AQA GCSE Physics | 8463

SPECIFICATION POINT 4.3.1.1

Density of materials

Past-paper questions

Tier	**Foundation**
Question groups	**14**
Available paper years	**2003–2025**

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:** _____

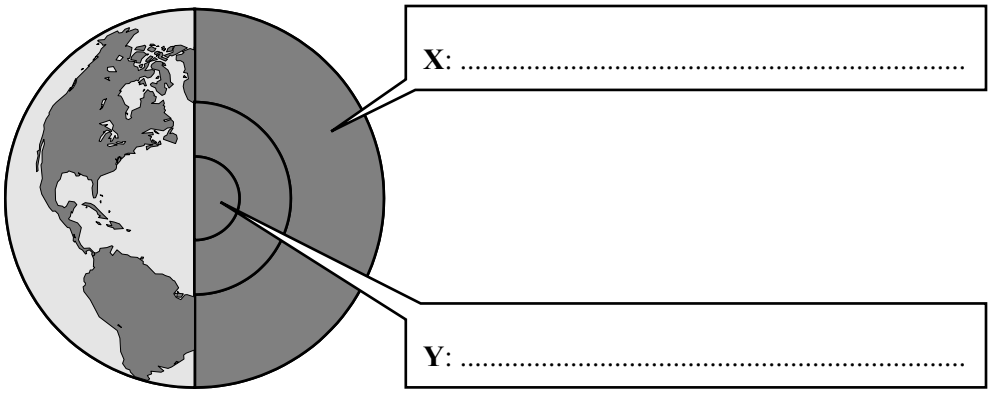
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.3.1.1 Density of materials

Question 01

June 2003 | 3451F | Original Q11 | Legacy

11 (a) The diagram shows the layered structure of the Earth.



(i) Write in the boxes the name of layer **X** and the name of layer **Y**.

(2 marks)

(ii) The overall density of the Earth is about 5500 kg/m^3. The average density of the rocks in the Earth's crust is about 2800 kg/m^3. What does this suggest about the material that makes up the lower layers of the Earth?

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.....

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(2 marks)

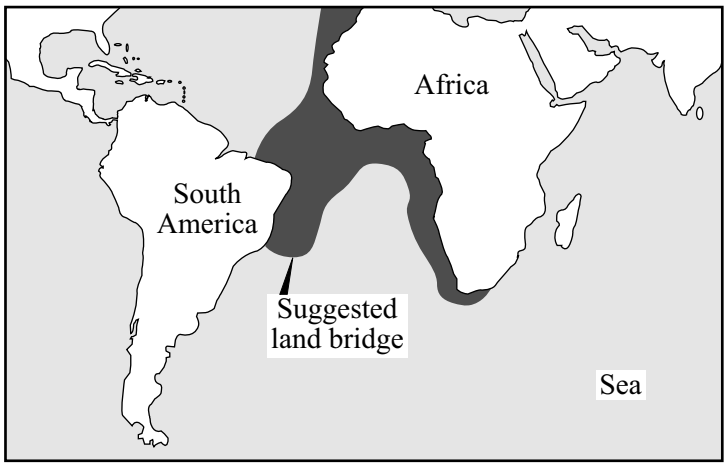
QUESTION 11 CONTINUES ON THE NEXT PAGE

4.3.1.1 Density of materials

Question 01 · continued

MARGIN BLANK

(b) In 1915, the scientist Alfred Wegener suggested that Africa and South America had once been joined but had since drifted apart. Evidence for his theory came from the animal fossils found in the two continents. The fossils are almost the same, although animals now living in Africa and South America are different. Other scientists did not agree with Wegener and suggested that a land bridge had once joined the two continents.



How could scientists use the idea of a land bridge to explain the evidence put forward by Wegener?

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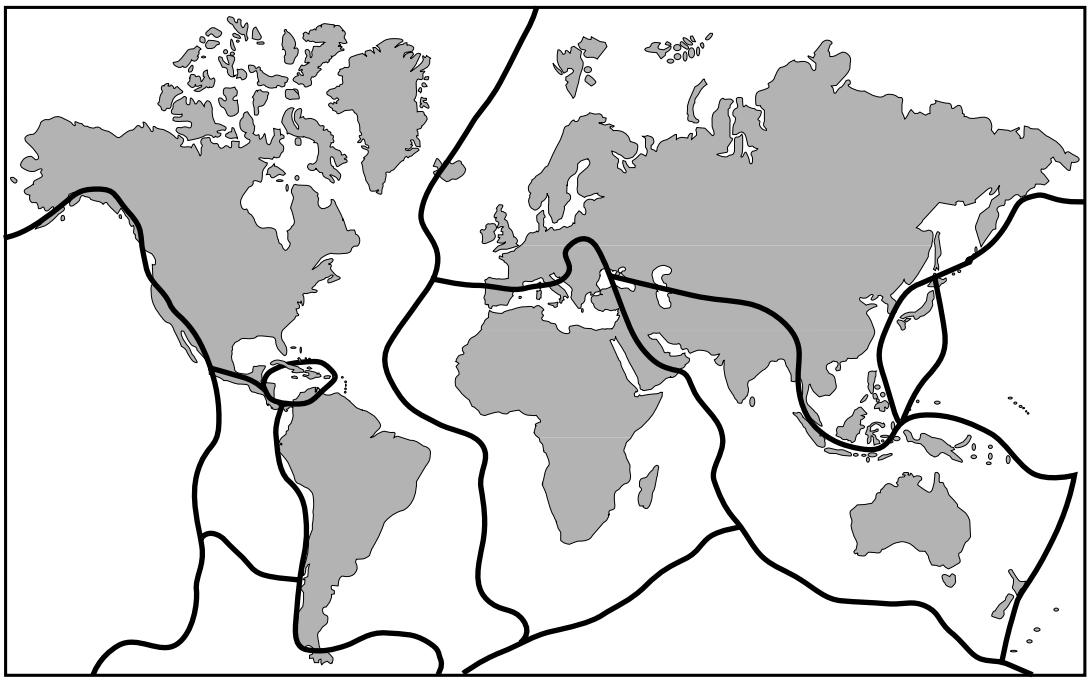
(2 marks)

Question 01 · continued

MARGIN BLANK

(c) Scientists now think that the outer layer of the Earth is cracked into a number of large pieces called tectonic plates. The tectonic plates are moving very slowly. The lines on the diagram show the boundaries between the major tectonic plates.



(i) Explain why there are no major earthquakes in Britain.

.....

.....

.....

.....

(2 marks)

(ii) What is causing the tectonic plates to move?

.....

.....

