

8300

GCSE MATHEMATICS

Foundation and Higher tier– Questions by Topic

Ratio, proportion and rates of change

Calculating with density and pressure

v1.0

Name _____

Materials

For this paper you must have:

- Mathematical instruments

Information

- The marks for questions are shown in brackets

Advice

- In all calculations, show clearly how you work out your answer

For questions 1 to 3 you must **NOT** use a calculator.



Q1.

A solid has volume 300 cm^3 and density 2 g/cm^3

Circle the mass of the solid.

150 g

298 g

302 g

600 g

(Total 1 mark)

Q2.

The air pressure in a tyre measures 7.2 bar.

Air is leaking out at the rate of 0.2 bar per day.

(a) Assume that the air continues to leak at the same rate.

After how many days will the pressure measure 4.8 bar?

(2)

(b) In fact, the rate that the air leaks out increases each day.

How does this affect your answer to part (a)?

(1)

(Total 3 marks)

Question 3 is **higher** tier only.

Q3.

Which **one** of these is a unit of density?

Circle your answer.

cm^2/g

cm^3/g

g/cm^2

g/cm^3

(Total 1 mark)

For the rest of the questions, you may use a calculator.



Q4.

The metal used to make a sphere costs £4320

The metal costs £3.60 per gram.

Each cubic centimetre of metal has a mass of 17.3 grams.

Work out the radius, r , of the sphere.

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

(Total 4 marks)

Q5.

Two objects, J and K, are applying pressure to areas of ground.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

For J, the force is 18.9 newtons and the area is 0.45 m^2

pressure for J : pressure for K = 7 : 8

area for J : area for K = 9 : 5

Work out the force for K.

(Total 4 marks)

Q6.

The heel of a shoe exerts a pressure of 198 pounds per square inch.
Convert this pressure into kilograms per square centimetre.

Use: 1 pound = 0.45 kilograms
1 square inch = 6.25 square centimetres

(Total 3 marks)

Q7.

A solid piece of silver has
mass 2.625 kilograms
volume 250 cm³

Work out the density of the piece of silver.
Give your answer in grams per cubic centimetre.

(Total 2 marks)

Q8.

Town A has
a population of 84 000
an area of 7 **square miles**.

Town B has a population density of 4695 people per **square kilometre**.

$$\text{Population density} = \frac{\text{population}}{\text{area}}$$

Which town has the greater population density?

Use 1 square mile = 2.6 square kilometres

Tick **one** box.

Town A

☐

Town B

☐

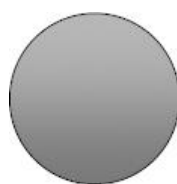
Show working to support your answer.

(Total 3 marks)

Q9.

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

A steel sphere, radius 3 cm, is shown.



(a) Work out the volume of the sphere.

(2)

(b) The density of the steel is 5.2 grams/cm³
Work out the mass of the sphere.

(2)

(Total 4 marks)

Q10.

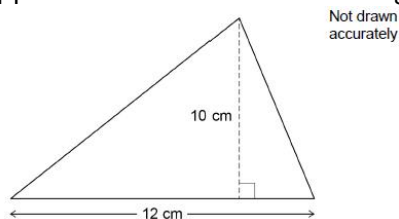
In this question use
1 pound = 0.4536 kilograms
1 inch = 2.54 centimetres

The density of concrete is 0.09 pounds per cubic inch.
Work out this density in grams per cubic centimetre.

(Total 4 marks)

Q11.

A force of 180 newtons (N) is applied to the surface of this triangle.



Work out the pressure.

$\text{pressure} = \frac{\text{force}}{\text{area}}$

Use $\text{pressure} = \frac{\text{force}}{\text{area}}$

(Total 3 marks)

Q12.

Two solids, J and K, have the same density.

Complete the table.

Include units in your answers.

	J	K
Mass	48 g	78 g
Volume	8 cm ³	
Density		

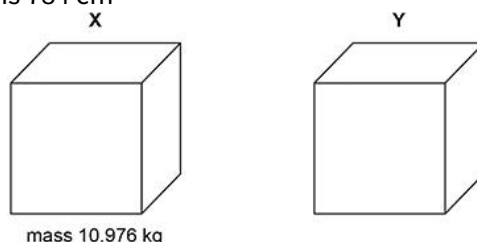
(Total 3 marks)

Q13.

Here are two solid cubes, X and Y.

The mass of X is 10.976 kg

The area of **each face** of X is 784 cm²



mass 10.976 kg

(a) Zayan wants to know the density of Y.

He assumes that Y is identical to X.

