

Compound Measures

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Higher tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (3 marks)

A train travels 51 km in 36 minutes.

- (a) Work out the average speed of the train.
Give your answer in km/h.

$$36 \text{ minutes} = \frac{36}{60} = 0.6 \text{ hours}$$

Speed = distance $\div$ time

$$51 \div 0.6 = 85 \text{ km/h}$$

Answer: 85 km/h

Tip: 36 minutes is 0.6 hours, not 0.36 hours. Divide the minutes by 60.

Marks: 1 mark for $51 \div \frac{36}{60}$ (or $51 \div 36 \times 60$). 1 mark for 85.

- (b) Write your answer to part (a) in metres per second.
Give your answer correct to 1 decimal place.

$$85 \text{ km} = 85\,000 \text{ m}$$

$$1 \text{ hour} = 60 \times 60 = 3600 \text{ seconds}$$

$$85\,000 \div 3600 = 23.61\ldots$$

To 1 decimal place: 23.6 m/s

Answer: 23.6 m/s

Tip: There are $60 \times 60 = 3600$ seconds in an hour, not 60 or 360.

2 (4 marks)

A tank contains 3020 litres of water.

Water is pumped out of the tank at a rate of 48.7 litres per minute.

- (a) Work out an estimate for the time it takes to empty the tank.
Give your answer in hours.

Round each number to 1 significant figure:

$$3020 \approx 3000 \text{ and } 48.7 \approx 50$$

Time = volume $\div$ rate

$$3000 \div 50 = 60 \text{ minutes}$$

$$60 \text{ minutes} = 1 \text{ hour}$$

Answer: 1 hour

Marks: 1 mark for rounding both values. 1 mark for $3000 \div 50$. 1 mark for 1 hour.

- (b) Is your answer to part (a) an underestimate or an overestimate?
Give a reason for your answer.

The volume was rounded down (3020 to 3000). This makes the time smaller.

The rate was rounded up (48.7 to 50). This also makes the time smaller.

So the estimate is too small.

Answer: Underestimate, because the volume was rounded down and the rate was rounded up

Tip: Mention **both** roundings and say how each one changes the time. Rounding a divisor **up** makes the answer smaller.

3 (3 marks)

A coach journey usually takes 2 hours 15 minutes at an average speed of 64 km/h.

One day, roadworks mean that the average speed for the same journey is only 48 km/h.

How many minutes longer does the journey take that day?

$$2 \text{ hours } 15 \text{ minutes} = 2.25 \text{ hours}$$

$$\text{Distance} = \text{speed} \times \text{time} = 64 \times 2.25 = 144 \text{ km}$$

Time at 48 km/h = $144 \div 48 = 3$ hours

3 hours – 2 hours 15 minutes = 45 minutes

Answer: 45 minutes

Tip: 2 hours 15 minutes is 2.25 hours, not 2.15 hours.

Marks: 1 mark for 64×2.25 (or 144). 1 mark for $144 \div 48$. 1 mark for 45.

4 (3 marks)

A solid cube of side 20 cm rests on the ground.

The cube exerts a force of 600 newtons on the ground.

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

Work out the pressure on the ground.

Give your answer in newtons/m²

Change the side to metres: 20 cm = 0.2 m

Area of the face on the ground = $0.2 \times 0.2 = 0.04 \text{ m}^2$

Pressure = $\frac{\text{force}}{\text{area}} = 600 \div 0.04 = 15\,000$ newtons/m²

Answer: 15 000 newtons/m²

Tip: The answer is in newtons/m², so the area must be in m². Using 400 cm² gives 1.5, which is the pressure in newtons/cm².

Marks: 1 mark for changing to metres (0.2 m or 0.04 m²). 1 mark for $600 \div 0.04$. 1 mark for 15 000.

5 (3 marks)

A solid block is a cuboid measuring 0.5 m by 0.3 m by 0.2 m.

