



5.5H Speed and Density: Higher Tier Practice

EDEXCEL Edexcel 1MA1 · Calculator allowed · about 75 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** A car travels 150 km in 2 hours 15 minutes. Work out the average speed of the car in km/h. Give your answer to 1 decimal place.

(Total for Question 1 is 2 marks)

- 2** A cyclist rides for 30 minutes at 18 km/h, then for 20 minutes at 24 km/h. Work out the total distance travelled in kilometres. Give your answer as a fraction in simplest form.

(Total for Question 2 is 3 marks)

- 3** A cylindrical metal rod has length 1.2 m and cross-sectional area 3.5 cm^2 . The density of the metal is 7.8 g/cm^3 . Calculate the mass of the rod in kilograms. Give your answer to 3 significant figures.

(Total for Question 3 is 4 marks)

- 4** A sealed container with volume 2.5 m^3 is filled with a liquid of density 920 kg/m^3 .
- (a) Work out the mass of the liquid in the container in kilograms.
- (b) The liquid is poured into small bottles each of volume 250 cm^3 . How many whole bottles can be filled?

(a) Work out the mass of the liquid in the container in kilograms. (2)

(b) How many whole bottles of volume 250 cm^3 can be filled? (2)

(Total for Question 4 is 4 marks)

- 5** A boat travels upstream against the river current for 2 hours and covers 30 km. It returns downstream along the same route in 1.2 hours.

(a) Find the speed of the boat in still water and the speed of the current in km/h.

(b) Explain briefly why the downstream time is less than the upstream time.

(a) Find the speed of the boat in still water and the speed of the current in km/h. (4)

(b) Explain briefly why the downstream time is less than the upstream time. (1)

(Total for Question 5 is 5 marks)

6 A material has density $\rho \text{ g/cm}^3$ and is formed into a hollow spherical shell with outer radius R cm and inner radius r cm.

(a) Write an expression in terms of ρ , R and r for the mass of the shell in grams.

(b) Given $\rho = 2.7$, $R = 8$ and $r = 7$, calculate the mass of the shell to the nearest gram.

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(b) Given $\rho = 2.7$, $R = 8$ and $r = 7$, calculate the mass of the shell to the nearest gram. (3)

(Total for Question 6 is 6 marks)

7 A lorry carries 12.0 tonnes of a granular material with density 1600 kg/m^3 in a rectangular container 4.00 m long and 1.50 m wide.

(a) Calculate the height of the material in the container in metres. Give your answer to 3 significant figures.

(b) The lorry travels a 180 km route. For the first 60 km the lorry averages 36 km/h because of roadworks. For the remaining distance it averages 72 km/h. Calculate the overall average speed for the whole journey in km/h. Give your answer to 3 significant figures.

(c) State one practical reason why average speed for a loaded lorry might be lower than for an unloaded lorry on the same road.

(a) Calculate the height of the material in the container in metres. Give your answer to 3 significant figures. **(6)**

(b) Calculate the overall average speed for the whole journey in km/h. Give your answer to 3 significant figures. **(8)**

(c) State one practical reason why average speed for a loaded lorry might be lower than for an unloaded lorry on the same road. **(2)**

(Total for Question 7 is 16 marks)

Mark scheme · 5.5H Speed and Density: Higher Tier Practice

Question 1

- **M1** Convert time to hours and divide: $150 / 2.25$ or equivalent method
- **A1** 66.7 km/h awrt
- **Answer: 66.7 km/h**

Question 2

- **M1** Convert minutes to hours and calculate distances: 0.5×18 and $(20/60) \times 24$
- **M1** Add distances: $9 + 8 = 17$ km (or express as fraction steps)
- **A1** 17 cao (fraction form 17/1 acceptable)
- **Answer: 17**

