AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.3.1.1

Density of materials

Past-paper questions

Tier	**Foundation**
Question groups	**5**
Available paper years	**2018–2024**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

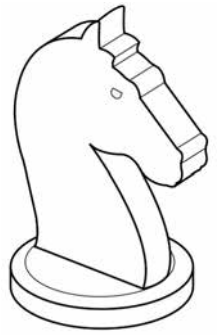
6.3.1.1 Density of materials

Question 01

June 2018 | 8464/P/1F | Original Q7

0 7 A student wanted to determine the density of the irregular shaped object shown in **Figure 11**

Figure 11



0 7 . 1 Plan an experiment that would allow the student to determine the density of the object.

[6 marks]

Question 7 continues on the next page

Question 01 · continued

0 7 . 2 Another student did a similar experiment.

He determined the density of five common plastic materials.

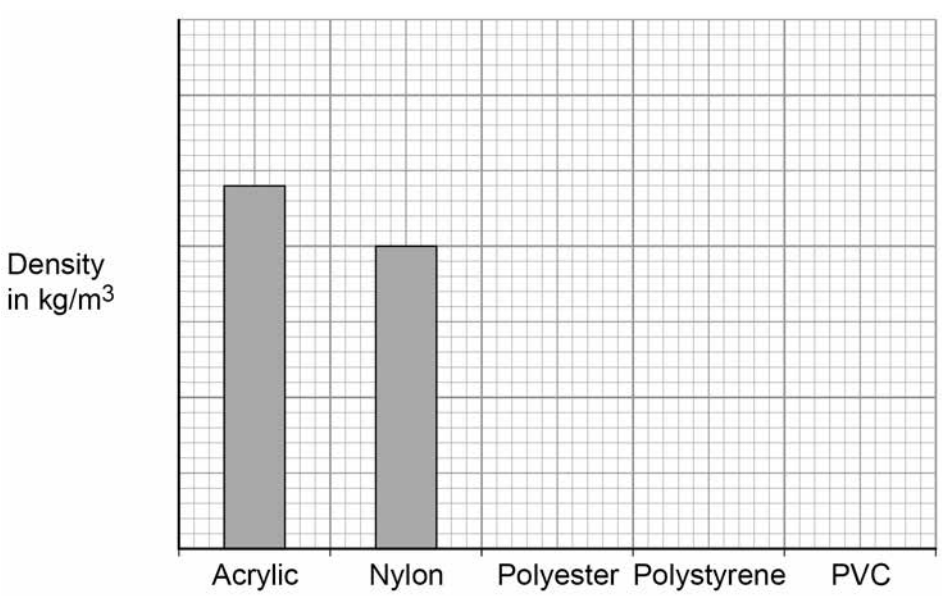
Table 3 shows the results.

Table 3

Plastic material	Density in kg/m^3
Acrylic	1200
Nylon	1000
Polyester	1380
Polystyrene	1040
PVC	1100

Figure 12 shows the results plotted in a bar chart.

Figure 12



Complete **Figure 12**

You should:

- Write the correct scale on the y-axis.
- Draw the bars for polyester, polystyrene and PVC.

[4 marks]

6.3.1.1 Density of materials

Question 01 · continued

0 7 . 3 The student is given a piece of a different plastic material.

The student determined the density of the material three times.

Table 4 shows the results.

Table 4

	Density in kg/m^3
1	960
2	1120
3	1040

Determine the uncertainty in the student's results.

[2 marks]

Uncertainty = _____ kg/m^3

12

6.3.1.1 Density of materials

Question 02

November 2021 | 8464/P/1F | Original Q1

0 1 A student investigated the density of different types of rock.

Figure 1 shows a piece of limestone.

Figure 1



0 1 . 1 The student was **not** able to calculate the volume of the piece of limestone using measurements taken with a ruler.

What is the reason?

[1 mark]

Tick (✓) **one** box.

A ruler is not very accurate. ☐

The piece of limestone has an irregular shape. ☐

There is a large uncertainty when using a ruler. ☐

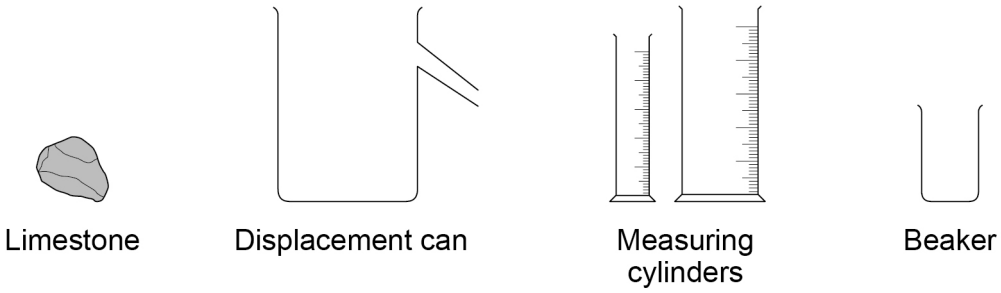
Question 1 continues on the next page

6.3.1.1 Density of materials

Question 02 · continued

0 1 . 2 **Figure 2** shows some of the equipment given to the student.

