



Similar shapes, speed, density and pressure, and distance-time graphs

Years 8–9 About 80 minutes Calculator allowed
86 marks

Name _____

Class _____

Date _____

A Before you start

Recall

You will need these in every question below.

A1 Write the ratio 18 : 24 in its simplest form.

[1 mark]

Answer

A2 Write 2 hours 45 minutes as a number of hours.

[1 mark]

Answer

A3 Change 3.6 km into metres.

[1 mark]

Answer

A4 Find the missing number: $9 : 15 = 12 : \dots$

[2 marks]

Answer

A5 A straight line passes through the points (0, 3) and (4, 15). Work out its gradient.

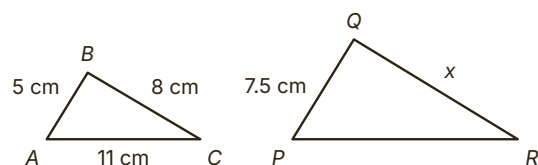
[2 marks]

Answer

Your teacher works through each example with you. Then try the one beside it on your own.

EXAMPLE 1

Triangle PQR is similar to triangle ABC . A matches P , B matches Q and C matches R . $AB = 5$ cm, $BC = 8$ cm, $CA = 11$ cm and $PQ = 7.5$ cm. Work out the length x .

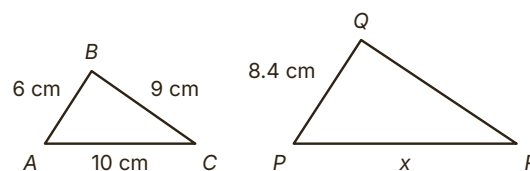


Not drawn accurately

Hint Find the scale factor from two matching sides. Every length in the bigger triangle is the matching length times the scale factor.

B1 Triangle PQR is similar to triangle ABC . A matches P , B matches Q and C matches R . [2 marks]

$AB = 6$ cm, $BC = 9$ cm, $CA = 10$ cm and $PQ = 8.4$ cm. Work out the length x .



Not drawn accurately

Answer

EXAMPLE 2

A train travels 186 km in 1 hour 30 minutes. Work out its average speed in km/h.

Hint Write the time in hours first: 30 minutes is 0.5 of an hour. Then speed = distance $\div$ time.

B2 A coach travels 147 km in 1 hour 45 minutes. Work out its average speed in km/h. [2 marks]

45 minutes. Work out its average speed in km/h.

Answer

EXAMPLE 3

A block of metal has a volume of 35 cm^3 and a density of 8.4 g/cm^3 . Work out its mass.

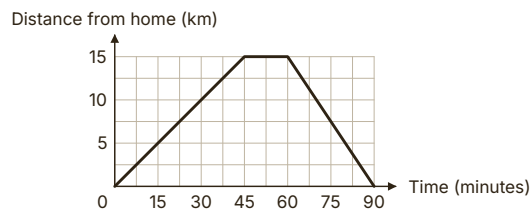
Hint Density = mass $\div$ volume, so mass = density $\times$ volume.

B3 A stone has a mass of 702 g. Its density is 2.7 g/cm^3 . Work out its volume. [2 marks]

Answer

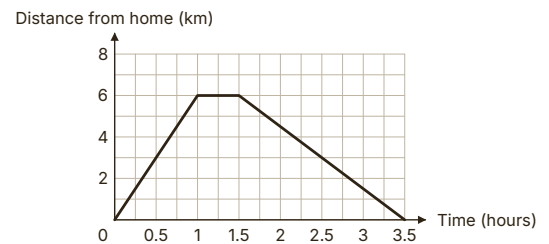
EXAMPLE 4

Tom cycles from home to a shop, waits, and cycles home. The graph shows his journey. Work out his speed on the way to the shop, in km/h.



Hint Read the distance and the time for the first straight section. Change the minutes into hours before you divide.

B4 Zara walks from home to a park, rests, and walks home. The graph shows her walk. Work out her speed on the way home, in km/h. [2 marks]



Answer

Each question asks for something different. Show your working.

C1 Each part describes two triangles. Write SSS, SAS, ASA or RHS to show why the two triangles are congruent.