Question 3

- **M1** Convert length to cm or area to m^2 consistently, e.g. length $1.2 \text{ m} = 120 \text{ cm}$ then volume = area * length = $3.5 \times 120 \text{ cm}^3$
- **M1** Use mass = density * volume: $7.8 \times (3.5 \times 120)$
- **A1** 3276 g (or equivalent) cao
- **A1** 3.28 kg awrt (3 s.f.)
- **Answer: 3.28 kg**

Question 4

- (a) **M1** Use mass = density * volume with consistent units: 920×2.5
- (a) **A1** 2300 kg cao
- (a) **Answer: 2300 kg**
- (b) **M1** Convert container volume to cm^3 : $2.5 \text{ m}^3 = 2.5 \times 10^6 \text{ cm}^3$ and divide by 250
- (b) **A1** 10000 cao
- (b) **Answer: 10000**

Question 5

- (a) **M1** Set up equations: upstream speed = $v - c$ with $(v - c) \times 2 = 30$ and downstream speed = $v + c$ with $(v + c) \times 1.2 = 30$
- (a) **M1** Solve the two equations: $v - c = 15$ and $v + c = 25$
- (a) **A1** $v = 20 \text{ km/h}$ cao
- (a) **A1** $c = 5 \text{ km/h}$ cao
- (a) **Answer: Boat speed in still water = 20 km/h; current speed = 5 km/h**
- (b) **B1** The current adds to the boat speed downstream and subtracts upstream, so downstream speed is greater hence time is less oe
- (b) **Answer: Because the current increases the effective speed downstream and reduces it upstream, so the downstream trip takes less time.**

Question 6

- (a) **M1** Volume of shell = $(4/3)\pi(R^3 - r^3)$ stated
- (a) **M1** Mass = density * volume, substitute ρ : mass = $\rho \times (4/3)\pi(R^3 - r^3)$
- (a) **A1** mass = $(4/3)\pi \rho (R^3 - r^3)$ (algebraic expression cao)
- (a) **Answer: mass = $(4/3)\pi \rho (R^3 - r^3)$ grams**
- (b) **M1** Substitute values: volume = $(4/3)\pi(8^3 - 7^3) = (4/3)\pi(512 - 343) = (4/3)\pi \times 169$
- (b) **M1** Multiply by ρ : mass = $2.7 \times (4/3)\pi \times 169$ and evaluate numerically
- (b) **A1** 1911 g cao (to nearest gram)
- (b) **Answer: 1911 g**

Question 7

- (a) **M1** Convert mass to kg: 12.0 tonnes = 12000 kg
- (a) **M1** Use volume = mass / density: volume = 12000 / 1600 = 7.5 m³
- (a) **M1** Compute base area: 4.00 * 1.50 = 6.00 m²
- (a) **M1** Height = volume / area = 7.5 / 6.00
- (a) **A1** Height = 1.25 m cao
- (a) **A1** Height to 3 s.f. = 1.25 m cao
- **(a) Answer: 1.25 m**
- (b) **M1** Calculate times for each section: t₁ = 60/36 hours, t₂ = 120/72 hours
- (b) **M1** Evaluate times: t₁ = 1.666666... h, t₂ = 1.666666... h
- (b) **M1** Total time = t₁ + t₂ = 3.333333... h
- (b) **M1** Total distance = 180 km stated
- (b) **M1** Average speed = total distance / total time = 180 / 3.333333...
- (b) **M1** Carry out division to get 54 km/h
- (b) **A1** 54.0 km/h awrt to 3 s.f.
- (b) **B1** Method explanation or check: times equal so average speed is harmonic mean leading to 54 km/h or equivalent check
- **(b) Answer: 54.0 km/h**
- (c) **B1** Practical reason given, e.g. heavier load increases braking distance and reduces acceleration so driver travels slower or
- (c) **B1** Alternate acceptable reason: speed limits for heavy vehicles, stability/safety concerns, or longer stopping distances leading to lower speeds
- **(c) Answer: Possible answer: A loaded lorry accelerates and brakes more slowly and has a longer stopping distance, so drivers travel more slowly for safety.**