



RATIO
&
SIMILARITY



Lesson 1

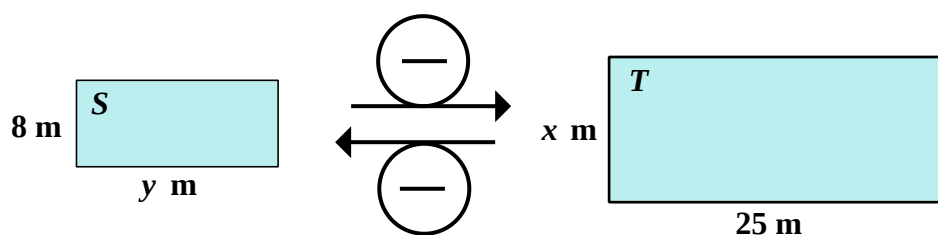
GCSE Mathematics Ratio and Similarity

1.1 Length Scale factor (*lsf*)

◇ Two shapes are similar when one is an enlargement of the other.

Example N° 1

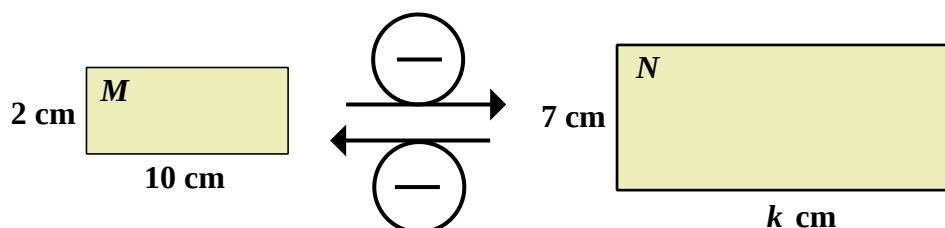
For the similar rectangles *S* and *T*, shown below, find the lengths marked *x* and *y* given that the length scale factor (greater than 1) of the similarity is $\frac{5}{4}$



[2 marks]

Example N° 2

For the similar rectangles *M* and *N*, shown below, find the length scale factor (greater than 1) of the similarity and also the length marked *k*



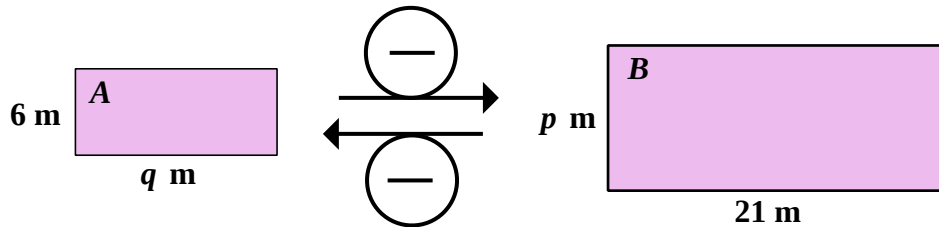
[2 marks]

1.2 Exercise

Marks Available : 32

Question 1

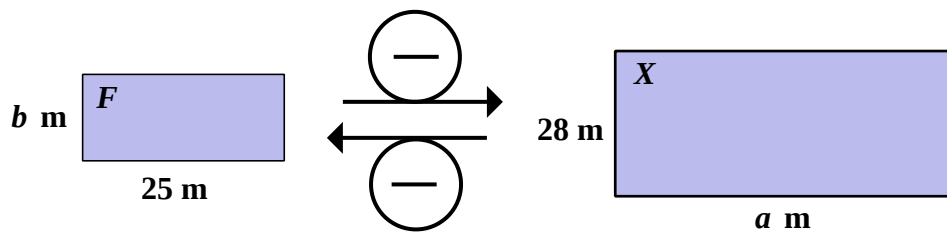
For the similar rectangles A and B , shown below, find the lengths marked p and q given that the length scale factor (greater than 1) of the similarity is $\frac{3}{2}$



[2 marks]

Question 2

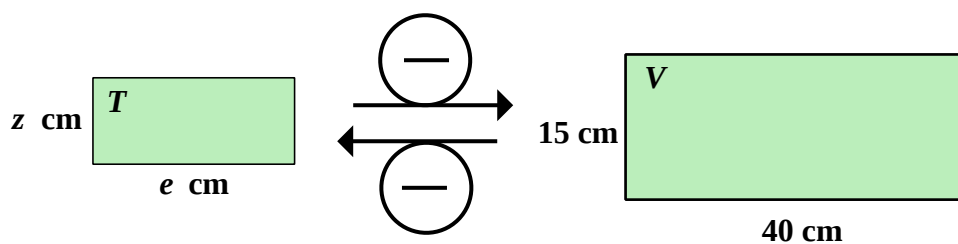
For the similar rectangles F and X , shown below, find the lengths marked a and b given that the length scale factor (greater than 1) of the similarity is $\frac{7}{5}$



[2 marks]

