

# GCSE Combined Science: Trilogy

## Worksheet: Density of materials

|                |                   |                       |                            |
|----------------|-------------------|-----------------------|----------------------------|
| TIME<br>35 min | TOTAL<br>31 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

A plastic block has a mass of 157.5 g and a volume of 150 cm<sup>3</sup>.

01.1

Calculate the density of the plastic block.  
Use the equation:

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

Density = ..... g/cm<sup>3</sup>  
[2 marks]

0 2

A student measures the mass and volume of five wooden cubes of different sizes, all cut from the same type of wood, to test the idea that density does not depend on the size of a sample.

0 2 . 1

Write a hypothesis for this investigation.

.....

.....

[1 mark]

0 2 . 2

Identify the independent variable and the dependent variable.

.....

.....

.....

.....

[2 marks]

0 2 . 3

State one variable that must be controlled, and explain why.

.....

.....

.....

.....

[2 marks]

0 2 . 4

Give one hazard in preparing the wooden cubes and a suitable control measure.

.....

.....

.....

.....

[2 marks]

0 3

A wooden block has a mass of 90 g and a volume of 150 cm<sup>3</sup>.

0 3 . 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 4

A student used digital callipers to measure the diameter of a small steel ball bearing five times.  
Table 1 shows the results.

Table 1

| Reading        | 1    | 2    | 3    | 4    | 5    |
|----------------|------|------|------|------|------|
| Diameter in mm | 8.02 | 7.96 | 8.00 | 8.04 | 7.98 |

0 4 . 1

Calculate the mean diameter of the ball bearing.

.....

.....

.....

Mean diameter = ..... mm

[1 mark]

0 4 . 2

The range of the five readings is 0.08 mm.  
Write down the uncertainty in the mean diameter.

.....

.....

.....

Uncertainty = ..... mm

[1 mark]

0 4 . 3

Calculate the volume of the ball bearing using the mean diameter.  
Use the equation:

$$\text{volume of a sphere} = \frac{4}{3}\pi r^3$$

Give your answer to 3 significant figures.

.....

.....

.....

.....

.....

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

[3 marks]

0 4 . 4

The mass of the ball bearing is 2.15 g.  
Calculate the density of the steel in g/cm<sup>3</sup>.  
Give your answer to 3 significant figures.

.....

.....

.....

.....

.....

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

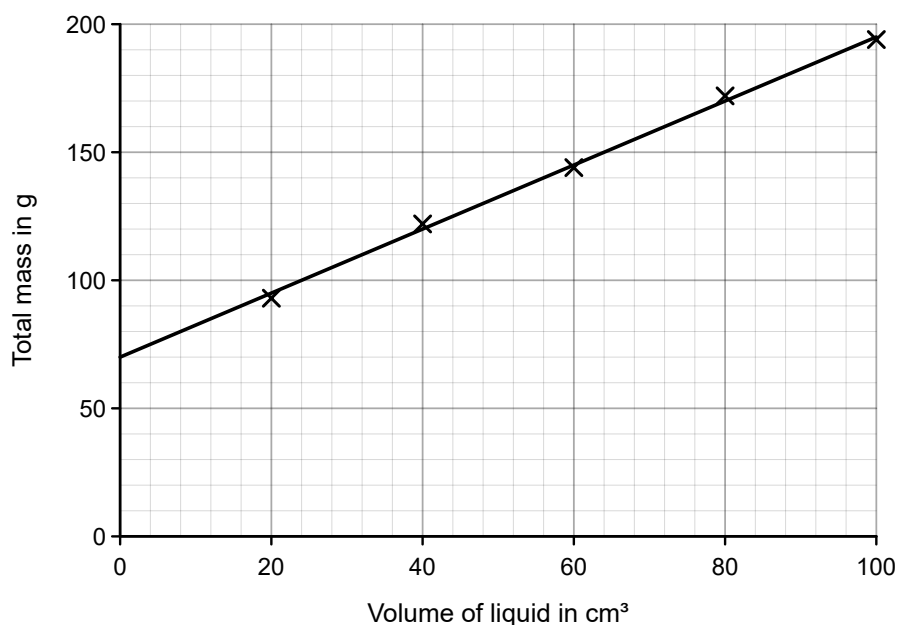
[3 marks]

0 5

A student investigated the density of a liquid. The student poured different volumes of the liquid into a measuring cylinder. Each time, the student measured the total mass of the measuring cylinder and the liquid.

Figure 1 shows the results.

Figure 1



0 5 . 1

Use Figure 1 to determine the mass of the empty measuring cylinder.

.....

.....

.....

Mass = ..... g

[1 mark]

0 5 . 2

Give the reason for your answer.

.....

.....

[1 mark]

0 5 . 3

Use Figure 1 to determine the density of the liquid in  $\text{kg/m}^3$ .

.....

.....

.....

.....

.....

Density = .....  $\text{kg/m}^3$

[3 marks]

0 5 . 4

Explain why finding the density from the gradient of the graph is better than using a single pair of measurements.

.....

.....

.....

.....

[2 marks]

0 6

The density of air is  $1.2 \text{ kg/m}^3$ . A classroom measures 9.0 m by 7.0 m and has a ceiling height of 3.0 m.

0 6 . 1

Calculate the volume of air in the classroom.

.....

.....

.....

Volume = .....  $\text{m}^3$

[1 mark]

0 6 . 2

Calculate the mass of the air in the classroom.  
Give your answer to 3 significant figures.

