

Speed, density and pressure

Exam questions

Foundation and Higher tiers

Please write clearly in block capitals.

Name

Class

Teacher

Time allowed: 145 minutes

Materials

For this booklet you need a black pen, a pencil, a ruler, a rubber and a calculator for Section B.

Instructions

- Use black ink or black ballpoint pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer all questions in the spaces provided.
- **Section A** (questions 1 to 11): you must not use a calculator.
- **Section B** (questions 12 to 36): you may use a calculator.
- Do all rough work in this booklet. Cross through any work you do not want marked.

Information

- The marks for each question are shown in brackets.
- The maximum mark for this booklet is 127.

Advice

- Read each question carefully.
- In all calculations, show clearly how you work out your answer.

For teacher's use

Q	Mark	Q	Mark
1		19	
2		20	
3		21	
4		22	
5		23	
6		24	
7		25	
8		26	
9		27	
10		28	
11		29	
12		30	
13		31	
14		32	
15		33	
16		34	
17		35	
18		36	
TOTAL			

Section A**You must not use a calculator**Do not
write
outside
the box

- 1** A train travels 150 miles in 2 hours 30 minutes

Work out the average speed of the train.

Answer _____ mph

[2 marks]

- 2** Washing-up liquid is sold in two sizes.

Small	Large
1.5 litres £4.20	2.5 litres £6.75

Which size is better value?

You must show your working.

[3 marks]

- 3** Leo runs 400 metres in 1 minute 20 seconds
He works out his speed in metres per second like this.

$400 \div 1.20 = 333$
My speed is 333 metres per second.

- (a)** Explain the mistake Leo has made.

[1 mark]

- (b)** Work out Leo's correct speed in metres per second.

Answer _____ m/s

[2 marks]

- 4** A bath holds 150 litres of water.
Tap A fills the bath at 12 litres per minute
Tap B fills the bath at 8 litres per minute

The bath is empty. Both taps are turned on at the same time.

How long does it take to fill the bath?

Give your answer in minutes and seconds.

Answer _____

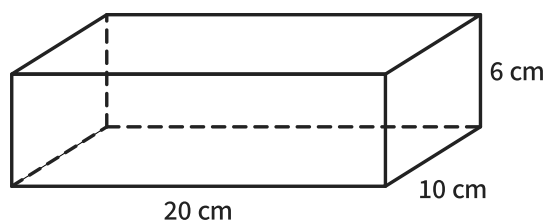
[3 marks]

5

A block of oak is a cuboid.

The density of oak is 0.75 g/cm^3

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



Not drawn accurately

Work out the mass of the block.

Answer _____ g

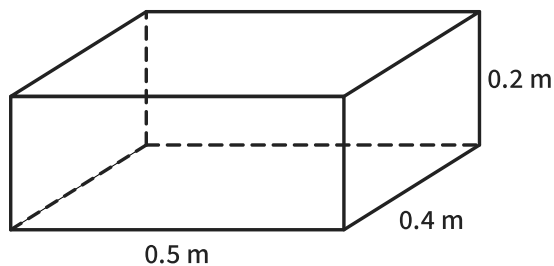
[3 marks]

Do not
write
outside
the box

6

A box is a cuboid. The box pushes on the floor with a force of 120 newtons

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



Not drawn accurately

The box can rest on any of its faces.

Work out the greatest pressure the box can put on the floor.

Give the units of your answer.

Answer _____

[3 marks]

7

Car A leaves a town at 09:00 and travels at a constant speed of 48 km/h

Car B leaves the same town at 09:15 and travels along the same road at a constant speed of 64 km/h

At what time does car B catch up with car A?

Answer _____

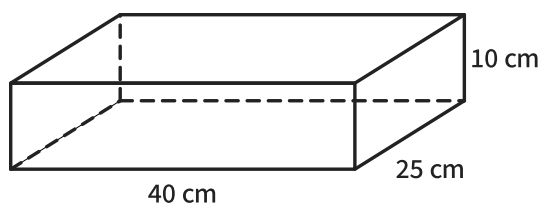
[4 marks]

Do not
write
outside
the box

- 8 A solid block is a cuboid 40 cm by 25 cm by 10 cm

When it rests on its largest face, the pressure on the table is 600 N/m^2

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



Not drawn accurately

The block is turned so that it rests on its smallest face.

Work out the pressure on the table now.

Answer _____ N/m^2

[3 marks]

- 9 Dev cycles from his home to a lake at an average speed of 18 km/h
He cycles back home along the same route at an average speed of 12 km/h

Show that his average speed for the whole trip is 14.4 km/h

[3 marks]

Do not
write
outside
the box

10

Liquid P has a density of 0.8 g/cm^3

Liquid Q has a density of 1.2 g/cm^3

Some of liquid P and some of liquid Q are mixed.

The mixture has a density of 0.95 g/cm^3

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

Work out the ratio volume of P : volume of Q

Give your answer in its simplest form.