Question 3

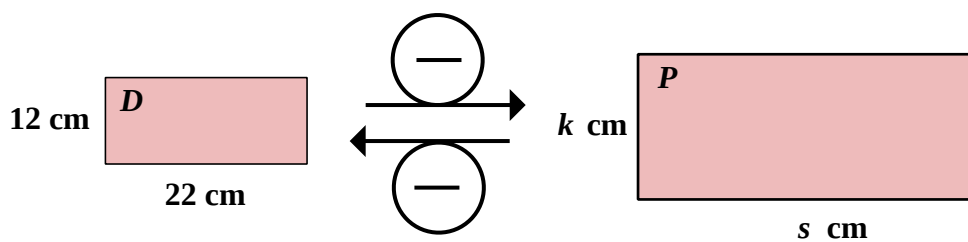
For the similar rectangles T and V , shown below, find the lengths marked e and z given that the length scale factor (greater than 1) of the similarity is $\frac{5}{3}$



[2 marks]

Question 4

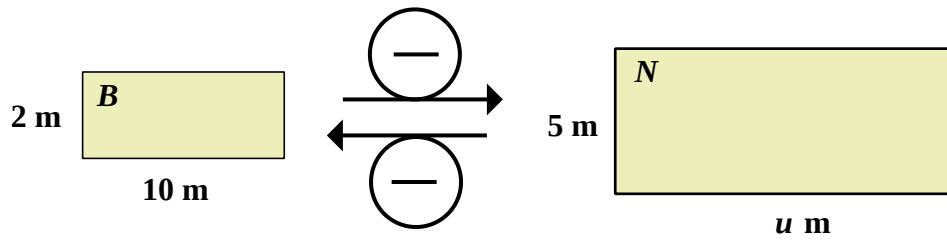
For the similar rectangles D and P , shown below, find the lengths marked k and s given that the length scale factor (less than 1) of the similarity is $\frac{2}{3}$



[2 marks]

Question 5

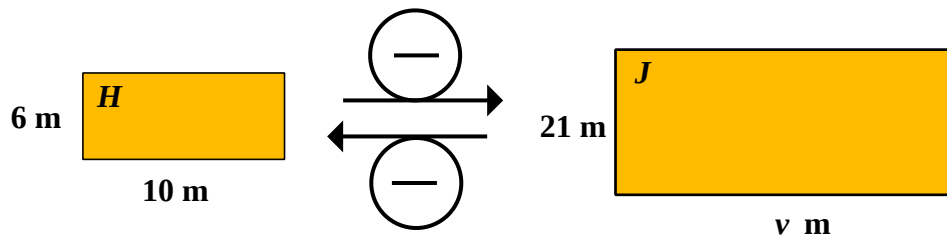
For the similar rectangles B and N , shown below, find the length scale factor (greater than 1) of the similarity and also the length marked u



[2 marks]

Question 6

For the similar rectangles H and J , shown below, find the length scale factor (greater than 1) of the similarity (cancel down the fraction) and also the length marked v



[2 marks]

Question 7

An elastic band of length 9 cm is stretched with length scale factor $\frac{7}{3}$.
What is the length of the stretched band ?

[2 marks]

Question 8

When made wet a 40 cm piece of string shrinks with length scale factor $\frac{4}{5}$.
What is the length of the shrunk string ?

[2 marks]

Question 9

Two rectangles are similar with length scale factor $\frac{11}{2}$
The smaller measures 8 cm by 18 cm.
What are the measurements of the larger ?

[2 marks]

Question 10

A rectangle has lengths that are $\frac{3}{5}$ times smaller than a larger, similar rectangle.
The larger rectangle measures 10 cm by 15 cm.
What are the measurements of the smaller rectangle ?

[2 marks]

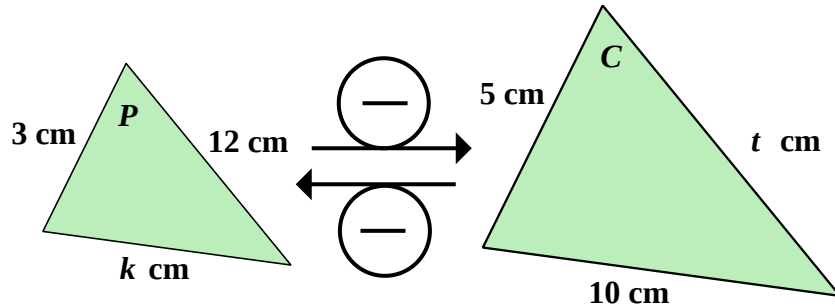
Question 11

What is the length scale factor of the enlargement that generates a line
of length 25 cm from one of length 15 cm ?
(cancel down your fraction)

[2 marks]