(1 mark)

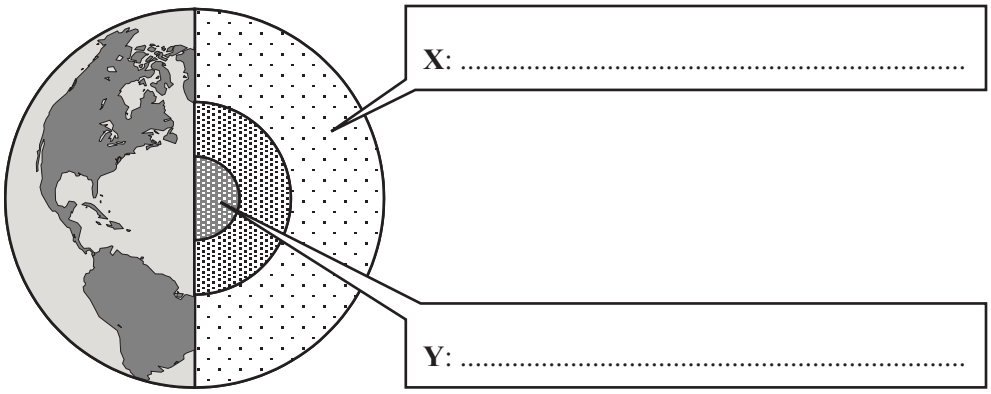
9

4.3.1.1 Density of materials

Question 02

June 2003 | 3462F3 | Original Q9 | Legacy

9 (a) The diagram shows the layered structure of the Earth.



(i) Write in the boxes the name of layer **X** and the name of layer **Y**.

(2 marks)

(ii) The overall density of the Earth is about 5500 kg/m^3. The average density of the rocks in the Earth's crust is about 2800 kg/m^3. What does this suggest about the material that makes up the lower layers of the Earth?

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(2 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

4.3.1.1 Density of materials

Question 02 · continued

MARGIN
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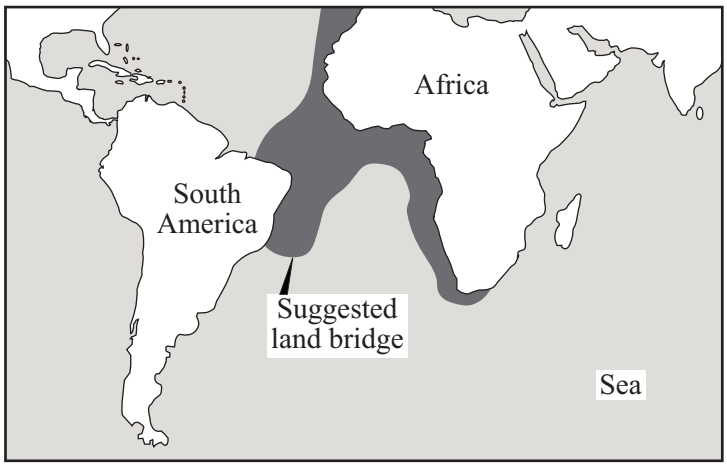
(b) In 1915, the scientist Alfred Wegener suggested that Africa and South America had once been joined but had since drifted apart. Evidence for his theory came from the animal fossils found in the two continents. The fossils are almost the same, although animals now living in Africa and South America are different. Other scientists did not agree with Wegener and suggested that a land bridge had once joined the two continents.



How could scientists use the idea of a land bridge to explain the evidence put forward by Wegener?

.....

.....

.....

.....

(2 marks)

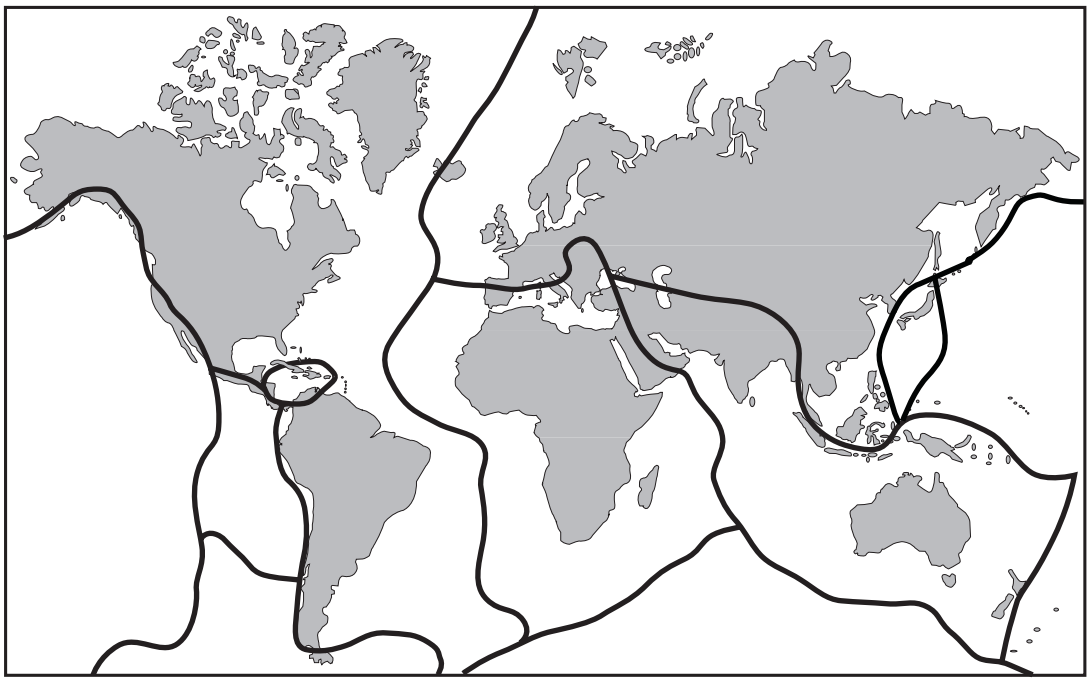
4.3.1.1 Density of materials

Question 02 · continued

1 /

MARGIN BLANK

(c) Scientists now think that the outer layer of the Earth is cracked into a number of large pieces called tectonic plates. The tectonic plates are moving very slowly. The lines on the diagram show the boundaries between the major tectonic plates.



(i) Explain why there are no major earthquakes in Britain.

.....

.....

.....

.....

(2 marks)

(ii) What is causing the tectonic plates to move?

.....

.....

(1 mark)

9

4.3.1.1 Density of materials

Question 03

June 2007 | PHY1A | Original Q5 | Legacy

QUESTION FIVE

Convection currents are formed when liquids are heated.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A decreases

B increases

C is unchanged

D rises

When liquids are heated, the particles gain kinetic energy.

The space between the particles in the liquid . . . **1** . . . so the density of the liquid . . . **2** . . . .

The warm liquid . . . **3** . . . .

The total mass of the liquid . . . **4** . . . .

4.3.1.1 Density of materials

Question 04

June 2014 | PH1FP | Original Q3 | Legacy

3 Energy can be transferred through some materials by convection.

3 (a) Use the correct answer from the box to complete the sentence.