What density should he get for Y?

Give your answer in **grams per cubic centimetre**.

(4)

(b) In fact,

the mass of Y is less than the mass of X

the area of each face of Y is greater than the area of each face of X.

What does this mean about the actual density of Y?

Tick **one** box.

☐
☐
☐
☐

It is less than the answer to part (a)

It is equal to the answer to part (a)

It is greater than the answer to part (a)

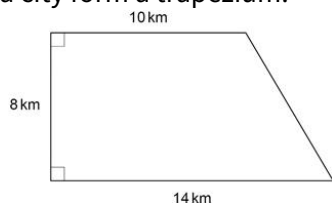
It is not possible to tell

(1)

(Total 5 marks)

Q14.

The boundaries of a city form a trapezium.



Not drawn
accurately

$$\text{Population density} = \frac{\text{number of people}}{\text{area}}$$

The population density of the city is 9450 people per square kilometre.
Work out the number of people who live in the city.

(Total 4 marks)

Q15.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the **force** when the pressure is 24 N/m^2 and the area is 3 m^2

0.125 N

8 N

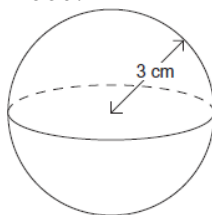
27 N

72 N

(Total 1 mark)

Q16.

The diagram shows a sphere made of wood.



The radius of the sphere is 3 cm

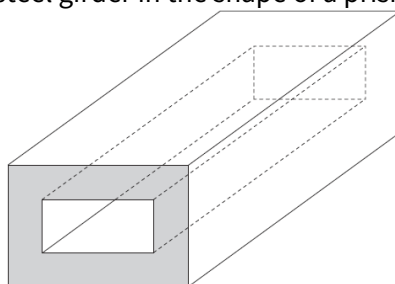
The mass of the sphere is 85 grams.

Work out the density of the wood.

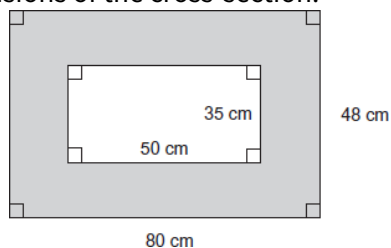
(Total 3 marks)

Q17.

The diagram shows a hollow steel girder in the shape of a prism.



The diagram shows the dimensions of the cross-section.



The length of the girder is 20 metres.

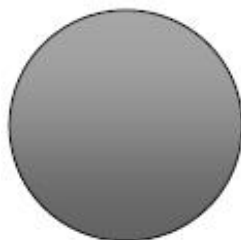
The density of the steel is 7.9 tonnes per cubic metre.

Work out the mass of the girder.

(Total 4 marks)

Q18.

Volume of a sphere = $\frac{4}{3} \pi r^3$
 A steel sphere, radius 9 cm, is shown.



(a) Work out the volume of the sphere.

(2)

(b) The density of the steel is 7.8 grams/cm³
 Work out the mass of the sphere.

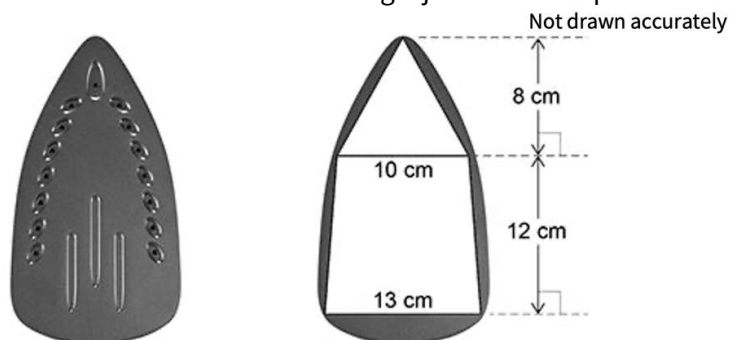
(2)

(Total 4 marks)

Q19.

Ralf has an iron.

He models the base as a triangle joined to a trapezium.



(a) The iron applies a force of 25 newtons (N)

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the pressure using Ralf's model.

(4)

(b) Is the actual pressure greater than, equal to or less than your answer to part (a)?
 Tick **one** box.

☐

greater than

☐

equal to

☐

less than

Give a reason for your answer.

(2)

(Total 6 marks)

Q20.

A solid statue has volume 512 cm³
 The statue has mass 3.6 kilograms.

density of iron = 7.87 grams per cubic centimetre

Is the statue made of iron?

You **must** show your working.

(Total 3 marks)

Q21.

