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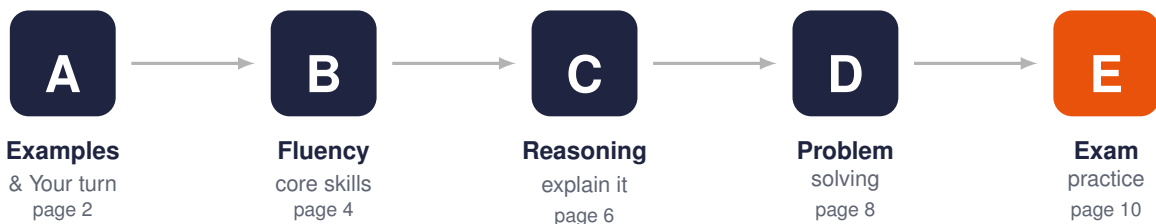
GCSE MATHEMATICS • RATIO & PROPORTION

Compound Measures

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator allowed

Free Compound Measures worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: use speed, density and pressure, and rearrange each formula • work with times in hours and minutes, and with rates such as flow and pay • read distance-time graphs • *Higher:* average speed over several stages, mixtures, pressure and meeting problems.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER The same skills where Higher papers use them: average speed over stages, mixtures, pressure on different faces, meeting problems and equations. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	19
Higher marks	16	13	17	15
My score				

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A**Worked examples & Your turn**

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1

A car travels 165 km in 2 hours 12 minutes. Work out its average speed in km/h.

Write the time in hours: $12 \text{ minutes} = \frac{12}{60} = 0.2 \text{ hours}$.

$$165 \div 2.2 = 75$$

75 km/h

Your turn A1

A runner runs 10 km in 50 minutes. Work out her average speed in km/h.

Worked example A2

The density of copper is 8.9 g/cm^3

Work out the mass of 15 cm^3 of copper.

$\text{Density} = \frac{\text{mass}}{\text{volume}}$, so $\text{mass} = \text{density} \times \text{volume}$.

$$8.9 \times 15 = 133.5$$

133.5 g

Your turn A2

The density of aluminium is 2.7 g/cm^3

Work out the volume of 810 g of aluminium.

Worked example A3

A force of 60 N acts on an area of 0.25 m^2

$\text{pressure} = \frac{\text{force}}{\text{area}}$ Work out the pressure.

$$60 \div 0.25 = 240$$

240 N/m²

Your turn A3

The pressure on an area of 0.6 m^2 is 150 N/m^2

$\text{pressure} = \frac{\text{force}}{\text{area}}$ Work out the force.



HIGHER*Higher strategies: these are new ways of thinking, not longer sums***Worked example A4: average speed**

A car travels 120 km at 60 km/h, then 40 km at 40 km/h. Find its average speed for the whole journey.

Total distance ÷ total time. Do not average the speeds.

$$\text{Time} = 2 + 1 = 3 \text{ hours} \quad 160 \div 3 = 53.33\dots$$

53.3 km/h

Your turn A4

Jo walks 6 km at 4 km/h, then runs 6 km at 12 km/h. Work out her average speed for the whole distance.

Worked example A5: the density of a mixture

386 g of gold (19.3 g/cm^3) is mixed with 178 g of copper (8.9 g/cm^3). Find the density of the mixture.

Find each volume, then total mass ÷ total volume.

$$386 \div 19.3 = 20 \quad 178 \div 8.9 = 20$$

$$564 \div 40 = 14.1$$

14.1 g/cm^3

Your turn A5

400 g of liquid A (0.8 g/cm^3) is mixed with 300 g of liquid B (1.2 g/cm^3). Find the density of the mixture, to 2 decimal places.

Worked example A6: closing speed

Two trains are 300 km apart. They travel towards each other at 90 km/h and 110 km/h. When do they meet?

Together they close the gap at $90 + 110 = 200 \text{ km/h}$.

$$300 \div 200 = 1.5$$

after 1.5 hours

Your turn A6

A bike leaves a town at 12 km/h. 30 minutes later a car leaves on the same road at 42 km/h. How long does the car take to catch the bike?

Worked example A7: which face gives the greatest pressure?