Figure 2



Describe a method the student could use to determine the volume of the piece of limestone.

[4 marks]

6.3.1.1 Density of materials

Question 02 · continued

0 1 . 3 The mass of the piece of limestone was 155 g.

The volume of the piece of limestone was 62 cm^3.

Calculate the density of the piece of limestone.

Use the equation:

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

[2 marks]

Density = _____ g/cm^3

0 1 . 4 Density can be measured in g/cm^3.

What is another unit for density?

[1 mark]

Tick (✓) **one** box.

- cm/g^3 ☐
- kg/m^3 ☐
- kg^3/m ☐
- kg^3/cm ☐

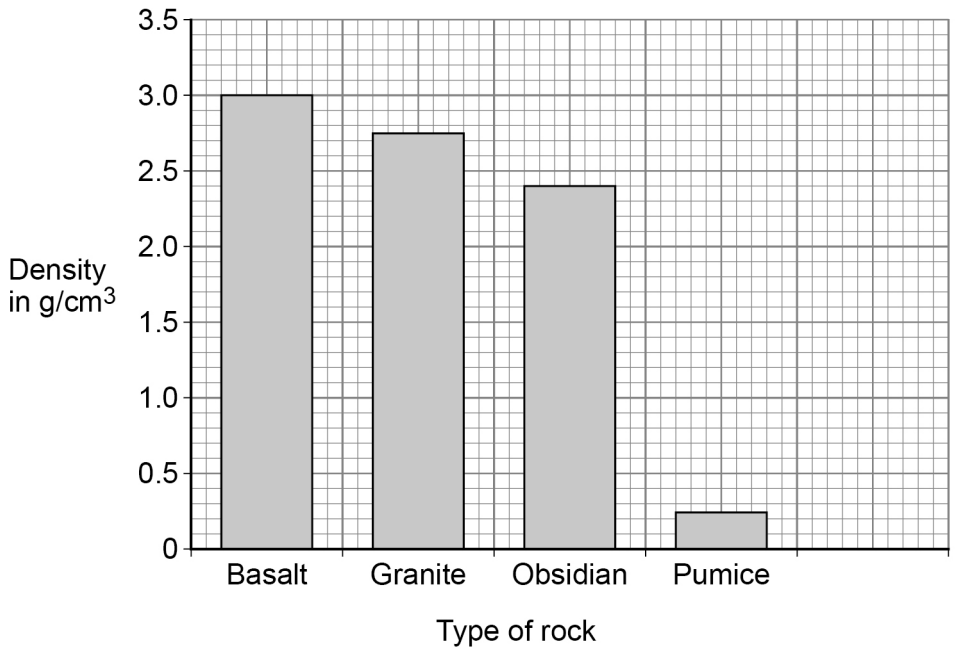
Question 1 continues on the next page

6.3.1.1 Density of materials

Question 02 · continued

Figure 3 gives the density of some other types of rock.

Figure 3



The student has a sample of an unknown type of rock.

The density of this rock is 2.4 g/cm^3.

0 1 . 5 Draw a bar on **Figure 3** to show the density of the unknown type of rock.

[1 mark]

0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

basalt	**granite**	**obsidian**	**pumice**

The data in **Figure 3** suggests that the unknown type of rock is _____ .

Question 02 · continued

0 1 . 7 The student **cannot** be certain that the unknown type of rock is one of the types of rock in **Figure 3**.

Give a reason why.

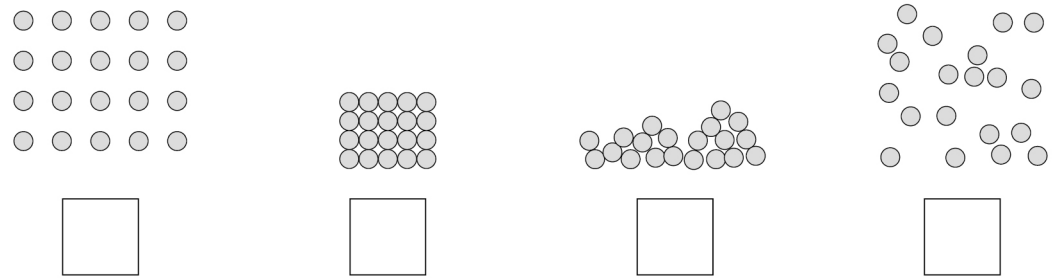
[1 mark]

Pumice is a type of rock that has holes in it. The holes contain air.