Answer _____

[4 marks]

11

At an airport there is a moving walkway.

When Sana stands still on the walkway, it takes her 90 seconds to travel its full length.

When she walks along the moving walkway, it takes her 36 seconds.

Sana walks at the same speed on the floor beside the walkway.

How long does it take her to walk the same length?

Answer _____ seconds

[3 marks]

Section B

You may use a calculator

Do not
write
outside
the box

- 12** Mia is paid £11.44 an hour for the first 35 hours she works each week.
For every hour after that she is paid time and a half.
One week Mia works 41 hours

Work out how much Mia is paid for this week.

Answer £ _____

[3 marks]

- 13** A cable car travels at a constant speed of 5.6 metres per second.
One trip takes 4 minutes 15 seconds.

Work out the distance the cable car travels on one trip.
Give your answer in kilometres.

Answer _____ km

[3 marks]

- 14** A ferry leaves a harbour at 10:50
It travels 38 km at an average speed of 24 km/h

At what time does the ferry arrive?

Answer _____

[3 marks]

- 15** A jeweller has a 50 g bar of silver.
The density of silver is 10.49 g/cm^3
Each pendant she makes uses 0.62 cm^3 of silver.

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

Work out the greatest number of pendants she can make from the bar.

Answer _____

[3 marks]

- 16** Zainab's car uses 6.4 litres of petrol for every 100 km it travels.
Petrol costs 142.9p per litre.
Zainab drives 275 km.

Work out the cost of the petrol she uses.
Give your answer in pounds.

Answer £ _____

[3 marks]

- 17** Two delivery drones are tested.

	Distance	Time
Drone A	7.8 km	13 minutes
Drone B	9.5 km	16 minutes

Which drone has the greater average speed?
You must show your working.

[3 marks]

- 18** Ama is paid £12.21 for each hour she works.
Olu is paid £24 650 a year.
Olu works 37.5 hours a week for 52 weeks a year.

Who is paid more for each hour they work?
You must show your working.

[3 marks]

- 19** A printer prints 38 pages per minute.
Nadia prints 25 copies of a booklet.
Each booklet has 46 pages.
- How long does the printer take to print all the copies?
Give your answer in minutes and seconds, to the nearest second.

Answer _____

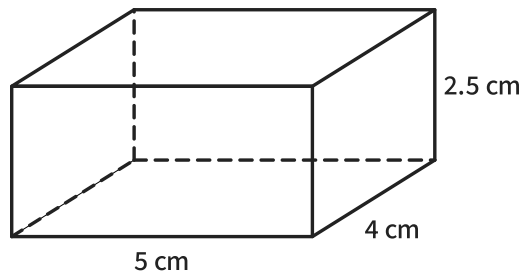
[3 marks]

20

A metal block is a cuboid. Its mass is 525 g

Metal	Aluminium	Iron	Copper	Silver
Density (g/cm ³)	2.7	7.9	9.0	10.5

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



Not drawn accurately

Which metal is the block made from?

You must show your working.

Answer _____

[3 marks]

21

Ravi drives 45 km at an average speed of 60 km/h

He then drives a further 30 km in 40 minutes

Work out his average speed for the whole journey.

Give your answer to 1 decimal place.

Answer _____ km/h

[4 marks]

22

A crate stands on a stage.

The base of the crate is a rectangle 1.2 m long and 0.75 m wide.

The crate pushes down on the stage with a force of 850 newtons.

The stage is safe for any pressure up to 1000 N/m^2

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

- (a) Work out the pressure the crate puts on the stage.
Give your answer to 3 significant figures.

Answer _____ N/m^2

[2 marks]

- (b) A speaker is put on top of the crate.
The speaker pushes down with a force of 260 newtons.
Is the stage still safe?
You must show your working.

[2 marks]

23

Amira cycles at a constant speed of 32 km/h

Theo rides a scooter at a constant speed of 9.2 m/s

Who is travelling faster?

You must show your working.

[3 marks]

- 24** A candle is a solid cylinder of wax with radius 3.5 cm
 The density of the wax is 0.9 g/cm^3
 The mass of the candle is 520 g

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

Work out the height of the candle.
 Give your answer to 1 decimal place.

Answer _____ cm

[3 marks]

- 25** A force of 45 newtons acts on an area of $A \text{ cm}^2$
 The pressure is 1800 N/m^2

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

Work out the value of A .

$A =$ _____

[3 marks]

- 26** 300 cm³ of syrup is mixed with 1.2 litres of water to make a drink.
 The density of the syrup is 1.3 g/cm³
 The density of the water is 1 g/cm³
 1 litre = 1000 cm³

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

Work out the density of the drink.

Answer _____ g/cm³

[4 marks]

- 27** A water butt is a cylinder with radius 28 cm and height 85 cm
 The water butt is empty.
 It is filled with water from a hose at a rate of 9.5 litres per minute.
 1 litre = 1000 cm³

How long does it take to fill the water butt?

Give your answer in minutes and seconds, to the nearest second.

