

Worksheet: Speed, density, pressure and best buys · Calculator

TIME 35 min	TOTAL 30 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium, Hard, Extreme
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Topics: Speed, density, pressure and best buys

DATE _____

- Use black ink or ball-point pen.
- Answer all questions. Answer the questions in the spaces provided – there may be more space than you need.
- Calculators may be used. If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.
- Diagrams are NOT accurately drawn, unless otherwise indicated.
- You must show all your working.

1

Jon runs at an average speed of 12 km/h.

Who runs at the greater average speed?

You must show your working.

(3)

(Total for Question 1 is 3 marks)

2

A coach travels for 2 hours 30 minutes at an average speed of 70 km/h.
Work out the distance travelled.

..... km

(2)

(Total for Question 2 is 2 marks)

3

A speedboat can travel at 30 m/s.
A car is driven at 95 km/h.
Which is faster? You must show how you get your answer.

(3)

(Total for Question 3 is 3 marks)

4

Harry travels to a festival by train and then by bus.

For the first 40 minutes, Harry travels by train at an average speed of 90 km/h.

The rest of the journey is 40 km, which Harry travels by bus at an average speed of 30 km/h.

Work out Harry's average speed for the whole journey.

..... km/h

(4)

(Total for Question 4 is 4 marks)

5

A solid cuboid measures 50 cm by 40 cm by 10 cm.

The cuboid rests on a horizontal table with its largest face on the table.

The pressure on the table is 2300 N/m^2 .

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

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

Work out the new pressure on the table.

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..... N/m^2

(4)

(Total for Question 5 is 4 marks)

6

A box rests on the floor. The box presses on the floor with a force of 175 N, over an area of 25 cm².

Work out the pressure on the floor in N/m².

..... N/m²

(3)

(Total for Question 6 is 3 marks)

7

Kofi cycles 30 km from home to a lake at an average speed of 15 km/h.

Kofi then cycles back home along the same route.

Kofi wants the average speed for the whole journey there and back to be 18 km/h.

Work out the average speed Kofi must cycle at on the way back.

This image shows a full page of white paper with ten horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

..... km/h

(5)

(Total for Question 7 is 5 marks)

8

Metal A has a density of 8 g/cm^3 . Metal B has a density of 4 g/cm^3 .

An alloy is made by melting metal A and metal B together. Assume that the volume of the alloy is the total volume of the metals used.

(a) Equal masses of metal A and metal B are used.

Rhys says, 'The density of the alloy is 6 g/cm^3 , the mean of 8 and 4.'

Show that Rhys is wrong.

(3)

(b) Work out the ratio mass of metal A : mass of metal B that gives an alloy with a density of 6 g/cm^3 .

Give your answer in its simplest form.

(3)

(Total for Question 8 is 6 marks)

END OF QUESTIONS

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Mark scheme

GCSE Mathematics · Worksheet: Speed, density, pressure and best buys · 30 marks

Question 1 (3 marks)

[3 marks]

Answer: Ella: her speed is 12.5 km/h, which is more than 12 km/h.

- **M1** for 24 minutes = 0.4 hours, or **5 ÷ 24** km per minute
- **A1** for 12.5 km/h (or Jon runs 4.8 km in 24 minutes, or Jon takes 25 minutes for 5 km)
- **C1** for Ella, from a correct comparison

Worked solution: 24 minutes = $\frac{24}{60} = 0.4$ hours. Ella's speed = $5 \div 0.4 = 12.5$ km/h.
12.5 km/h > 12 km/h, so Ella is faster.

Question 2 (2 marks)

[2 marks]

Answer: 175 km

- **M1** for **70 × 2.5** oe
- **A1** for 175 cao

Worked solution: 2 hours 30 minutes = **2.5** hours, so the distance is **70 × 2.5 = 175** km.

Question 3 (3 marks)

[3 marks]

Answer: A speedboat (30 m/s = 108 km/h)

- **M1** for converting one speed to the other units, e.g. **30 × 3600 ÷ 1000** or **95 × 1000 ÷ 3600**
- **A1** for 108 km/h or 26.4 m/s
- **C1** for a speedboat, supported by correct values

Worked solution: **30 m/s** = $30 \times 3600 \div 1000 = 108$ km/h. 108 > 95, so a speedboat is faster.

Question 4 (4 marks)

[4 marks]

Answer: 50 km/h

- P1 for the distance of the first part, $90 \times \frac{40}{60} = 60$ km
- P1 for the time of the second part, $40 \div 30 \times 60 = 80$ minutes
- P1 for $(60 + 40) \div 2$ (total distance $\div$ total time in hours)
- A1 for 50 cao

Notes: The mean of the two speeds, 60, scores 0 marks.