A cuboid measures 20 cm by 30 cm by 50 cm and weighs 300 N. Find the greatest pressure it can exert on the floor.

Use the smallest face: $0.2 \times 0.3 = 0.06 \text{ m}^2$

$$300 \div 0.06 = 5000$$

5000 N/m^2

Your turn A7

A cuboid measures 0.1 m by 0.4 m by 0.5 m and weighs 200 N. Work out the least pressure it can exert on the floor.



B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION*Everyone starts here***B1** Work out

- (a) the speed for 150 km in 3 hours (b) the distance at 50 km/h for 4.5 hours
(c) the time for 225 km at 50 km/h (d) the distance at 50 km/h for 24 minutes

[4 marks]**B2** (a) Write 2 hours 30 minutes in hours. (b) Write 1 hour 45 minutes in hours.

- (c) Write 0.4 hours in minutes. (d) Write 3.15 hours in hours and minutes.

[4 marks]**B3** (a) Work out the density of a stone with mass 600 g and volume 250 cm^3

- (b) The same stone has density 2.4 g/cm^3 . Work out the mass of 40 cm^3

- (c) Work out the volume of 30 g of the same stone.

- (d) Steel has density 7.8 g/cm^3 . Work out the mass, in kg, of 1 m^3 of steel.

[4 marks]**B4** $\text{pressure} = \frac{\text{force}}{\text{area}}$ Work out

- (a) the pressure: 240 N on 3 m^2 (b) the pressure: 240 N on 0.3 m^2
(c) the force: 80 N/m^2 on 1.5 m^2 (d) the area: 20 N at 80 N/m^2

[4 marks]**B5** (a) Kim is paid £75.60 for 7 hours of work. Work out her rate of pay per hour.

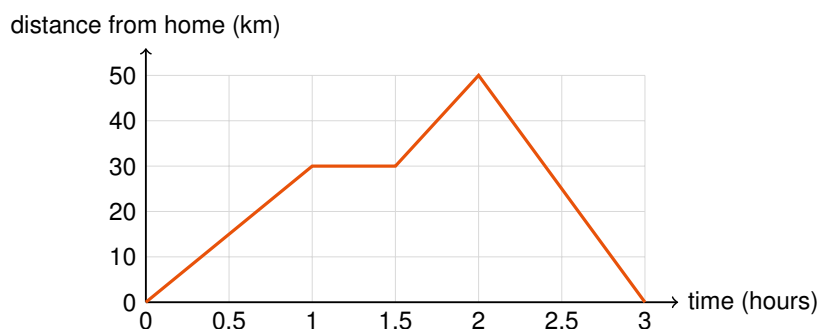
- (b) A car uses 35 litres of fuel to travel 420 km. How many kilometres does it travel per litre?

- (c) Water flows into a tank at 3 litres per minute. How many minutes does it take to put 45 litres in the tank?

[3 marks]

FOUNDATION*continued: distance-time graphs*

B6 The graph shows a cyclist's journey from home and back.



- (a) Work out the speed for the first hour. (b) For how many minutes did the cyclist stop?
 (c) Work out the speed between 1.5 and 2 hours. (d) Work out the speed on the way home.

[4 marks]**HIGHER***Higher tier only*

B7 Work out the average speed for each whole journey.

- (a) 40 km at 20 km/h, then 40 km at 40 km/h (b) 1 hour at 20 km/h, then 1 hour at 40 km/h
 (c) 30 km at 60 km/h, a 30-minute stop, then 30 km at 60 km/h (d) out at 60 km/h, then back along the same road at 40 km/h

[4 marks]

B8 Work out the density of each mixture. Give (b) and (c) to 2 decimal places.

- (a) 100 cm³ of density 2 g/cm³ and 100 cm³ of density 4 g/cm³
 (b) 100 g of density 2 g/cm³ and 100 g of density 4 g/cm³
 (c) 300 g of density 3 g/cm³ and 200 g of density 5 g/cm³
 (d) 60 cm³ of density 1.5 g/cm³ is mixed with 40 cm³ of liquid B. The mixture has density 1.9 g/cm³. Find the density of liquid B.