When the block rests on its 0.5 m by 0.3 m face, the pressure on the ground is 2400 newtons/m²

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

The block is turned so that it rests on its 0.3 m by 0.2 m face.

Work out the new pressure on the ground.

$$\text{Area of the first face} = 0.5 \times 0.3 = 0.15 \text{ m}^2$$

$$\text{Force} = \text{pressure} \times \text{area} = 2400 \times 0.15 = 360 \text{ N}$$

The force (the weight of the block) does not change.

$$\text{Area of the new face} = 0.3 \times 0.2 = 0.06 \text{ m}^2$$

$$\text{New pressure} = 360 \div 0.06 = 6000 \text{ newtons/m}^2$$

Answer: 6000 newtons/m²

Tip: The block pushes down with the same force whichever face it rests on. A smaller area gives a bigger pressure.

Marks: 1 mark for 2400×0.15 (or 360). 1 mark for $360 \div 0.06$. 1 mark for 6000.

6 (3 marks)

A train travels 45 miles at an average speed of 60 mph and then 30 miles at an average speed of 40 mph.

Work out the average speed for the whole journey.

$$\text{Time} = \text{distance} \div \text{speed}$$

$$\text{First part: } 45 \div 60 = 0.75 \text{ hours}$$

$$\text{Second part: } 30 \div 40 = 0.75 \text{ hours}$$

$$\text{Total distance} = 45 + 30 = 75 \text{ miles}$$

$$\text{Total time} = 0.75 + 0.75 = 1.5 \text{ hours}$$

Average speed = $75 \div 1.5 = 50$ mph

Answer: 50 mph

Marks: 1 mark for both times. 1 mark for $75 \div 1.5$. 1 mark for 50.

7 (4 marks)

Liquid P and liquid Q are mixed in the ratio 2:3 by **mass** to make liquid R .

Liquid P has density 0.9 g/cm^3

Liquid Q has density 1.5 g/cm^3

Work out the density of liquid R .

Give your answer correct to 3 significant figures.

Take 2 g of P and 3 g of Q (any masses in the ratio 2:3 work).

Volume = mass $\div$ density

Volume of $P = 2 \div 0.9 = 2.222 \dots \text{ cm}^3$

Volume of $Q = 3 \div 1.5 = 2 \text{ cm}^3$

Total mass = $2 + 3 = 5 \text{ g}$

Total volume = $2.222 \dots + 2 = 4.222 \dots \text{ cm}^3$

Density of $R = 5 \div 4.222 \dots = 1.184 \dots$

To 3 significant figures: 1.18

Answer: 1.18 g/cm^3

Tip: The ratio is by mass, so divide each mass by its density to get volumes. Multiplying the ratio numbers by the densities would be the method for a ratio by volume.

Marks: 1 mark for one correct volume. 1 mark for the total volume. 1 mark for total mass $\div$ total volume. 1 mark for 1.18

8 (4 marks)

A car travels at an average speed of 90 km/h for 2 hours 40 minutes.
The car uses 6.2 litres of fuel for every 100 km it travels.
The density of the fuel is 0.74 kg per litre.

Work out the mass of the fuel the car uses on this journey.
Give your answer in kg correct to 3 significant figures.
You must show all your working.

$$2 \text{ hours } 40 \text{ minutes} = 2\frac{2}{3} \text{ hours}$$

$$\text{Distance} = 90 \times 2\frac{2}{3} = 240 \text{ km}$$

$$\text{Fuel used} = \frac{240}{100} \times 6.2 = 14.88 \text{ litres}$$

$$\text{Mass} = \text{density} \times \text{volume} = 0.74 \times 14.88 = 11.0112 \text{ kg}$$

To 3 significant figures: 11.0 kg

Answer: 11.0 kg

Tip: 2 hours 40 minutes is $2\frac{2}{3}$ hours (2.666 ...), not 2.4 hours.

Marks: 1 mark for 240 km. 1 mark for 14.88 litres. 1 mark for 0.74×14.88 . 1 mark for 11.0
