kg                | <input type="checkbox"/> |
| m <sup>3</sup>    | <input type="checkbox"/> |
| kg/m <sup>3</sup> | <input type="checkbox"/> |
| N/kg              | <input type="checkbox"/> |

[1 mark]

01.2

Name a piece of apparatus a student could use to measure the volume of a liquid.

[1 mark]

01.3

Name a piece of apparatus a student could use to measure the mass of a solid object.

.....

.....

.....

.....

[1 mark]

02

A student wanted to identify the metal that a rectangular block was made from.

02.1

Name a measuring instrument the student could use to measure the length, width and height of the block.

.....

.....

.....

.....

[1 mark]

02.2

The block measured 6.0 cm × 3.0 cm × 2.5 cm.  
Calculate the volume of the block.

.....

.....

.....

Volume = ..... cm<sup>3</sup>

[1 mark]

0 2 . 3

The mass of the block was 121.5 g.  
Calculate the density of the metal.  
Use the equation:

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

.....

.....

.....

.....

Density = ..... g/cm<sup>3</sup>

[2 marks]

0 2 . 4

Table 1

| Metal     | Density in g/cm <sup>3</sup> |
|-----------|------------------------------|
| Aluminium | 2.7                          |
| Titanium  | 4.5                          |
| Zinc      | 7.1                          |
| Copper    | 9.0                          |

Table 1 shows the densities of four metals.  
Use your value for the density and Table 1 to identify the metal.

.....

.....

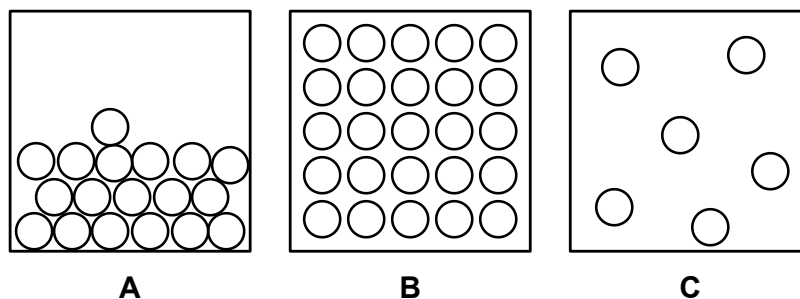
.....

.....  
[1 mark]

0 3

Figure 1 shows the arrangement of the particles of a substance in three different states, A, B and C.

Figure 1



0 3 . 1

Which diagram shows the particles in the liquid state?

Tick (✓) **one** box.

A

☐

B

☐

C

☐

[1 mark]

0 3 . 2

The density of the substance in the gas state is much lower than its density in the liquid state.

Explain why. Use Figure 1.

.....

.....

.....

.....

[2 marks]

0 3 . 3

A candle is made of wax. The candle has a mass of 0.18 kg and a volume of 0.00020 m<sup>3</sup>.

Calculate the density of the wax.

Use the equation:

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

.....

.....

.....

.....

Density = ..... kg/m<sup>3</sup>

[2 marks]

0 4

A wooden block has a mass of 40 g and a volume of 50 cm<sup>3</sup>.

0 4 . 1

Calculate the density of the wooden block.

Use the equation:

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

.....

.....

.....

.....

Density = ..... g/cm<sup>3</sup>

[2 marks]

0 5

A student measured the density of some olive oil using this method.

1. Measure the mass of an empty measuring cylinder.
2. Pour some olive oil into the measuring cylinder and read the volume.
3. Measure the mass of the measuring cylinder and the olive oil.

Table 2 shows the results.

**Table 2**

| Measurement                              | Value                |
|------------------------------------------|----------------------|
| Mass of empty measuring cylinder         | 62.4 g               |
| Volume of olive oil                      | 50.0 cm <sup>3</sup> |
| Mass of measuring cylinder and olive oil | 108.4 g              |

0 5 . 1

Write down the equation that links density ( $\rho$ ), mass ( $m$ ) and volume ( $V$ ).

.....

.....

[1 mark]

0 5 . 2

Calculate the density of the olive oil in kg/m<sup>3</sup>.

.....

.....

.....

.....

.....

Density = ..... kg/m<sup>3</sup>

[3 marks]

0 5 . 3

Describe how the student should read the volume of the olive oil from the scale on the measuring cylinder to obtain an accurate value.

.....

.....

.....

.....

[2 marks]

0 5 . 4

The density of water is  $1000 \text{ kg/m}^3$ . Olive oil and water do not mix. Predict what happens when olive oil is poured into a glass of water. Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

.....

0 6

Table 3 shows the density of four materials being considered for the hull of a small boat. A solid block of a material floats on water if its density is less than the density of water,  $1000 \text{ kg/m}^3$ .

**Table 3**

| Material                  | Density in $\text{kg/m}^3$ |
|---------------------------|----------------------------|
| Pine wood                 | 500                        |
| Aluminium                 | 2700                       |
| Expanded polystyrene foam | 30                         |
| Steel                     | 7850                       |

0 6 . 1

Which **two** of the materials in Table 3 would float on water if shaped into a solid block?

Tick (✓) **two** boxes.