0 1 . 8 Which diagram shows the arrangement of particles in air?

[1 mark]

Tick (✓) **one** box.



0 1 . 9 Complete the sentence.

Choose the answer from the box.

[1 mark]

less than	the same as	more than

The holes containing air cause the density of pumice to

be _____ the density of other types of rock.

13

6.3.1.1 Density of materials

Question 03

June 2022 | 8464/P/1F | Original Q4

0 4 **Figure 6** shows a swimmer wearing a wetsuit.

The wetsuit helps to keep the swimmer warm.

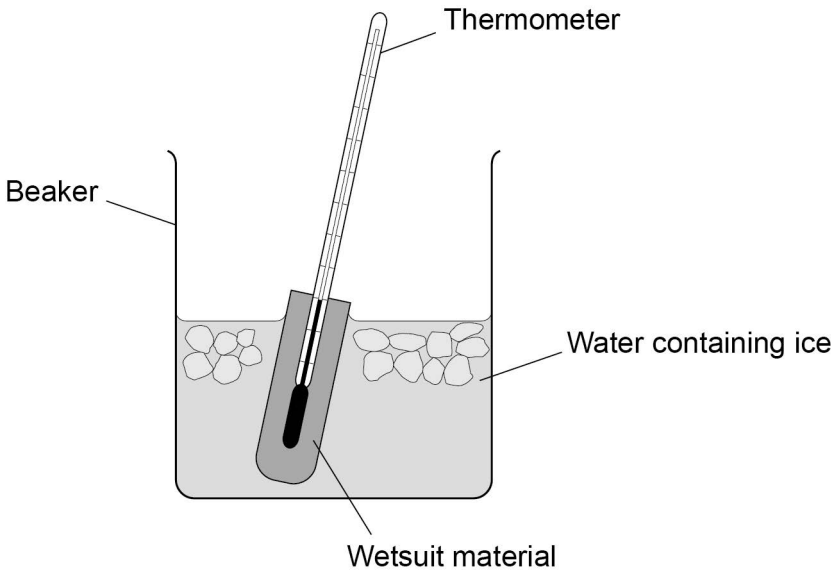
Figure 6



A student wrapped a thermometer in a piece of wetsuit material and placed the thermometer in water containing ice.

Figure 7 shows the apparatus.

Figure 7



6.3.1.1 Density of materials

Question 03 · continued

0 4 . 1 After 30 seconds in the water the temperature of the thermometer had decreased by 7.5 °C

Calculate the average decrease in temperature each second.

[2 marks]

Average decrease in temperature each second = _____ °C

Question 4 continues on the next page

Question 03 · continued

The student recorded the temperature of the thermometer after 30 seconds for four materials. Each piece of material was the same size and thickness.

In each test the starting temperature of the thermometer was 21.0 °C

Table 2 shows the results.

Table 2

Material	W	X	Y	Z
Temperature in °C	13.5	8.0	16.0	12.0

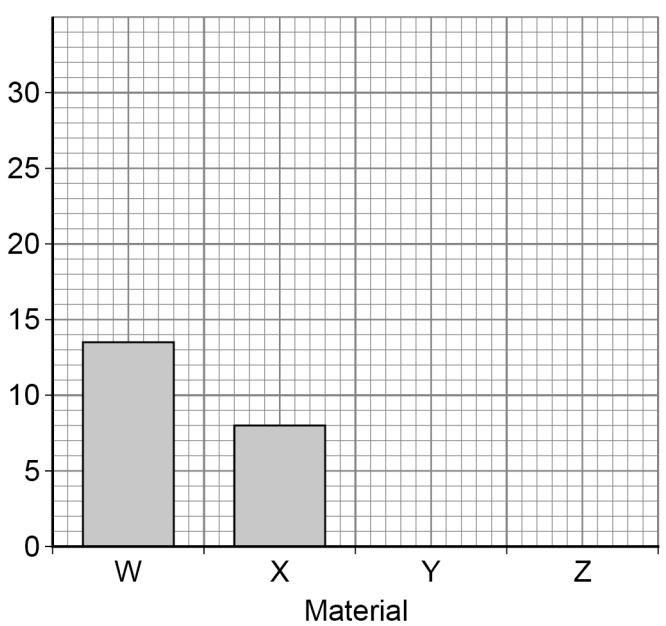
0 4 . 2 Complete **Figure 8** using the data in **Table 2**.

