



KS3.M-R9 Compound Measures: Speed, Density and Rates

AQA KS3.M-R9 · Calculators not allowed · about 60 minutes

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** Convert the following speeds so that each is in metres per second (m/s). Give exact values where possible.
- (a) Convert 18 km/h to m/s. (1)
- (b) Convert 54 km/h to m/s. Give your answer as a simplified fraction if necessary. (1)
- (c) Convert 9 m/s to km/h. (1)
- (d) Convert 2.5 m/s to km/h. Give your answer to 1 decimal place. (1)
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- 2** A cyclist travels 7.2 km in 24 minutes. Work out the cyclist's average speed in km/h. (2)
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- 3** A lorry travels at a steady speed of 22 m/s. How far in metres does it travel in 3 minutes? (3)

- 4** The density of a metal is 8 g/cm^3 . Find the mass, in kilograms, of a block of this metal with volume 0.012 m^3 . Show your working.

(3)

- 5** A car is driven 120 km in 1 hour 30 minutes. Meanwhile a train covers 300 km in 2 hours 15 minutes. Which is faster? Work out both speeds in km/h to 1 decimal place and state which is faster.

(4)

- 6** Complete the table: give the missing value in each row. Use units shown.

(a) Speed = 20 m/s, Time = 50 s, Distance = ? (m) (1)

(b) Distance = 150 km, Time = 3 hours, Speed = ? (km/h) (1)

(c) Speed = 72 km/h, Time = ? hours, Distance = 36 km (1)

- 7** A gold bar has volume 25 cm^3 and density 19.3 g/cm^3 . Find its mass in grams. Give your answer to the nearest gram.

(2)

- 8** A pedestrian walks 400 m in 5 minutes, then runs 1.2 km in 8 minutes. Calculate their average speed for the whole journey in m/s. Give your answer to 2 decimal places.

(3)

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- 9** A warehouse stores 2500 kg of grain in a container that has volume 2.5 m^3 . Find the density of the grain in kg/m^3 . Give your answer to the nearest whole number.

(3)

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- 10** A courier delivers parcels at a steady rate. She delivers 18 parcels in 45 minutes. Find the delivery rate in parcels per hour and then in parcels per minute. Give both answers.

(3)

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- 11** A small boat travels upstream against a current of 2 km/h. Its speed in still water is 8 km/h. What is the boat's speed relative to the riverbank when going upstream and when going downstream? Then find how long it will take to travel 10 km upstream. Give time in hours to 2 decimal places.

(4)

- 12** A recipe uses 300 g of flour to make 12 biscuits. Work out how many grams of flour are needed to make 20 biscuits. Then give the unit rate in grams of flour per biscuit.

(4)

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- 13** A drone can fly at 12 m/s in still air. On a test flight it must cover a round trip from the base to a point 2 km away and return. There is a steady headwind of 4 m/s when flying out and a tailwind of 4 m/s on the return. Ignore acceleration and deceleration. Calculate the total time for the round trip in minutes. Give your answer to 2 decimal places.

(5)

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- 14** Stretch: A pipeline fills a storage tank at a rate of 0.75 m^3 per minute. A second pipeline empties the tank at 6 m^3 per hour. If the tank starts empty, how long in minutes will it take to reach 15 m^3 when both pipes are open? Give your answer to 1 decimal place.

(7)

Mark scheme · KS3.M-R9 Compound Measures: Speed, Density and Rates

Question 1

- (a) **B1** 5 m/s cao
- (a) Answer: **5**
- (b) **B1** 15 m/s cao
- (b) Answer: **15**
- (c) **B1** 32.4 km/h cao
- (c) Answer: **32.4**
- (d) **B1** 9.0 km/h cao
- (d) Answer: **9.0**

Question 2

- **M1** convert 24 minutes to hours or use proportion: 7.2 km in 0.4 h or equivalent method
- **A1** 18 km/h cao
- Answer: **18**

Question 3

- **M1** convert 3 minutes to 180 seconds and multiply by speed
- **A1** 3960 m cao
- **A1** answer with units shown
- Answer: **3960**

Question 4

- **M1** convert volume to cm^3 or density to kg/m^3 correctly
- **M1** use mass = density x volume
- **A1** 96 kg cao
- Answer: **96**

Question 5

- **M1** calculate car speed: 120 km / 1.5 h
- **M1** calculate train speed: 300 km / 2.25 h
- **A1** car 80.0 km/h, train 133.3 km/h to 1 d.p. cao
- **A1** state train is faster
- Answer: **Car 80.0 km/h; Train 133.3 km/h; Train is faster**

Question 6

- (a) **B1** 1000 m cao
- (a) Answer: **1000**
- (b) **B1** 50 km/h cao
- (b) Answer: **50**
- (c) **B1** 0.5 h or 30 minutes cao
- (c) Answer: **0.5**

Question 7

- **M1** mass = density x volume method used
- **A1** 483 g cao
- Answer: **483**

Question 8

- **M1** find total distance in metres: $400 + 1200 = 1600$ m
- **M1** find total time in seconds: $5 + 8 = 13$ minutes = 780 s
- **A1** 2.05 m/s to 2 d.p. cao
- **Answer: 2.05**

Question 9

- **M1** use density = mass/volume
- **M1** substitute: $2500 / 2.5$
- **A1** 1000 kg/m^3 cao
- **Answer: 1000**

Question 10

- **M1** convert 45 minutes to hours or use proportion to find parcels per hour
- **M1** find parcels per minute as a second rate
- **A1** 24 parcels/hour and 0.4 parcels/minute cao
- **Answer: 24 per hour; 0.4 per minute**

Question 11

- **M1** calculate upstream speed $8 - 2$ and downstream speed $8 + 2$
- **M1** use time = distance/speed to find time for 10 km upstream
- **A1** upstream 6 km/h, downstream 10 km/h cao
- **A1** time = $10/6 = 1.666\dots$ so 1.67 h to 2 d.p. cao
- **Answer: Upstream 6 km/h; Downstream 10 km/h; Time 1.67 h**

Question 12

- **M1** scale up 300 g for 12 to 20 biscuits or find unit rate first
- **M1** calculate flour for 20 biscuits
- **A1** 500 g cao
- **A1** unit rate 25 g per biscuit cao
- **Answer: 500 g; 25 g per biscuit**

Question 13

- **M1** convert 2 km to metres or use consistent units: 2000 m each way
- **M1** find effective speeds: out $12 - 4 = 8$ m/s; return $12 + 4 = 16$ m/s
- **M1** find times for each leg: $2000/8$ and $2000/16$
- **A1** total time in seconds $250 + 125 = 375$ s or 6.25 minutes cao
- **A1** final answer stated to 2 d.p. as 6.25 minutes cao
- **Answer: 6.25**

Question 14

- **M1** convert emptying rate to same time unit: $6 \text{ m}^3/\text{h} = 0.1 \text{ m}^3/\text{min}$
- **M1** find net filling rate: $0.75 - 0.1 = 0.65 \text{ m}^3/\text{min}$
- **M1** use time = volume / rate
- **M1** substitute: $15 / 0.65$
- **A1** 23.0769... minutes rounded to 23.1 min cao
- **M1** method shown clearly linking conversion and division
- **A1** final answer 23.1 minutes cao
- **Answer: 23.1**