[1 mark]

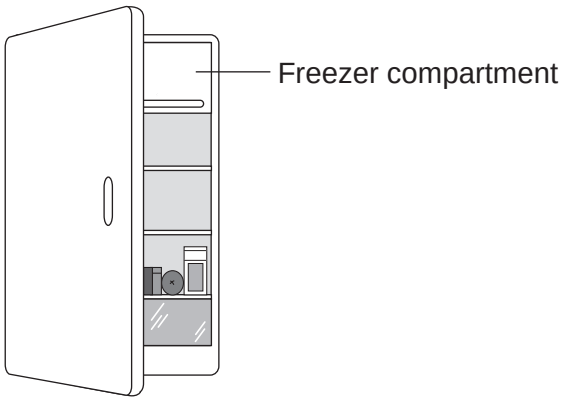
gas	liquid	solid

Energy **cannot** be transferred by convection through a ..... .

3 (b) **Figure 4** shows a fridge with a freezer compartment.

The temperature of the air inside the freezer compartment is –5 °C.

Figure 4



Use the correct answer from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

[3 marks]

decreased	unchanged	increased

When the air near the freezer compartment is cooled, the energy of the air particles is ..... .

The spaces between the air particles are ..... .

The density of the air is ..... .

4.3.1.1 Density of materials

Question 04 · continued

3 (c) **Table 1** shows some information about three fridges, **A**, **B** and **C**.

The efficiency of each fridge is the same.

Table 1

Fridge	Volume in litres	Energy used in one year in kWh
A	232	292
B	382	409
C	622	524

3 (c) (i) Which fridge, **A**, **B** or **C**, would cost the least to use for 1 year?

[2 marks]

Give **one** reason for your answer.

.....

.....

3 (c) (ii) A householder looks at the data in **Table 1**.

What should she conclude about the pattern linking the volume of the fridge and the energy it uses in one year?

[1 mark]

.....

.....

3 (c) (iii) The householder could not be certain that her conclusion is correct for all fridges.

Suggest **one** reason why not.

[1 mark]

.....

.....

8

4.3.1.1 Density of materials

Question 05

June 2018 | 8463/1F | Original Q4

0 4 A student wanted to determine the density of a small piece of rock.

0 4 . 1 Describe how the student could measure the volume of the piece of rock.

[4 marks]

0 4 . 2 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:

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

[2 marks]

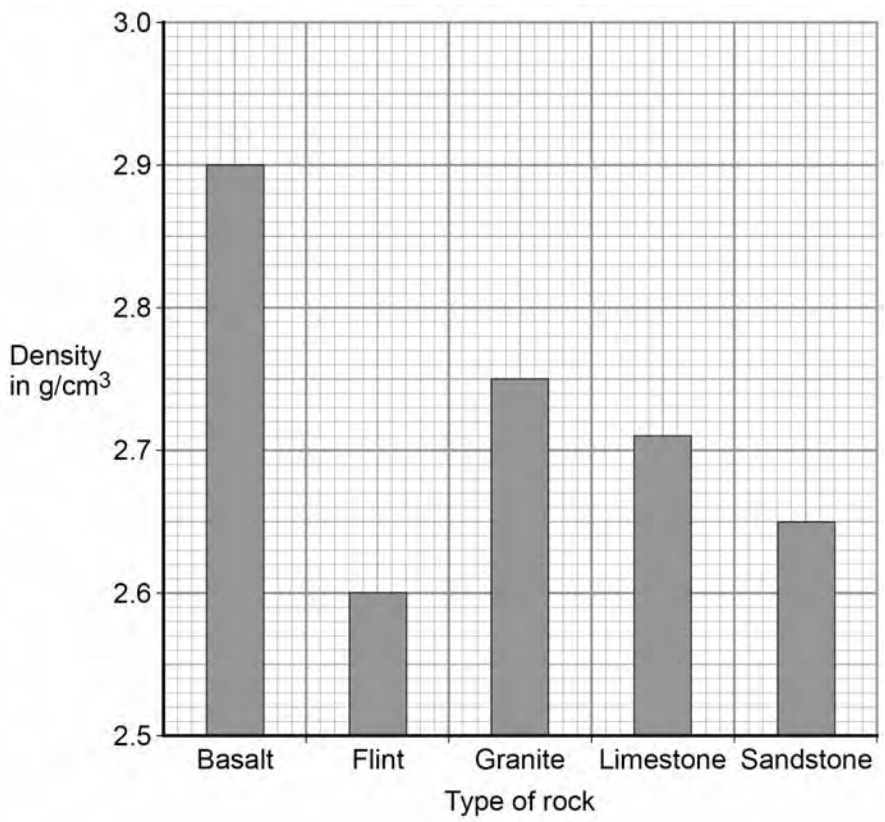
Density = _____ g/cm^3

4.3.1.1 Density of materials

Question 05 · continued

Figure 4 shows the densities of different types of rock.

Figure 4



0 4 . 3 What is the most likely type of rock that the student had?

Tick **one** box.

[1 mark]

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

4.3.1.1 Density of materials

Question 05 · continued

0 4 . 4 Give **one** source of error that may have occurred when the student measured the volume of the rock.

[1 mark]

0 4 . 5 How would the error you described in question **04.4** affect the measured volume of the rock?

[1 mark]

9

4.3.1.1 Density of materials

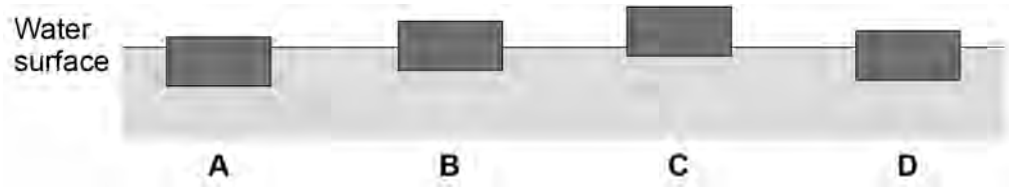
Question 06

June 2018 | 8463/2F | Original Q6

0 6 **Figure 7** shows four blocks of different materials floating on water.

The four blocks are the same volume.

Figure 7



0 6 . 1 Which of the blocks has the smallest weight?

Tick **one** box.