You should:

- label the *y*-axis
- draw the bars for materials Y and Z.

[2 marks]

Figure 8



0 4 . 3 Which material is the best thermal insulator?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

W ☐ **X** ☐ **Y** ☐ **Z** ☐

Reason _____

_____

0 4 . 4 The student tested a new material with a greater thermal conductivity than material Z.

The piece of new material was the same size and thickness as the piece of material Z.

What was the temperature of the thermometer after 30 seconds?

[1 mark]

Tick (✓) **one** box.

Less than 12.0 °C ☐

Exactly 12.0 °C ☐

Greater than 12.0 °C ☐

Question 4 continues on the next page

Question 03 · continued

0 4 . 5 During the investigation 0.0150 kg of the ice melted. The temperature of the water and ice did not change.

specific latent heat of fusion of ice = 334 000 J/kg

Calculate the energy needed to melt the ice.

Use the equation:

energy to melt the ice = mass × specific latent heat

[2 marks]

Energy needed to melt the ice = _____ J

The student wanted to determine the density of a wetsuit material.

The student measured the length of one side of a cube of wetsuit material with:

- a micrometer
- a ruler.

Table 3 shows the results.

Table 3

Equipment	Length in cm		
	Measurement 1	**Measurement 2**	**Measurement 3**
Micrometer	0.581	0.557	0.576
Ruler	0.6	0.6	0.6

6.3.1.1 Density of materials

Question 03 · continued

0 4 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

calibration	**precision**	**reproducibility**	**resolution**

The results show that compared to the ruler the micrometer has a higher

_____ .

Use the Physics Equations Sheet to answer questions **04.7** and **04.8**.

0 4 . 7 Write down the equation that links density (ρ), mass (m) and volume (V).

[1 mark]

_____

_____

0 4 . 8 The student calculated the volume of the cube of wetsuit material to be 0.186 cm^3

The density of the cube was 0.300 g/cm^3

Calculate the mass of the cube.

Give your answer in grams.

[3 marks]

_____

_____

_____

_____

_____

_____

Mass = _____ g

14

6.3.1.1 Density of materials

Question 04

June 2023 | 8464/P/1F | Original Q3

0 3 A piece of steel is heated until it has all melted.

0 3 . 1 Calculate the change in thermal energy when the temperature of the piece of steel is increased by 50 °C.

mass of steel = 4.0 kg

specific heat capacity of steel = 420 J/kg °C

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

Change in thermal energy = _____ J

0 3 . 2 The internal energy of the steel increases as the steel is heated.

What is meant by 'internal energy of the steel'?

[1 mark]

Tick (✓) **one** box.

- The change in energy of the steel particles as the steel melts. ☐
- The energy added to the steel particles as they are heated. ☐
- The total kinetic energy and potential energy of the steel particles. ☐

0 3 . 3 Solid steel cannot be poured.

Which statement about the particles in a solid gives the reason why?

[1 mark]

Tick (✓) **one** box.

- The number of particles always stays the same. ☐
- The particles are close together. ☐
- The particles are in fixed positions. ☐
- The particles have a fixed size. ☐

0 3 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

As the piece of solid steel melts, the mass of the steel _____.

Question 3 continues on the next page

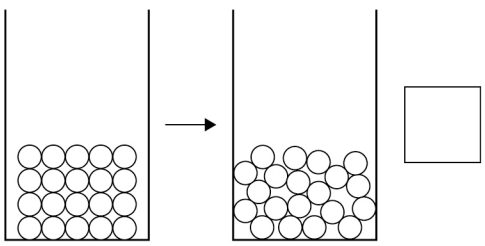
6.3.1.1 Density of materials

Question 04 · continued

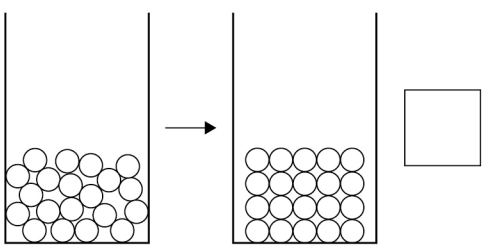
0 3 . 5 Which diagram shows how the arrangement of particles changes when a solid melts and becomes a liquid?