Answer _____

[4 marks]

28

Rain falls on a flat roof.

The roof is a rectangle 8.5 m long and 6.2 m wide.

All the rain that falls on the roof runs into a tank.

The tank holds 1000 litres. It already has 120 litres of water in it.

Rain falls at a rate of 7.2 mm per hour for 2 hours 30 minutes.

$1 \text{ m}^3 = 1000 \text{ litres}$

Will the tank overflow?

You must show your working.

[4 marks]**29**

Priya drives 150 km.

Her journey takes 2 hours 15 minutes, including a stop of 20 minutes.

She drives the first 85 km at an average speed of 72 km/h

Work out her average speed for the rest of the journey.

Give your answer to 1 decimal place.

Answer _____ km/h

[4 marks]

30

A factory makes 50 solid copper rods.

Each rod is a cylinder with radius 1.5 cm and length 12 cm

The density of copper is 8.96 g/cm^3

Copper costs £7.40 per kilogram.

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

Work out the cost of the copper needed for the 50 rods.

Answer £ _____

[5 marks]

31

Brass is made from copper and zinc.

The ratio of the mass of copper to the mass of zinc is 13 : 7

The density of copper is 8.96 g/cm^3

The density of zinc is 7.13 g/cm^3

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

Work out the density of the brass.

Give your answer to 3 significant figures.

Answer _____ g/cm^3

[4 marks]

32

A solid metal cone has radius 4 cm and perpendicular height 9 cm

The density of the metal is 7.85 g/cm^3

The cone is melted down. The metal is used to make as many solid spheres of radius 1.2 cm as possible.

$\text{volume of a cone} = \frac{1}{3}\pi r^2 h$	$\text{volume of a sphere} = \frac{4}{3}\pi r^3$
--	--

Work out the mass of the metal left over.

Give your answer to 3 significant figures.

Answer _____ g

[5 marks]

33

Water flows through a pipe into an empty tank.

The pipe is a cylinder with internal diameter 2.4 cm

The water flows along the pipe at 1.5 metres per second.

The tank holds 500 litres.

1 litre = 1000 cm^3

How long does it take to fill the tank?

Give your answer in minutes and seconds, to the nearest second.

Answer _____

[4 marks]

34

A concrete post is a solid cylinder with radius 0.4 m and height 1.5 m

It stands on one of its circular faces on flat ground.

The density of the concrete is 2400 kg/m^3

The force, in newtons, the post puts on the ground is its mass in kg $\times 9.8$

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

- (a) Work out the pressure the post puts on the ground.
Give your answer to 3 significant figures.

Answer _____ N/m^2

[4 marks]

- (b) A second post is made from the same concrete.
It has the same height but twice the radius.
Jack says,
“The second post puts 4 times the pressure on the ground.”
Is Jack correct?
Give a reason for your answer.

[1 mark]

35

Two signals on a railway line are 2.4 km apart, correct to 1 decimal place.

A train takes 55 seconds, correct to the nearest second, to travel from one signal to the other.

The driver says,

“My average speed between the signals was definitely less than 160 km/h”

Is the driver right?

You must show your working.

[4 marks]

36

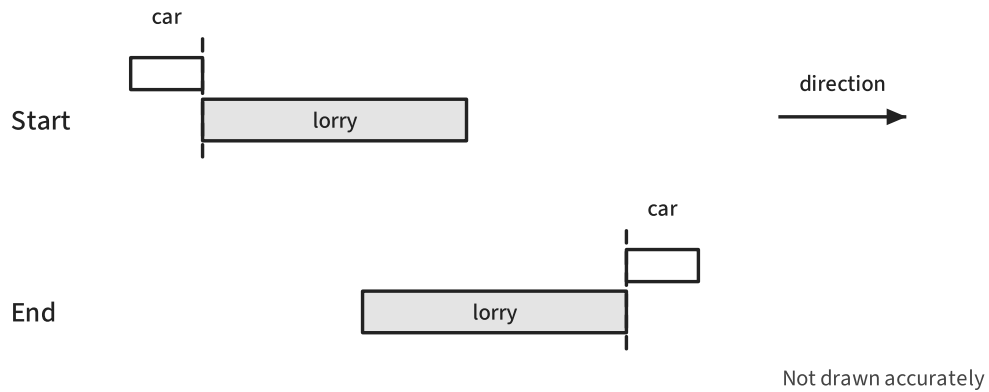
A lorry is 16.5 m long. It travels at a constant 80 km/h

A car is 4.5 m long. It travels at a constant 96 km/h in the next lane.

The car overtakes the lorry.

The overtaking starts when the front of the car is level with the back of the lorry.

It ends when the back of the car is level with the front of the lorry.



- (a) Work out the time the overtaking takes.
Give your answer in seconds to 1 decimal place.

Answer _____ seconds

[4 marks]

- (b) Work out the distance the car travels while it is overtaking.

Answer _____ m

[2 marks]

END OF QUESTIONS