[1 mark]

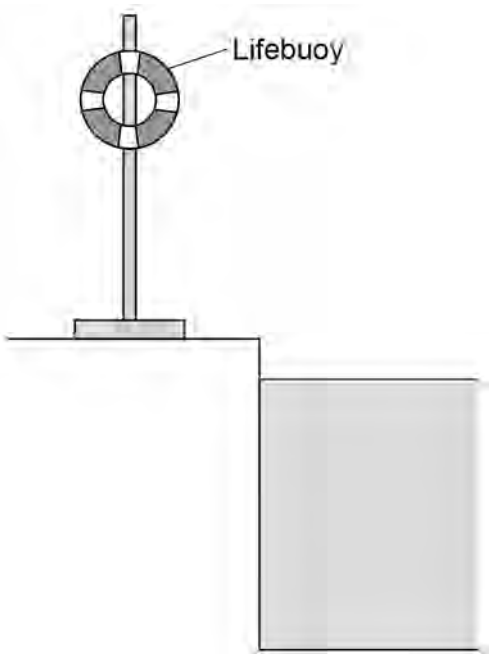
A ☐ **B** ☐ **C** ☐ **D** ☐

Question 6 continues on the next page

Question 06 · continued

Figure 8 shows a lifebuoy next to a deep swimming pool.

Figure 8



0 6 . 2 The lifebuoy has a mass of 2.5 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the lifebuoy.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

4.3.1.1 Density of materials

Question 06 · continued

0 6 . 3 When thrown into the water the lifebuoy floats. The two forces acting on the lifebuoy are the weight of the lifebuoy downwards and upthrust upwards.

How big is the upthrust on the lifebuoy compared to the weight of the lifebuoy?

Tick **one** box.

[1 mark]

The upthrust is greater than the weight. ☐

The upthrust is less than the weight. ☐

The upthrust is the same as the weight. ☐

0 6 . 4 Write down the equation which links acceleration, mass and resultant force.

[1 mark]

_____

0 6 . 5 A rope is used to pull the lifebuoy to the side of the swimming pool.

A resultant force of 4.0 N acts on the lifebuoy.

The mass of the lifebuoy is 2.5 kg.

Calculate the acceleration of the lifebuoy.

[3 marks]

_____

_____

_____

_____

Acceleration = _____ m/s^2

8

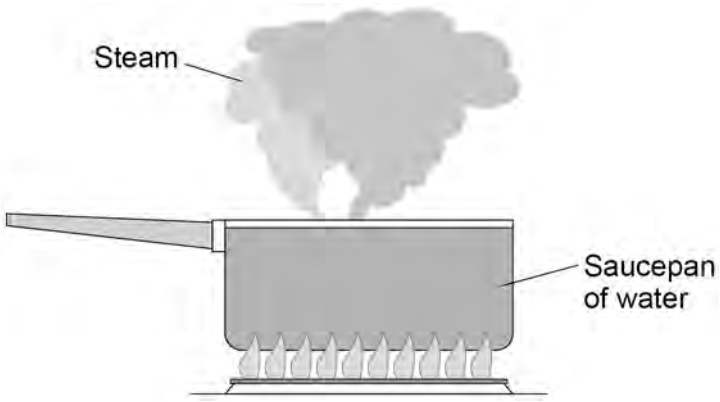
4.3.1.1 Density of materials

Question 07

June 2019 | 8463/1F | Original Q1

0 1 **Figure 1** shows water being heated. Eventually the water changed into steam.

Figure 1



0 1 . 1 Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

greater than	**less than**	**the same as**

The distance between the particles in steam is _____ the distance between the particles in liquid water.

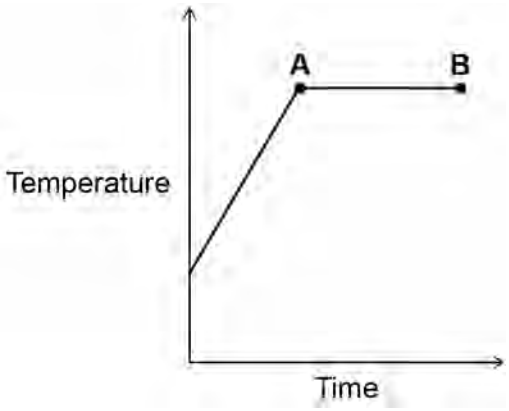
The density of steam is _____ the density of liquid water.

4.3.1.1 Density of materials

Question 07 · continued

Figure 2 shows how the temperature of the water varied with time.

Figure 2



0 1 . 2 What is the name of the process that is taking place between points **A** and **B**?

Give a reason for your answer.

[2 marks]

Process _____

Reason _____

_____

0 1 . 3 A mass of 0.063 kg of water was turned into steam.

The specific latent heat of vaporisation of water is 2 260 000 J/kg

Calculate the thermal energy transferred to the water to turn it into steam.

Use the equation:

thermal energy for a change of state = mass × specific latent heat

[2 marks]

_____

_____

_____

Energy = _____ J

4.3.1.1 Density of materials

Question 07 · continued

0 1 . 4 The mass of the steam was 0.063 kg

The volume of the steam was 0.105 m^3

Calculate the density of steam.

Use the equation:

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

Choose the unit from the box.

[3 marks]

kg	m^3 / kg	kg / m^3

Density = _____ Unit _____

9

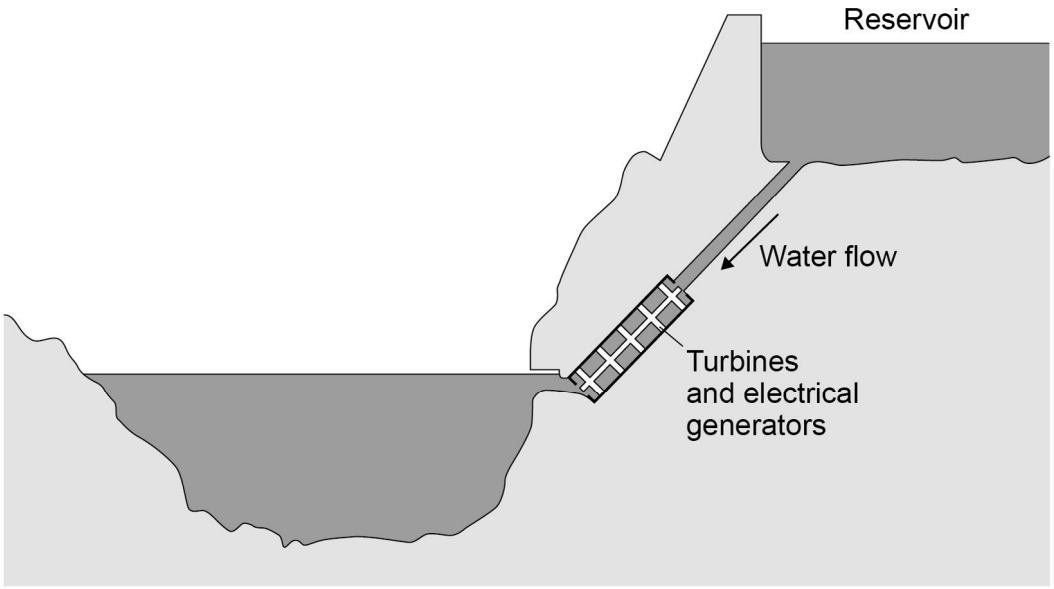
4.3.1.1 Density of materials

Question 08

November 2020 | 8463/1F | Original Q10

1 0 **Figure 14** shows a hydroelectric power station.