[4 marks]

B9 Convert

- (a) 72 km/h to m/s (b) 15 m/s to km/h (c) 2.7 g/cm³ to kg/m³ (d) 5 N/cm² to N/m²

[4 marks]

B10 Work out how long it takes

- (a) for two cars 120 km apart, driving towards each other at 30 km/h and 50 km/h, to meet
 (b) for a car at 50 km/h to catch a car 12 km ahead of it at 30 km/h. Give your answer in minutes.
 (c) for two runners 200 m apart, running towards each other at 3 m/s and 5 m/s, to meet
 (d) for a runner at 6 m/s to catch a runner 80 m ahead of her running at 4 m/s

[4 marks]

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C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Tom travels 120 km in 1 hour 30 minutes. He writes $120 \div 1.30 = 92.3$, so 92.3 km/h
(a) Explain Tom's mistake. (b) Work out the correct average speed. [2 marks]
- C2** Which has the greater mass: 1 m^3 of wood with density 0.6 g/cm^3 , or 500 litres of water with density 1 g/cm^3 ?
You must show your working. (1 litre = 1000 cm^3) [2 marks]
- C3** Jo's weight is 600 N. When she stands on both feet, the area of her feet touching the floor is 0.03 m^2
(a) Work out the pressure on the floor.
(b) Explain what happens to the pressure when Jo stands on one foot, and why. [3 marks]
- C4** A gold bar is a cuboid measuring 25 cm by 8 cm by 5 cm. The density of gold is 19.3 g/cm^3
Show that the mass of the gold bar is more than 19 kg. [3 marks]



HIGHER*Higher tier only*

- C5** Show that a speed of 25 m/s is faster than a speed of 85 km/h. [3 marks]
- C6** Ben mixes equal masses of two liquids, with densities 0.8 g/cm^3 and 1.2 g/cm^3 .
He says, "The density of the mixture is 1.0 g/cm^3 ."
Show that Ben is wrong, and that the density of the mixture is 0.96 g/cm^3 [3 marks]
- C7** Two solid cubes are made of the same material. The second cube has sides twice as long as the first.
Each cube rests on the floor on one face. Show that the second cube exerts twice the pressure of the first. [3 marks]
- C8** A car makes a journey out at $u \text{ km/h}$ and back along the same road at $v \text{ km/h}$.
(a) Show that the average speed for the whole journey is $\frac{2uv}{u+v} \text{ km/h}$
(b) Prove that, when $u \neq v$, this average speed is less than $\frac{u+v}{2}$ [4 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

- D1** A train leaves at 09 47 and arrives at 11 32. It travels 147 km.
Work out the average speed of the train in km/h. [3 marks]
- D2** A swimming pool is a cuboid 25 m long, 10 m wide and 1.6 m deep.
It is filled with water at 20 litres per second. $1 \text{ m}^3 = 1000$ litres.
Will the pool be full within 6 hours? You must show your working. [4 marks]
- D3** A solid silver cube has sides of 4 cm. The density of silver is 10.5 g/cm^3
Silver costs £0.65 per gram. Work out the value of the cube. [3 marks]
- D4** Ali is paid £11.40 per hour on weekdays. At weekends he is paid $1\frac{1}{2}$ times this rate.
One week he works 30 hours on weekdays and 6 hours at the weekend. Work out his total pay. [3 marks]



HIGHER*Higher tier only*

- D5** A high-speed train travels 515 km in 2 hours 30 minutes.
A normal train's average speed is 40% lower. How much longer does the normal train take for the same journey?
Give your answer in hours and minutes. [4 marks]
- D6** A solid concrete cylinder stands on its circular end. Its radius is 0.5 m and its height is 2 m.
The density of concrete is 2400 kg/m^3 . Its weight, in newtons, is its mass in kg $\times 10$
Work out the pressure on the ground in N/m^2 [4 marks]
- D7** Water flows through a pipe with a cross-section of area 12 cm^2 . The water moves along the pipe at 0.5 m/s.
How many litres of water flow out of the pipe each minute? (1 litre = 1000 cm^3) [4 marks]
- D8** An alloy of copper and zinc has a mass of 800 g and a volume of 100 cm^3
The density of copper is 8.9 g/cm^3 and the density of zinc is 7.1 g/cm^3
Work out the mass of copper in the alloy. [5 marks]



**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover*

E1 A train travels 216 km in 2 hours 15 minutes.