Worked solution: First part: $90 \times \frac{40}{60} = 60$ km. Second part: $\frac{40}{30} \times 60 = 80$ minutes.
Total distance = 100 km, total time = 120 minutes = 2 hours.
Average speed = $100 \div 2 = 50$ km/h

Question 5 (4 marks)

[4 marks]

Answer: 11,500 N/m²

- P1 for the area of the largest face, $50 \times 40 = 2000$ cm² = 0.2 m²
- P1 for the force, $2300 \times 0.2 = 460$ N
- P1 for $460 \div 0.04$ (the area of the smallest face is 0.04 m²)
- A1 for 11,500 cao

Notes: A method using the ratio of the areas, $2300 \times \frac{2000}{400}$, scores full marks.

Worked solution: Largest face: $50 \times 40 = 2000$ cm² = 0.2 m². Force = $2300 \times 0.2 = 460$ N.
Smallest face: $40 \times 10 = 400$ cm² = 0.04 m².
New pressure = $460 \div 0.04 = 11,500$ N/m²

Question 6 (3 marks)

[3 marks]

Answer: 70,000 N/m²

- M1 for $175 \div 25 = 7$ (N/cm²)
- M1 for using $1 \text{ m}^2 = 10\,000 \text{ cm}^2$, e.g. $7 \times 10\,000$ or $25 \text{ cm}^2 = 0.0025 \text{ m}^2$
- A1 for 70,000 cao

Notes: Using $1 \text{ m}^2 = 100 \text{ cm}^2$ gives 700 (M1 M0 A0).

Worked solution: Pressure = $175 \div 25 = 7$ N/cm².
There are $100 \times 100 = 10\,000$ cm² in 1 m², so the pressure is $7 \times 10\,000 = 70,000$ N/m².

Question 7 (5 marks)

[5 marks]

Answer: 22.5 km/h

- P1 for the time for the outward journey, $\frac{30}{15}$ hours
- P1 for the total time needed, $\frac{60}{18}$ hours
- P1 for the time available for the return journey, $\frac{60}{18} - \frac{30}{15} (= \frac{4}{3}$ hours)
- P1 for $30 \div$ their time
- A1 for 22.5

Notes: The answer 21 km/h (from $\frac{15+v}{2} = 18$) scores 0 marks: the two halves of the journey take different times.

Worked solution: Outward time = $\frac{30}{15}$ hours. For an average of 18 km/h over 60 km, the total time must be $\frac{60}{18}$ hours.

Time for the return = $\frac{60}{18} - \frac{30}{15} = \frac{4}{3}$ hours.

Speed on the way back = $30 \div \frac{4}{3} = 22.5$ km/h.

Question 8 (6 marks)

(a) [3 marks]

Answer: E.g. 8 g of each: volumes 1 cm³ and 2 cm³, so density = $\frac{16}{3} = 5\frac{1}{3}$ g/cm³, not 6.

- M1 for the volumes of equal masses, e.g. 8 g of each gives 1 cm³ and 2 cm³ (or $\frac{m}{8}$ and $\frac{m}{4}$)
- M1 for total mass $\div$ total volume, e.g. $16 \div 3$ or $\frac{2m}{\frac{3m}{8}}$
- C1 for $\frac{16}{3}$ (5.33...) g/cm³ with the conclusion that it is not 6

Worked solution: Take 8 g of each metal. Volume of A = $8 \div 8 = 1$ cm³; volume of B = $8 \div 4 = 2$ cm³.

Density = $\frac{16}{3} = 5.33 \dots$ g/cm³, not 6. The less dense metal takes up more of the volume.

(b) [3 marks]

Answer: 2 : 1

- P1 for volumes $\frac{a}{8}$ and $\frac{b}{4}$ for masses a and b
- P1 for $\frac{a+b}{\frac{a}{8}+\frac{b}{4}} = 6$ leading to $\frac{a}{4} = \frac{b}{2}$ oe
- A1 for 2 : 1

Notes: Alternative: volume ratio A : B found as 1 : 1 (since 6 is midway between 8 and 4 by volume), then masses 8 : 4 = 2 : 1 scores full marks.

Worked solution: $a + b = 6 \left(\frac{a}{8} + \frac{b}{4} \right) = \frac{3a}{4} + \frac{3b}{2}$, so $\frac{a}{4} = \frac{b}{2}$ and $a = 2b$.

Mass of A : mass of B = 2 : 1. (Check: 2 g and 1 g have volumes 0.25 cm³ each; $3 \div 0.5 = 6$.)