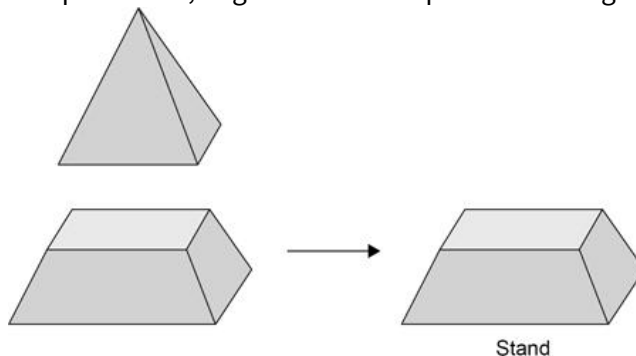
A solid trophy consists of a stand and a player.



Trophy

The stand is made by removing a small pyramid from a large pyramid.

Large pyramid	Square base, edge 8 cm	Perpendicular height 16 cm
Small pyramid	Square base, edge 5 cm	Perpendicular height 10 cm



$$\text{Volume of a pyramid} = \frac{1}{3} \times \text{area of base} \times \text{perpendicular height}$$

- (a) Show that the volume of the **stand** is 258 cm³

(2)

- (b) The trophy is made from a metal of density 7.5 grams per cm³
The **total** mass of the trophy is 2340 grams.
Work out the volume of the **player**.

(2)

(Total 4 marks)

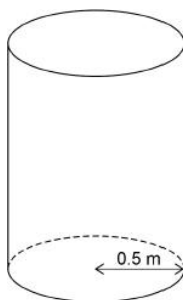
Questions 22 to 31 are **higher** tier only.

Q22.

Some concrete has volume 3.8 m³

- (a) The density of the concrete is 2400 kg/m³
Work out the mass of the concrete.
- (b) The 3.8 m³ of concrete is made into the shape of a cylinder.
The base has radius 0.5 metres.

(2)



Work out the height of the cylinder.

(2)

(Total 4 marks)

Q23.

Three items were bought at a car boot sale.

Item A
Mass = 9.5 grams
Volume = 2 cm³

Item B
Mass = 57 grams
Volume = 3 cm³

Item C
Mass = 76 grams
Volume = 4 cm³

The density of gold is **approximately** 19 grams per cm³.

Which item or items **cannot** be gold?

You **must** show your working.

(Total 4 marks)

Q24.

In this question use

1 pound = 0.4536 kilograms

1 inch = 2.54 centimetres.

The pressure of a basketball is 7.5 pounds per square inch.

Work out this pressure in grams per square centimetre.

(Total 4 marks)

Q25.

Jack is making spheres out of clay.

A box of clay contains 25 packs.

Each pack is a cuboid measuring 10 cm by 10 cm by 4 cm.

(a) How many spheres of radius 6 cm can Jack make from a **box** of clay?

(6)

(b) A **pack** of clay has a mass of 500 grams.

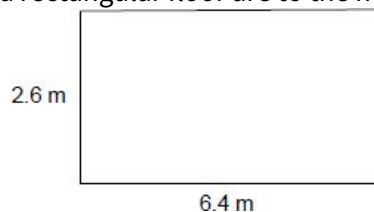
Work out the density of the clay.

(2)

(Total 8 marks)

Q26.

The dimensions of a rectangular floor are to the nearest 0.1 metres.



Not drawn
accurately

A force of 345 Newtons is applied to the floor.

The force is to the nearest 5 Newtons.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the upper bound of the pressure.

Give your answer to 4 significant figures.

You **must** show your working.

(Total 5 marks)

Q27.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

A force of 40 Newtons is applied to an area of 3.2 square metres.
Work out the pressure.
Give the units of your answer.

(Total 2 marks)

Q28.

The pressure in a tyre is 30 pounds per square inch.
Convert the pressure into kilograms per square centimetre.

Use 1 pound = 0.45 kilograms
and
1 inch = 2.54 centimetres

(Total 3 marks)

Q29.

Which **one** of these is a unit of density?

kg/m²

m²/kg

kg/m³

m³/kg

(Total 1 mark)

Q30.

The volume of a medal is 45 cm³
The medal is made from copper and tin.

volume of copper : volume of tin = 22 : 3

The density of copper is 8.96 g / cm³

The density of tin is 7.31 g / cm³

Work out the mass of the medal.

(Total 4 marks)

Q31.

A town has
a population density of 278 people per km²
and
a population of 158 460

$$\text{population density} = \frac{\text{population}}{\text{area}}$$

The population increases to 168 720
Work out the population density after the increase.

(Total 3 marks)