Pine wood

☐

Aluminium

☐

Expanded polystyrene foam

☐

Steel

☐

**[2 marks]**

0 6 . 2

A steel ship floats, even though the density of steel is much greater than the density of water.

Suggest how this is possible.

.....

.....

.....

.....

**[2 marks]**

0 7

An empty measuring cylinder has a mass of 69 g.

A student pours 40 cm<sup>3</sup> of a liquid into the cylinder.

The mass of the cylinder and the liquid together is 105.8 g.

0 7 . 1 Calculate the density of the liquid in g/cm<sup>3</sup>.

.....

.....

.....

.....

.....

Density = ..... g/cm<sup>3</sup>

[3 marks]

.....

**END OF QUESTIONS**

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

# Mark scheme

## GCSE Physics · Worksheet: Density of materials · 30 marks

---

---

### Question 1 (3 marks)

01.1 [1 mark]

**Correct:**  $\text{kg/m}^3$

---

01.2 [1 mark]

**Answer:** A measuring cylinder.

- measuring cylinder (allow burette / pipette) (1)
- 

01.3 [1 mark]

**Answer:** A (top-pan) balance.

- (top-pan) balance / scales (1)
- 
- 

### Question 2 (5 marks)

02.1 [1 mark]

**Answer:** A ruler (or vernier callipers).

- ruler / metre rule / vernier callipers / micrometer (1)
- 

02.2 [1 mark]

**Answer:**  $45 \text{ cm}^3$

- $45 \text{ (cm}^3\text{)}$  (1)
- 

02.3 [2 marks]

**Answer:**  $2.7 \text{ g/cm}^3$

- density =  $121.5 \div 45$  (1)
- $2.7 \text{ (g/cm}^3\text{)}$  (1)

**Notes:** An answer of 2.7 scores 2 marks. Allow ECF from the volume calculated.

---

02.4 [1 mark]

**Answer:** Aluminium

- aluminium (1)

**Notes:** Allow ECF: the metal in Table 1 with the density closest to the student's calculated value.

---

---

### Question 3 (5 marks)

03.1 [1 mark]

Correct: A

---

03.2 [2 marks]

**Answer:** In a gas the particles are much further apart than in a liquid, so each cubic metre contains fewer particles and less mass.

- the particles in a gas are (much) further apart (than in a liquid) (1)
- so there is less mass in each unit volume / the same mass takes up a much larger volume (1)

**Notes:** Allow the converse argument for the liquid. Do not accept 'gas particles are lighter' or 'gas particles are smaller'.

---

03.3 [2 marks]

**Answer:**  $900 \text{ kg/m}^3$

- density =  $0.18 \div 0.00020$  (1)
- $900 \text{ (kg/m}^3\text{)}$  (1)

**Notes:** An answer of 900 scores 2 marks.

---

---

### Question 4 (2 marks)

04.1 [2 marks]

**Answer:**  $0.8 \text{ g/cm}^3$

- density =  $40 \div 50$  (1)
  - $0.8 \text{ (g/cm}^3\text{)}$  (1)
-

---

## Question 5 (8 marks)

### 05.1 [1 mark]

**Answer:**  $\rho = \frac{m}{V}$

- $\rho = m / V$  (density = mass  $\div$  volume) (1)

**Notes:** Allow any correct rearrangement, in symbols or words.

---

### 05.2 [3 marks]

**Answer:** 920 kg/m<sup>3</sup>

- mass of olive oil = 108.4 – 62.4 = 46.0 (g) (1)
- density = 46.0  $\div$  50.0 = 0.92 (g/cm<sup>3</sup>) (1)
- 920 (kg/m<sup>3</sup>) (1)

**Notes:** An answer of 920 scores 3 marks. An answer of 0.92 scores 2 marks. Using 108.4 g as the mass of the oil scores the conversion mark only (2168 kg/m<sup>3</sup>).

---

### 05.3 [2 marks]

**Answer:** Stand the cylinder on a level bench and read the scale at the bottom of the meniscus with the eye level with the oil surface.

- stand the measuring cylinder on a flat, level surface (1)
- have the eye level with the surface of the oil (to avoid a parallax error) (1)
- read the scale at the bottom of the meniscus (1)

Any 2 of the points above.

---

### 05.4 [2 marks]

**Answer:** The oil floats on top of the water because its density (920 kg/m<sup>3</sup>) is less than that of water.

- the olive oil floats on (top of) the water (1)
- because olive oil is less dense than water (1)

**Notes:** The reason mark depends on the prediction mark. Allow ECF from the calculated density.

---

---

## Question 6 (4 marks)

06.1 [2 marks]

**Correct:** Pine wood; Expanded polystyrene foam

---

06.2 [2 marks]

**Answer:** The hull encloses a lot of air, so the ship's overall (average) density is less than water's, even though steel alone is denser than water.

- the hull encloses a large volume of air (and cargo space) (1)
  - so the average density of the whole ship (steel plus the enclosed air) is less than the density of water (1)
- 

---

## Question 7 (3 marks)

07.1 [3 marks]

**Answer:**  $0.92 \text{ g/cm}^3$

- mass of liquid =  $105.8 - 69 = 36.8 \text{ (g)}$  (1)
  - density =  $36.8 \div 40$  (1)
  - $0.92 \text{ (g/cm}^3\text{)}$  (1)
-