(a) Both triangles have sides of 6 cm, 11 cm and 13 cm. [1 mark]

Answer

(b) Both triangles have a right angle, a hypotenuse of 17 cm and another side of 8 cm. [1 mark]

Answer

(c) Both triangles have angles of 35° and 80° , and the side between those two angles is 12 cm. [1 mark]

Answer

Total for C1: 3 marks

C2 Two rectangles are similar. The smaller one is 4 cm long and the larger one is 10 cm long. The area of the smaller rectangle is 12 cm^2 . Work out the area of the larger rectangle. [2 marks]

Answer

C3 Change 72 km/h into metres per second. [2 marks]

Answer

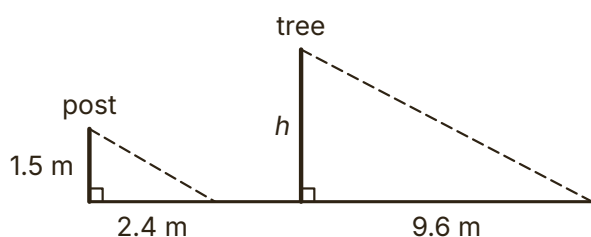
C4 A box has a weight of 180 newtons (N). It rests on a face with an area of 0.6 m^2 . Work out the pressure on the floor, in N/m^2 . [2 marks]

Answer

- C5** A runner runs 6 km at 12 km/h, then a further 6 km at 8 km/h. Work out her average speed for the whole 12 km. [3 marks]

Answer

- C6** A post 1.5 m tall casts a shadow 2.4 m long. At the same time, a tree casts a shadow 9.6 m long. Work out the height h of the tree. [2 marks]



Not drawn accurately

Answer

- C7** Silver has a density of 10.5 g/cm^3 . Copper has a density of 8.9 g/cm^3 .
(a) A silver ring has a mass of 31.5 g. Work out its volume. [2 marks]

Answer

- (b) A copper ring has the same volume as the silver ring. Work out its mass. [1 mark]

Answer

Total for C7: 3 marks

- C8** On a car's distance-time graph, one straight section goes from the point (1.5 hours, 20 km) to the point (4 hours, 120 km). Work out the speed of the car on this section. [2 marks]

Answer

- C9** A car travels 54 km at an average speed of 72 km/h. How many minutes does the journey take? [2 marks]

Answer

D Test-style questions

Stretch

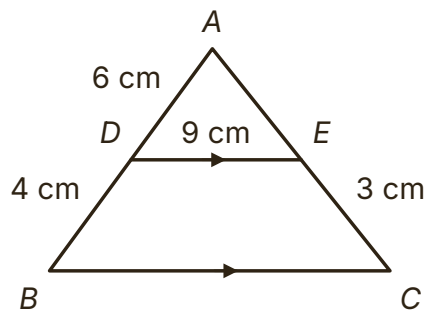
Answer every question in the space given. Show your working: most of the marks are for method.

- D1** Two picture frames are similar. The larger frame is twice as long and twice as wide as the smaller one. The smaller frame has an area of 40 cm^2 . Sam says, "The larger frame has an area of 80 cm^2 ." [2 marks]

Sam is wrong. Explain why, and work out the area of the larger frame.

Answer

- D2** In the diagram, D is on AB and E is on AC . DE is parallel to BC . $AD = 6$ cm, $DB = 4$ cm, $DE = 9$ cm and $EC = 3$ cm.



Not drawn accurately

- (a) Work out the length of BC .

[2 marks]

Answer

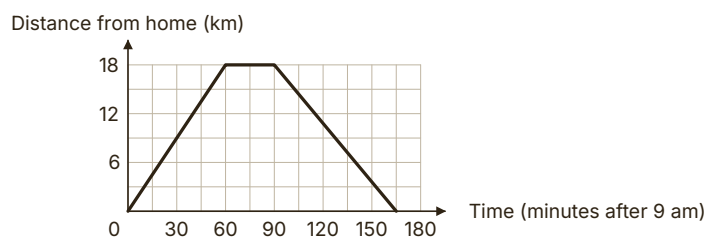
- (b) Work out the length of AE . You must show your working.

[3 marks]

Answer

Total for D2: 5 marks

- D3** Ben leaves home at 9 am and cycles to a lake. He stops at the lake, then cycles home. The graph shows his journey.



- (a) Work out Ben's speed on the way to the lake, in km/h.

[2 marks]

Answer

(b) Work out Ben's speed on the way home, in km/h.

[2 marks]

Answer

(c) Work out Ben's average speed for the whole journey, including his stop. Give your answer to 1 decimal place. [2 marks]

Answer

Total for D3: 6 marks

D4 Ali leaves a car park at 10:00 am and walks along a path at 4 km/h. Bea leaves the same car park at 10:45 am and cycles along the same path at 16 km/h. [4 marks]

At what time does Bea catch up with Ali? How far from the car park are they then? You must show your working.

Answer time distance km

D5 A crate has a weight of 2400 N. It rests on a face that is 1.2 m long and 0.8 m wide.