.....

.....

.....

.....

Mass = ..... kg

[2 marks]

0 6 . 3

A student says the air in the classroom has a mass of about a quarter of a tonne.  
1 tonne = 1000 kg.  
Comment on whether the student is correct.

.....

.....

.....

.....

[2 marks]

**END OF QUESTIONS**

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

# Mark scheme

## GCSE Combined Science: Trilogy · Worksheet: Density of materials · 31 marks

---

### Question 1 (2 marks)

#### 01.1 [2 marks]

**Answer:**  $1.05 \text{ g/cm}^3$

- density =  $157.5 \div 150$  (1)
  - $1.05 \text{ (g/cm}^3\text{)}$  (1)
- 

### Question 2 (7 marks)

#### 02.1 [1 mark]

**Answer:** Cubes of different sizes, but made of the same material, will all have the same density (density does not depend on the size of the sample).

- cubes of different sizes but the same material will all have the same density / density does not depend on the size of the sample (1)
- 

#### 02.2 [2 marks]

**Answer:** Independent: the volume (size) of the cube. Dependent: the density of the cube.

- independent variable: the volume / size (side length) of the cube (1)
  - dependent variable: the density of the cube (calculated from its mass and volume) (1)
- 

#### 02.3 [2 marks]

**Answer:** The type of wood must be the same for every cube; otherwise any difference in density could be caused by a difference in material rather than size, making the comparison unfair.

- a control variable, e.g. the type/species of wood, or its moisture content (1)
  - a correct reason, e.g. so that any pattern in density is caused by size alone, not by a difference in material (a fair test) (1)
- 

#### 02.4 [2 marks]

**Answer:** Cutting the wood with a saw or craft knife could cut skin; cut on a suitable surface, keep fingers away from the blade, and use a guard or adult supervision.

- a hazard, e.g. a saw or craft knife used to cut the cubes could cut skin (1)
  - a control measure that matches the hazard, e.g. cut on a stable surface away from the body, keep fingers clear of the blade, or use adult supervision/a guide (1)
-

---

### Question 3 (2 marks)

03.1 [2 marks]

**Answer:**  $0.6 \text{ g/cm}^3$

- density =  $90 \div 150$  (1)
  - $0.6 \text{ (g/cm}^3\text{)}$  (1)
- 

### Question 4 (8 marks)

04.1 [1 mark]

**Answer:** 8.00 mm

- 8.00 (mm) (1)
- 

04.2 [1 mark]

**Answer:**  $\pm 0.04 \text{ mm}$

- $\pm 0.04 \text{ (mm)}$  (half the range) (1)
- 

04.3 [3 marks]

**Answer:**  $268 \text{ mm}^3$

- $r = 8.00 \div 2 = 4.00 \text{ (mm)}$  (1)
  - $V = \frac{4}{3} \times \pi \times 4.00^3$  (1)
  - $268 \text{ (mm}^3\text{)}$  (1)
- 

04.4 [3 marks]

**Answer:**  $8.02 \text{ g/cm}^3$

- $V = 268 \div 1000 = 0.268 \text{ (cm}^3\text{)}$  (1)
- density =  $2.15 \div 0.268$  (1)
- $8.02 \text{ (g/cm}^3\text{)}$  (1)

**Notes:** Allow ECF from the volume calculated in the previous part.

---

---

## Question 5 (7 marks)

### 05.1 [1 mark]

**Answer:** 70 g

- 70 (g) (allow 68–72) (1)

---

### 05.2 [1 mark]

**Answer:** It is the intercept on the mass axis, where the volume of liquid is zero.

- it is the (total) mass when the volume of liquid is zero / where the line meets the mass axis (1)

---

### 05.3 [3 marks]

**Answer:** 1250 kg/m<sup>3</sup>

- gradient found using a large triangle, e.g.  $(195 - 70) \div 100$  (1)
- = 1.25 (g/cm<sup>3</sup>) (1)
- 1250 (kg/m<sup>3</sup>) (1)

**Notes:** Allow 1230–1270. An answer in this range scores 3 marks. Dividing a single total mass by its volume without subtracting the mass of the cylinder (e.g.  $195 \div 100$ ) scores max 1 mark, for the unit conversion.

---

### 05.4 [2 marks]

**Answer:** The line uses all the results, so random errors average out, and a constant error such as the cylinder's mass does not change the gradient.

- the gradient uses all of the results, so the effect of random errors in individual readings is reduced (1)
- an anomalous result would be easy to spot (and ignore) (1)
- the mass of the measuring cylinder (or a zero error on the balance) does not affect the gradient (1)

Any 2 of the points above.

---

---

## Question 6 (5 marks)

06.1 [1 mark]

**Answer:**  $189 \text{ m}^3$

- $189 \text{ (m}^3\text{)} (1)$

---

06.2 [2 marks]

**Answer:**  $227 \text{ kg}$

- $m = 1.2 \times 189 (1)$
- $227 \text{ (kg)} (1)$

**Notes:** Allow ECF from the volume calculated.

---

06.3 [2 marks]

**Answer:** A quarter of a tonne is  $250 \text{ kg}$ . The actual mass,  $227 \text{ kg}$ , is close to this, so the student's estimate is reasonable.

- a quarter of a tonne is  $250 \text{ kg} (1)$
  - $227 \text{ kg}$  is reasonably close to  $250 \text{ kg}$ , so the student's estimate is about right / a fair approximation  $(1)$
-