Figure 14



Electricity is generated when water from the reservoir flows through the turbines.

1 0 . 1 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

1 0 . 2 The reservoir stores 6 500 000 m^3 of water.

The density of the water is 998 kg/m^3.

Calculate the mass of water in the reservoir.

Give your answer in standard form.

[4 marks]

Mass (in standard form) = _____ kg

4.3.1.1 Density of materials

Question 08 · continued

1 0 . 3 Write down the equation which links energy transferred (E), power (P) and time (t).

[1 mark]

1 0 . 4 The electrical generators can provide 1.5×10^9 W of power for a maximum of 5 hours.

Calculate the maximum energy that can be transferred by the electrical generators.

[3 marks]

Energy transferred = _____ J

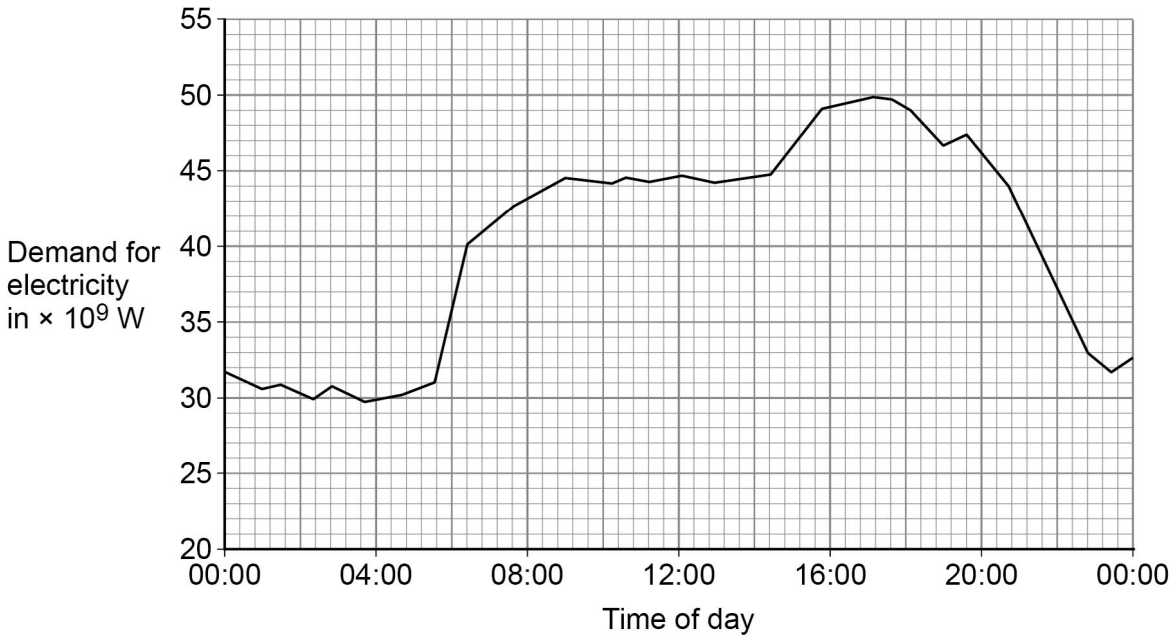
Question 10 continues on the next page

4.3.1.1 Density of materials

Question 08 · continued

1 0 . 5 **Figure 15** shows how the UK demand for electricity increases and decreases during one day.

Figure 15



The hydroelectric power station in **Figure 14** can provide 1.5×10^9 W of power for a maximum of 5 hours.

Give **two** reasons why this hydroelectric power station is not able to meet the increase in demand shown between 04:00 and 16:00 in **Figure 15**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

11

4.3.1.1 Density of materials

Question 09

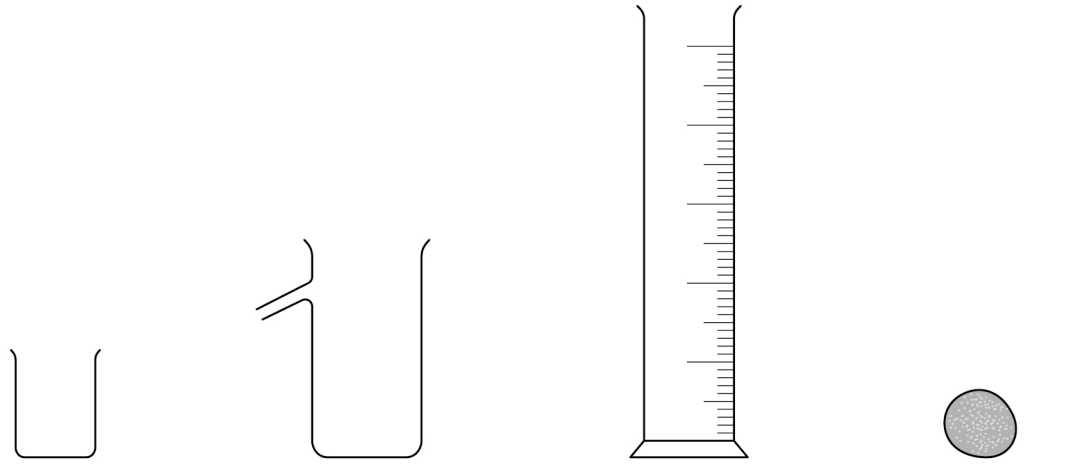
November 2021 | 8463/1F | Original Q3

0 3 A student investigated the density of different fruits.

To determine the density of each fruit, the student measured the volume of each fruit.

Figure 3 shows the equipment the student could have used.

Figure 3



0 3 . 1 Describe a method the student could have used to measure the volume of the lime.

[4 marks]

4.3.1.1 Density of materials

Question 09 · continued

0 3 . 2 The student measured the volume of each fruit three times and then calculated a mean value.

The three measurements for a grape were

2.1 cm^3 2.1 cm^3 2.4 cm^3

Calculate the mean value.

[2 marks]

Mean value = _____ cm^3

0 3 . 3 What are the advantages of taking three measurements and calculating a mean value?

[2 marks]

Tick (✓) **two** boxes.

- Allows anomalous results to be identified and ignored. ☐
- Improves the resolution of the volume measurement. ☐
- Increases the precision of the measured volumes. ☐
- Reduces the effect of random errors when using the equipment. ☐
- Stops all types of error when using the equipment. ☐

Question 3 continues on the next page

4.3.1.1 Density of materials

Question 09 · continued

0 3 . 4 The mass of an apple was 84.0 g.

The volume of the apple was 120 cm^3.

Calculate the density of the apple.