(a) Work out the pressure on the floor, in N/m^2 . [2 marks]

Answer

(b) The crate is turned onto a face that is 0.8 m long and 0.5 m wide. Show that the pressure goes up by 3500 N/m^2 . [2 marks]

Total for D5: 4 marks

- D6** Two water bottles are similar. The smaller bottle is 15 cm tall and the larger bottle is 20 cm tall. The smaller bottle holds 270 ml. [3 marks]

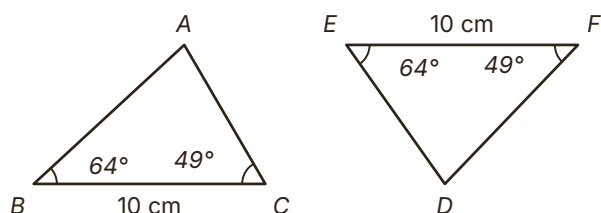
Work out how much the larger bottle holds. You must show your working.

Answer

- D7** A cheetah can run at 29 m/s. A car is travelling at 100 km/h. Which is faster? You must show your working. [2 marks]

Answer

- D8** In triangles ABC and DEF , angle $B = \text{angle } E = 64^\circ$, angle $C = \text{angle } F = 49^\circ$, and $BC = EF = 10 \text{ cm}$.



Not drawn accurately

- (a)** Write down the condition that shows the two triangles are congruent. [1 mark]

Answer

- (b)** Work out the size of angle D . [2 marks]

Answer

Total for D8: 3 marks

- D9** A train travels at 90 km/h for 40 minutes. It then travels at 120 km/h for 1 hour 10 minutes. [4 marks]

Work out the average speed of the train for the whole journey. Give your answer to 1 decimal place.

Answer

- D10** Two triangles are similar. Their areas are 18 cm^2 and 50 cm^2 . The smaller triangle has a base of 6 cm. [3 marks]

Work out the base of the larger triangle.

Answer

E Challenge

UKMT level

No route is given. Spend five minutes on a problem before you look at a hint. The hints are on the last page of the worksheet, and you can use one at a time.

- E1** Two triangles are similar. Their perimeters are 30 cm and 45 cm. The area of the larger triangle is 40 cm^2 more than the area of the smaller triangle. [4 marks]

Work out the area of the smaller triangle.

Answer

- E2** Two trains start 300 km apart and travel towards each other on parallel tracks. One train is 20 km/h faster than the other. They pass each other after 2 hours 30 minutes. [3 marks]
Work out the speed of the slower train.

Answer

- E3** If Jo walks to school at 5 km/h, she arrives 6 minutes late. If she walks at 6 km/h, she arrives 4 minutes early. [4 marks]
How far is it from Jo's home to school?

Answer

- E4** Two solid cubes are made from the same metal. One has a mass of 250 g and the other has a mass of 2 kg. The smaller cube has a surface area of 150 cm². [3 marks]
Work out the surface area of the larger cube.

Answer

F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can find a missing side of similar shapes from the scale factor, use area and volume scale factors, and say which condition makes two triangles congruent.	☐	☐	☐
I can work with speed, density and pressure, change between units, and find an average speed for a journey.	☐	☐	☐
I can read a distance-time graph, work out a speed from a straight section, and find where two journeys meet.	☐	☐	☐

Extension hints

Use one hint at a time. Cover the ones below it with a sheet of paper.

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- E1**
- Hint 1** The perimeters give you the length scale factor. What does that do to the areas?
- Hint 2** The length scale factor is $45 \div 30 = 1.5$, so the larger area is $1.5^2 = 2.25$ times the smaller area.
- Hint 3** If the smaller area is S , then $2.25S - S = 40$, so $1.25S = 40$ and $S = 32$.
-
- E2**
- Hint 1** Think about how fast the gap between the two trains closes.
- Hint 2** Together they close 300 km in 2.5 hours, so the gap closes at $300 \div 2.5 = 120$ km/h.
- Hint 3** The two speeds add to 120 and differ by 20, so they are 70 km/h and 50 km/h.
-
- E3**
- Hint 1** The two walks take different times. How many minutes apart are they?
- Hint 2** The slow walk takes 10 minutes longer, which is $\frac{1}{6}$ of an hour. For a distance d km,
 $\frac{d}{5} - \frac{d}{6} = \frac{1}{6}$.
- Hint 3** $\frac{d}{5} - \frac{d}{6} = \frac{d}{30}$, so $\frac{d}{30} = \frac{1}{6}$ and $d = 5$.
-
- E4**
- Hint 1** The same metal means the masses compare in the same way as the volumes.
- Hint 2** The volume scale factor is $2000 \div 250 = 8$, so the length scale factor is 2.
- Hint 3** Areas are multiplied by $2^2 = 4$, so the surface area is $150 \times 4 = 600 \text{ cm}^2$.
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