[1 mark]

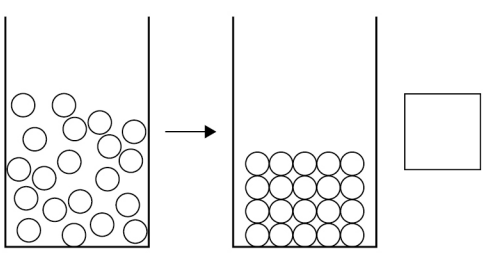
Tick (✓) **one** box.



☐



☐



☐

0 3 . 6 The density of steel decreases as it melts.

How does the spacing of the particles change as the steel melts?

[1 mark]

6.3.1.1 Density of materials

Question 04 · continued

0 3 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

chemical	**permanent**	**physical**

Melting is an example of a _____ change.

0 3 . 8 Steel is a mixture of iron and a small amount of carbon.

Table 1 shows the mass of carbon in 1.0 kg of different types of steel.

Table 1

Type of steel	Mass of carbon in 1.0 kg of steel
Low carbon	2.0 g
Medium carbon	4.5 g
High carbon	7.0 g

A 4.0 kg piece of steel contains 18 grams of carbon.

Determine which type of steel the 4.0 kg piece is made from.

You should include a calculation in your answer.

[3 marks]

Type of steel _____

6.3.1.1 Density of materials

Question 04 · continued

0 3 . 9 The 4.0 kg piece of solid steel was heated until it reached its melting point.

The additional energy required to melt the piece of steel was 280 000 J.

Calculate the specific latent heat of fusion of the steel.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of fusion of steel = _____ J/kg

14

6.3.1.1 Density of materials

Question 05

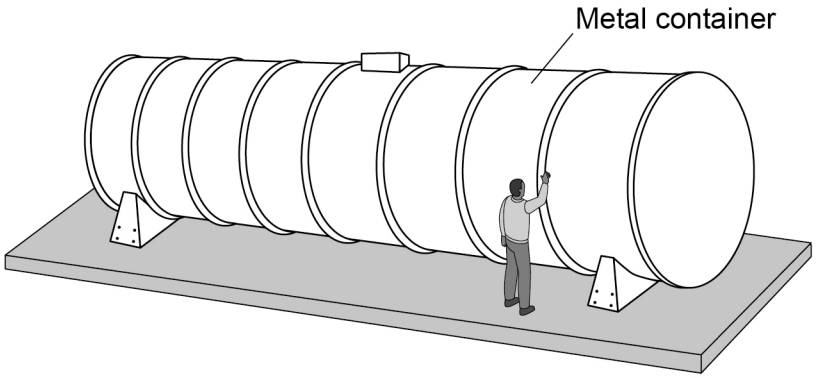
0 5 Data-storage computers get very hot.

Scientists investigated using the sea to cool data-storage computers.

The computers were set up inside a large metal container.

Figure 8 shows the metal container before it was lowered into the sea.

Figure 8



0 5 . 1 Why is the container made of metal?

[1 mark]

Tick (✓) **one** box.

Metal has a high thermal conductivity. ☐

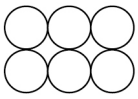
Metal is a good thermal insulator. ☐

Metal is a poor conductor of thermal energy. ☐

0 5 . 2 The walls of the container are solid.

Figure 9 shows an arrangement of six particles in a solid.

Figure 9



The air inside the container is a gas.

Draw an arrangement of six particles in a gas in the box below.

[1 mark]

0 5 . 3 How does the air in the container exert pressure on the container?

[1 mark]

Tick (✓) **one** box.

Air particles absorb energy from the container. ☐

Air particles collide with the walls of the container. ☐

Air particles expand to fill the container. ☐

Question 5 continues on the next page

6.3.1.1 Density of materials

Question 05 · continued

0 5 . 4 As the container is lowered into the sea, the temperature of the air in the container decreases.

Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

When the temperature of the air in the container decreases, the average speed of the air particles _____.

0 5 . 5 After the temperature of the air in the container had decreased, the computers were switched on.

The computers caused the temperature of the air to then increase.

Describe how the air pressure in the container changed as the temperature decreased and then increased.

[2 marks]

6.3.1.1 Density of materials

Question 05 · continued

0 5 . 6 The container has a length of 12 m.

The container has a cross-sectional area of 7.5 m^2.

Calculate the volume of the container.

Use the equation:

volume = length × cross-sectional area

[1 mark]

Volume = _____ m^3

Use the Physics Equations Sheet to answer questions **05.7** and **05.8**.

0 5 . 7 Write down the equation that links density (ρ), mass (m) and volume (V).

[1 mark]

0 5 . 8 The average density of the container and its contents is 1100 kg/m^3.

Calculate the mass of the container and its contents.

Use your answer to Question **05.6**

[3 marks]

Mass = _____ kg

11