Give your answer in g/cm^3.

Use the equation:

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

[2 marks]

Density = _____ g/cm^3

10

4.3.1.1 Density of materials

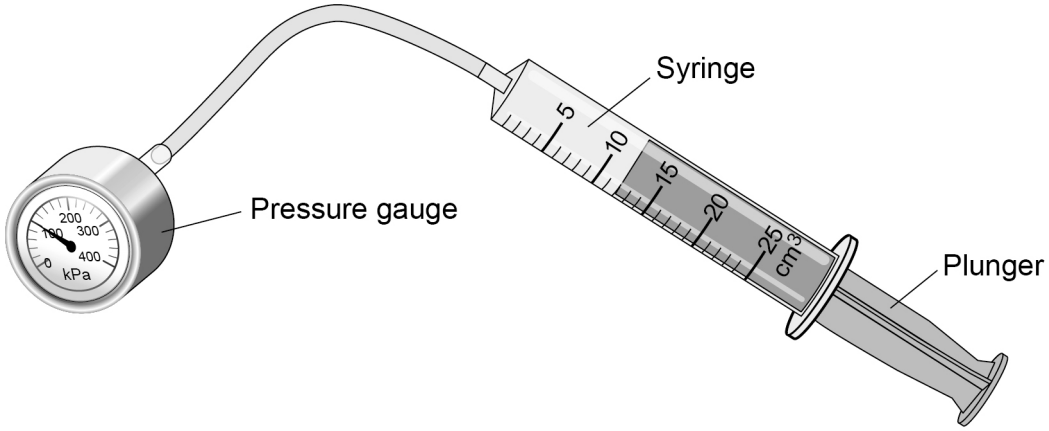
Question 10

November 2021 | 8463/1F | Original Q8

0 8 A teacher demonstrated the relationship between the pressure in a gas and the volume of the gas.

Figure 12 shows the equipment used.

Figure 12



0 8 . 1 What is the range of the syringe?

[1 mark]

Tick (✓) **one** box.

From 0 to 1 cm^3 ☐

From 0 to 5 cm^3 ☐

From 0 to 25 cm^3 ☐

0 8 . 2 The relationship between the pressure and volume of a gas is given by the equation:

pressure × volume = constant

Complete the sentence.

[1 mark]

For this equation to apply, both the mass of gas and the _____

of the gas must stay the same.

4.3.1.1 Density of materials

Question 10 · continued

0 8 . 3 The initial volume of the gas in the syringe was 12 cm^3.

The initial pressure of the gas in the syringe was 101 000 Pa.

Calculate the constant in the equation below.

pressure × volume = constant

[2 marks]

Constant = _____ Pa cm^3

0 8 . 4 The teacher pulled the plunger slowly outwards and the gas expanded.

The new volume of the gas was 24 cm^3.

Calculate the new pressure in the gas.

The constant has the same value as in Question **08.3**

[3 marks]

New pressure = _____ Pa

Question 8 continues on the next page

4.3.1.1 Density of materials

Question 10 · continued

0 8 . 5 Which change occurs when the plunger is pulled slowly outwards?

[1 mark]

Tick (✓) **one** box.

- The gas particles stop moving. ☐
- There are more frequent collisions between the gas particles. ☐
- There is more space between the gas particles. ☐

8

4.3.1.1 Density of materials

Question 11

June 2022 | 8463/1F | Original Q10

1 0 **Figure 14** shows a rock found by a student on a beach.

To help identify the type of rock, the student took measurements to determine its density.

Figure 14



1 0 . 1 Describe a method the student could use to determine the density of the rock.

[6 marks]

Question 11 · continued

The student determined the density of the rock to be 2.55 ± 0.10 g/cm^3.

10.2 What are the maximum and minimum values for the density of the rock?

[1 mark]

Maximum density = _____ g/cm^3

Minimum density = _____ g/cm^3

10.3 **Table 3** gives the density of five different types of rock.

Table 3

Type of rock	Density in g/cm^3
Basalt	2.90 ± 0.10
Chalk	2.35 ± 0.15
Flint	2.60 ± 0.10
Sandstone	2.20 ± 0.20
Slate	2.90 ± 0.20

Which two types of rock in **Table 3** could be the type of rock the student had?

[1 mark]

Tick (✓) **one** box.

- Basalt or chalk ☐
- Chalk or flint ☐
- Flint or sandstone ☐
- Sandstone or slate ☐

Question 10 continues on the next page

4.3.1.1 Density of materials

Question 11 · continued

10.4 The student only took one set of measurements to determine the density of the rock.

Explain why taking the measurements more than once may improve the accuracy of the density value.

[2 marks]

10

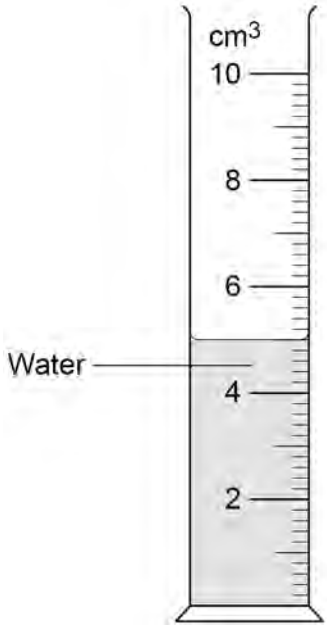
4.3.1.1 Density of materials

Question 12

June 2024 | 8463/1F | Original Q4

0 4 **Figure 8** shows a measuring cylinder containing some water.

Figure 8



0 4 . 1 What range of volumes can be measured using the measuring cylinder?

[1 mark]

Tick (✓) **one** box.

0.0 to 0.2 cm^3 ☐

0.0 to 2.0 cm^3 ☐

0.0 to 10.0 cm^3 ☐

Question 4 continues on the next page

4.3.1.1 Density of materials

Question 12 · continued

A student used the measuring cylinder to measure the volume of a metal ring.

0 4 . 2 The student tied the metal ring to some very thin string and lowered the ring into the measuring cylinder.

The student could have used thick string instead of thin string.

How would using thick string have affected the measured volume of the metal ring?

[1 mark]

Tick (✓) **one** box.

The measured volume would be smaller. ☐

The measured volume would not be affected. ☐

The measured volume would be larger. ☐

0 4 . 3 **Table 1** shows the results.

Table 1

Volume of water in cm^3	Volume of water and ring in cm^3	Volume of ring in cm^3
5.0	5.4	**X**

Calculate value **X** in **Table 1**.

[1 mark]

X = _____ cm^3

4.3.1.1 Density of materials

Question 12 · continued

0 4 . 4 The student measured the volume of the ring three times.

The results were all the same.

Which of the following describes the student's results?

[1 mark]

Tick (✓) **one** box.