Work out the average speed of the train.

..... km/h

(Total for Question E1 is 3 marks)

E2 A block of metal is a cuboid 5 cm by 3 cm by 10 cm. Its mass is 1.35 kg.

Work out the density of the metal in g/cm³

..... g/cm³

(Total for Question E2 is 3 marks)

E3 pressure = $\frac{\text{force}}{\text{area}}$

(a) A force of 450 N acts on an area of 1.5 m². Work out the pressure.

..... N/m²

(2)

(b) The same force acts on half the area. What happens to the pressure?

.....

(1)

(Total for Question E3 is 3 marks)

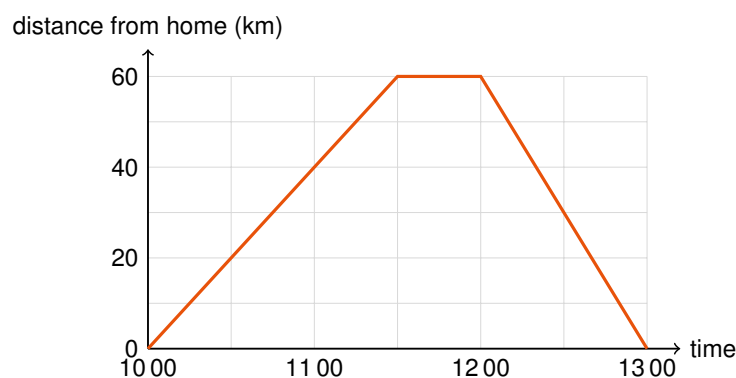


- E4** Sam cycles 18 km at an average speed of 12 km/h. He then cycles 10 km at an average speed of 20 km/h. Work out his average speed for the whole 28 km.

..... km/h

(Total for Question E4 is 4 marks)

- E5** The graph shows Rhea's car journey from home to a beach and back.



- (a)** How long did Rhea stay at the beach?

.....

(1)

- (b)** Work out her average speed on the way home.

..... km/h

(2)

(Total for Question E5 is 3 marks)

- E6** Water flows into a tank at 2.5 litres per second. The tank holds 1.8 m^3
 $1 \text{ m}^3 = 1000$ litres. Work out how long it takes to fill the empty tank. Give your answer in minutes.

..... minutes

(Total for Question E6 is 3 marks)



HIGHER*Higher tier only*

- E7** Metal A has density 19.3 g/cm^3 . Metal B has density 10.5 g/cm^3
579 g of metal A and 210 g of metal B are melted together to make an alloy.
Work out the density of the alloy.

..... g/cm^3 **(Total for Question E7 is 3 marks)**

- E8** The diagram shows a solid cuboid. Its weight is 480 N.

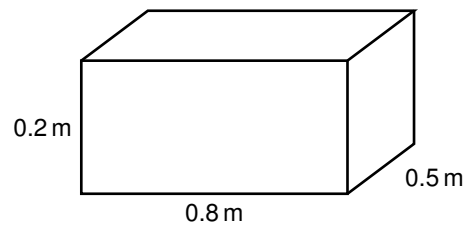


Diagram NOT accurately drawn

pressure = $\frac{\text{force}}{\text{area}}$ The cuboid can rest on any of its faces.

Work out the difference between the greatest and least pressures it can exert on the floor.

..... N/m^2 **(Total for Question E8 is 4 marks)**

- E9** Ali leaves town A at 09 00 and drives towards town B at 60 km/h.
Ben leaves town B at 09 30 and drives towards town A at 80 km/h, on the same road. The towns are 170 km apart.
At what time do they meet?

.....
(Total for Question E9 is 3 marks)

- E10** A cyclist rides 12 km up a hill at an average speed of v km/h. She rides back down the same 12 km at $(v + 12)$ km/h.

The whole ride takes 2 hours 40 minutes.

- (a) Show that $v^2 + 3v - 54 = 0$

(3)

- (b) Work out her average speed for the whole ride.

..... km/h

(2)

(Total for Question E10 is 5 marks)

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