The results are anomalies. ☐

The results are repeatable. ☐

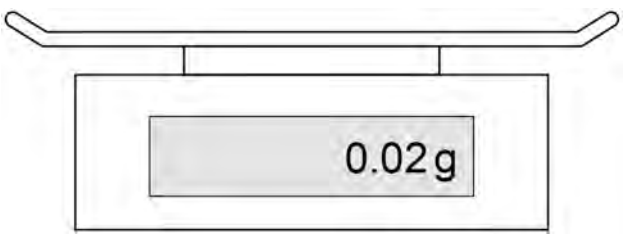
The results contain random errors. ☐

Question 4 continues on the next page

0 4 . 5 The student used a balance to measure the mass of the ring.

Figure 9 shows the balance.

Figure 9



The student noticed that the balance had a reading of 0.02 g when there was no object on the balance.

How should the student correct this error **after** the mass of the ring had been measured?

[1 mark]

Tick (✓) **one** box.

- Add 0.02 to the measurement ☐
- Divide the measurement by 0.02 ☐
- Multiply the measurement by 0.02 ☐
- Subtract 0.02 from the measurement ☐

4.3.1.1 Density of materials

Question 12 · continued

Use the Physics Equations Sheet to answer questions **04.6** and **04.7**.

0 4 . 6 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

0 4 . 7 A different metal ring has a volume of 0.3 cm^3.

The density of this ring is 22 g/cm^3.

Calculate the mass of this ring.

Give your answer in grams.

[3 marks]

Mass = _____ g

9

4.3.1.1 Density of materials

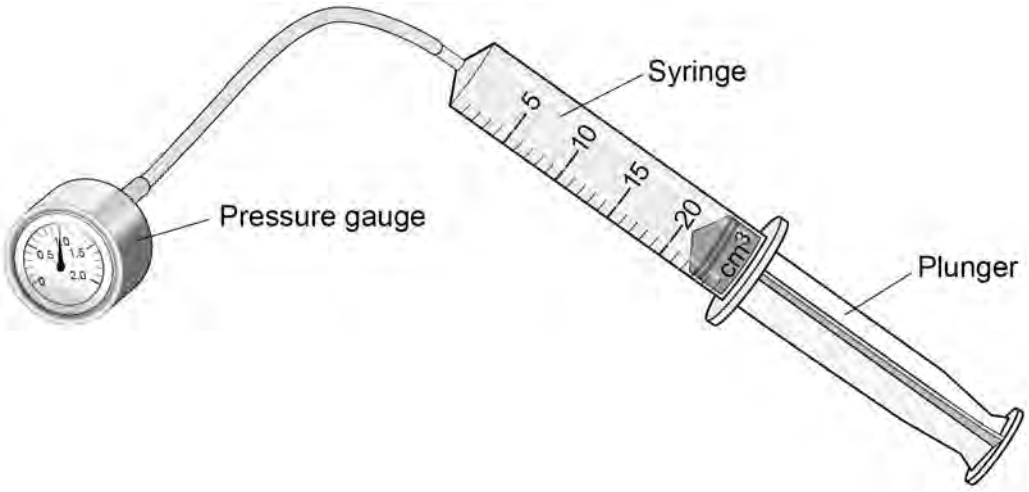
Question 13

June 2024 | 8463/1F | Original Q5

0 5 A student investigated how the pressure in a fixed mass of air varies with the volume of the air.

Figure 10 shows the equipment used.

Figure 10



When the plunger was pushed slowly into the syringe, the temperature of the air stayed the same.

0 5 . 1 How did pushing the plunger in affect the volume of air in the syringe?

[1 mark]

Tick (✓) **one** box.

The volume decreased. ☐

The volume stayed the same. ☐

The volume increased. ☐

4.3.1.1 Density of materials

Question 13 · continued

0 5 . 2 How did pushing the plunger in affect the distance between the air particles in the syringe?

[1 mark]

Tick (✓) **one** box.

The distance decreased. ☐

The distance stayed the same. ☐

The distance increased. ☐

0 5 . 3 How did pushing the plunger in affect the frequency of collisions between the air particles and the syringe walls?

[1 mark]

Tick (✓) **one** box.

The frequency of collisions decreased. ☐

The frequency of collisions stayed the same. ☐

The frequency of collisions increased. ☐

0 5 . 4 How did pushing the plunger in affect the air pressure in the syringe?

[1 mark]

Tick (✓) **one** box.

The air pressure decreased. ☐

The air pressure stayed the same. ☐

The air pressure increased. ☐

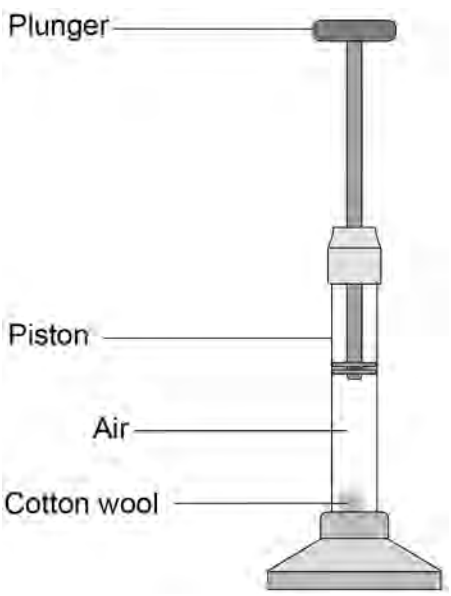
4.3.1.1 Density of materials

Question 13 · continued

A fire piston is a special type of syringe that can be used to start fires.

Figure 11 shows a fire piston.

Figure 11



The plunger is pushed quickly downwards and compresses the air.

When the air is compressed quickly, the temperature of the air increases.

0 5 . 5 How does an increase in temperature affect the mean speed of the air particles inside the syringe?

[1 mark]

Tick (✓) **one** box.

The mean speed of the particles decreases. ☐

The mean speed of the particles does not change. ☐

The mean speed of the particles increases. ☐

4.3.1.1 Density of materials

Question 13 · continued

0 5 . 6 When the air is hot enough, a small piece of cotton wool in the piston catches fire.

The energy transferred to the air in the piston is 0.0130 J.

The mass of air in the piston is 2.60×10^{-8} kg.

specific heat capacity of air = 1010 J/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.

[3 marks]

Temperature change = _____ °C

8

4.3.1.1 Density of materials

Question 14

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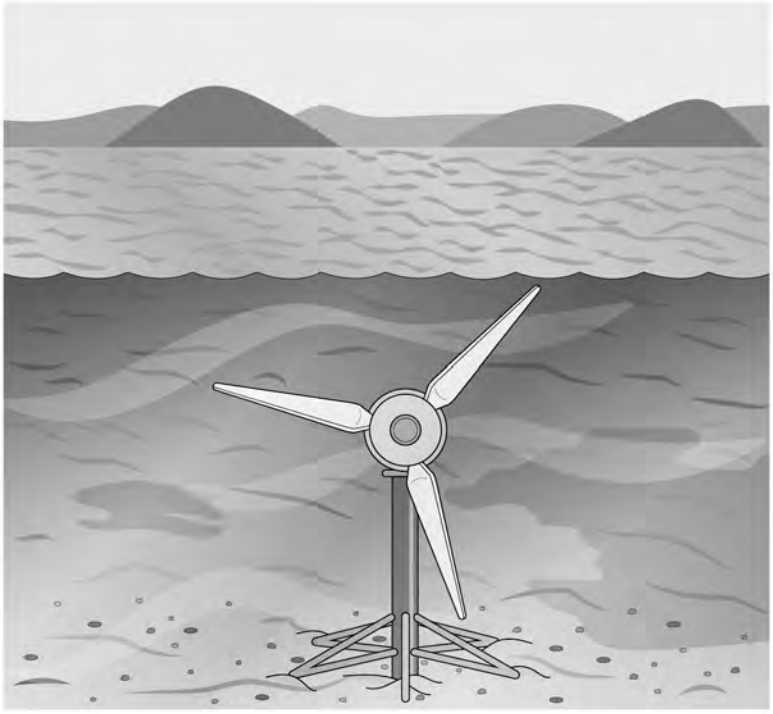
0 8 Tides and wind are two renewable energy resources.

0 8 . 1 Describe the difference between renewable energy resources and non-renewable energy resources.

[2 marks]

Figure 14 shows a new design of tidal turbine to generate electricity using the tides.

Figure 14



4.3.1.1 Density of materials

Question 14 · continued

Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

0 8 . 2 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

0 8 . 3 The mass of seawater passing through the tidal turbine each second is 824 000 kg.

The density of seawater is 1030 kg/m^3.

Calculate the volume of seawater passing through the tidal turbine each second.

[3 marks]

Volume = _____ m^3

Question 8 continues on the next page

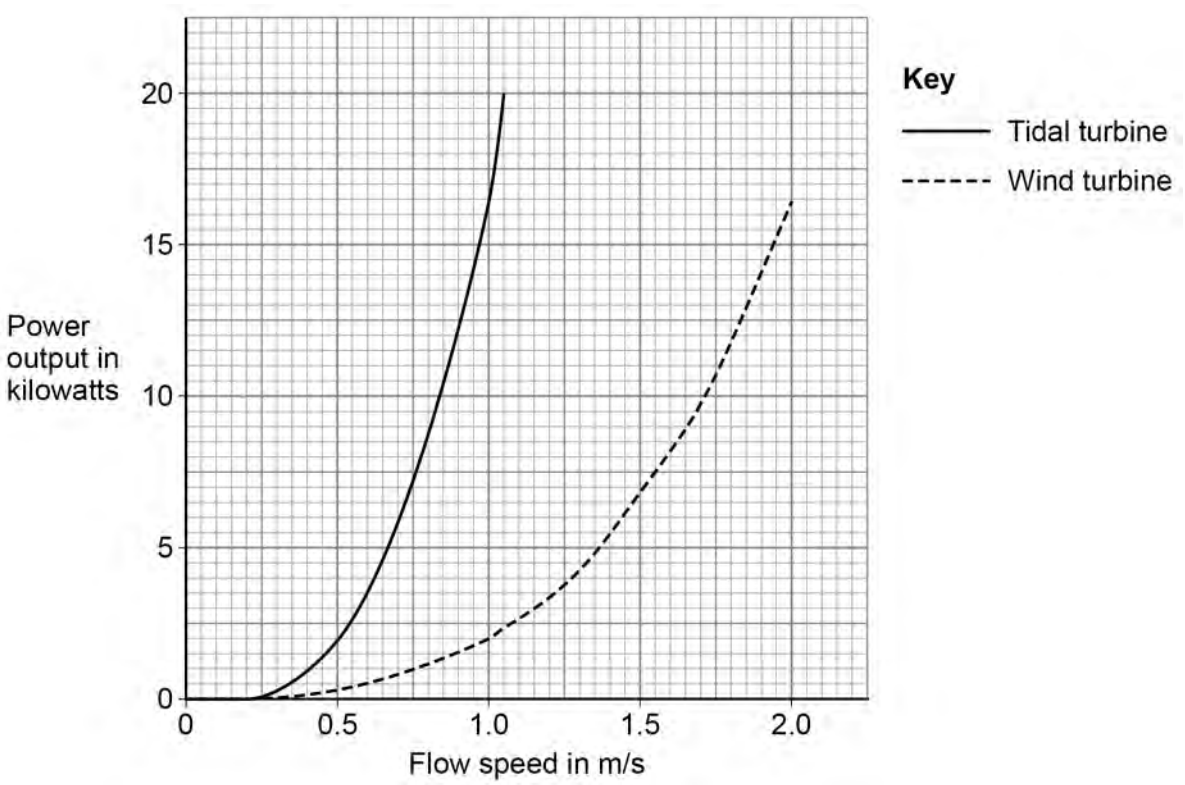
4.3.1.1 Density of materials

Question 14 · continued

The speed of the tide or the speed of the wind past a turbine is called the 'flow speed'.

Figure 15 shows how the power output of a tidal turbine compares with a wind turbine for different flow speeds.

Figure 15



0 8 . 4 As flow speed increases, power output increases.

Give **two** other conclusions that can be made using information from **Figure 15**.

[2 marks]

1 _____

_____

2 _____

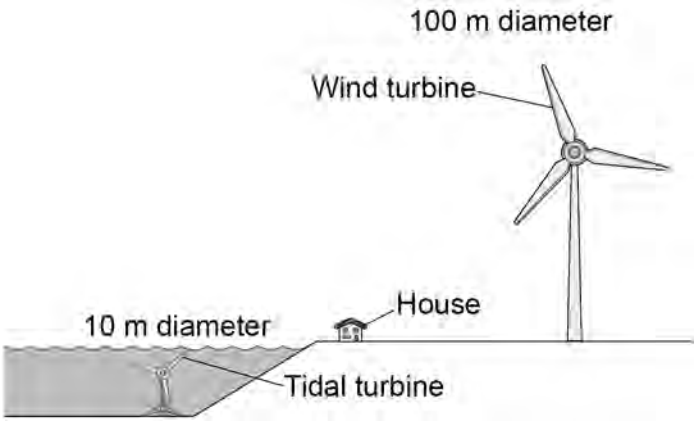
_____

4.3.1.1 Density of materials

Question 14 · continued

0 8 . 5 **Figure 16** shows the turbines used to obtain the data for **Figure 15**.

Figure 16



Compare the environmental impacts of the wind turbine and the tidal turbine in **Figure 16**.

[4 marks]

12