Question 12

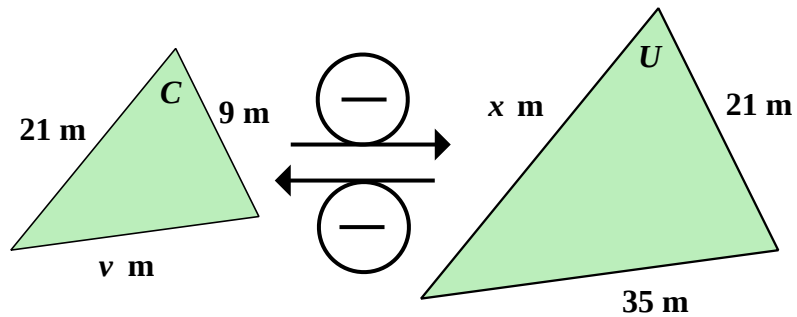
For the similar triangles P and C , shown below, find the length scale factor (greater than 1) of the similarity (cancel down the fraction) and also the lengths marked t and k



[3 marks]

Question 13

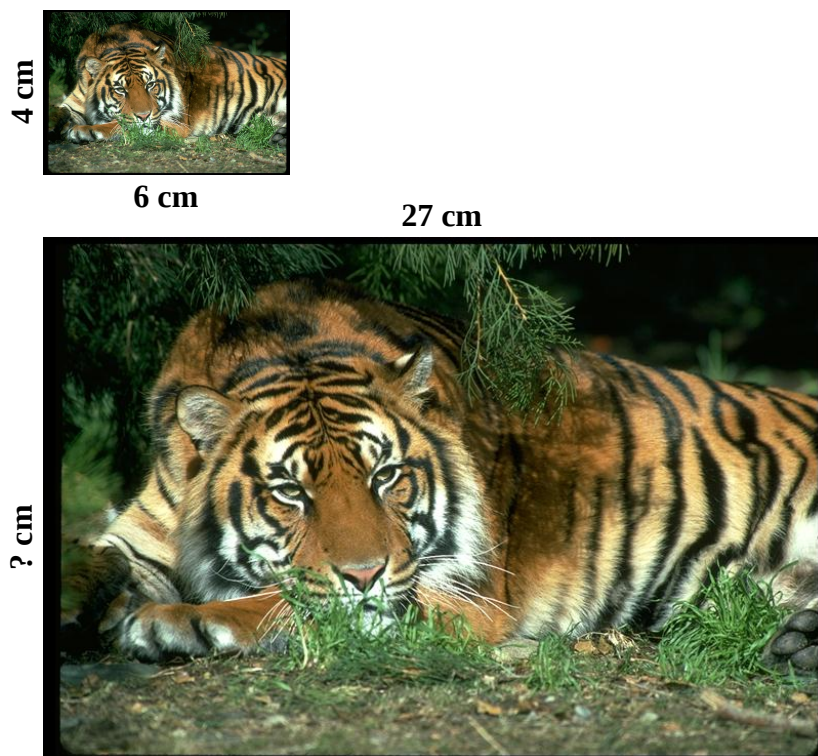
For the similar triangles C and U , shown below, find the length scale factor (greater than 1) of the similarity (cancel down the fraction) and also the lengths marked x and v



[3 marks]

Question 14

A photograph measuring 6 cm in width and 4 cm in height is to be enlarged.
The enlargement is, of course, to be similar to the original.
If the enlargement has a width of 27 cm, what must be its height ?



[2 marks]

Question 15

Rectangle *A* measures 8 cm by 9 cm.
Rectangle *B* measures 12 cm by 15 cm.

(i) Is rectangle *A* similar to rectangle *B* ?

[1 mark]

(ii) Explain your **part (i)** answer.

[1 mark]

1.3 Homework

GCSE Mathematics
Ratio and Similarity

Marks Available : 20

Question 1

What is the **length scale factor** of the enlargement that generates a line of length 12 cm from one of length 16 cm ?

[1 mark]

Question 2

Two lines have lengths in the ratio of 3 : 8.

The shorter line is of length 15cm.

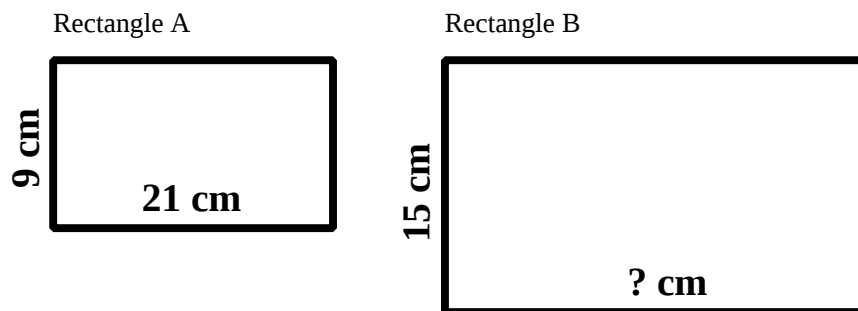
What is the length of the longer line ?

[1 mark]

Question 3

Two shapes are *similar* if they are of the same *shape* although not necessarily the same *size*.

Two similar rectangles, A and B, are shown below.



(i) What is the **length scale factor** of the similarity, B from A ?

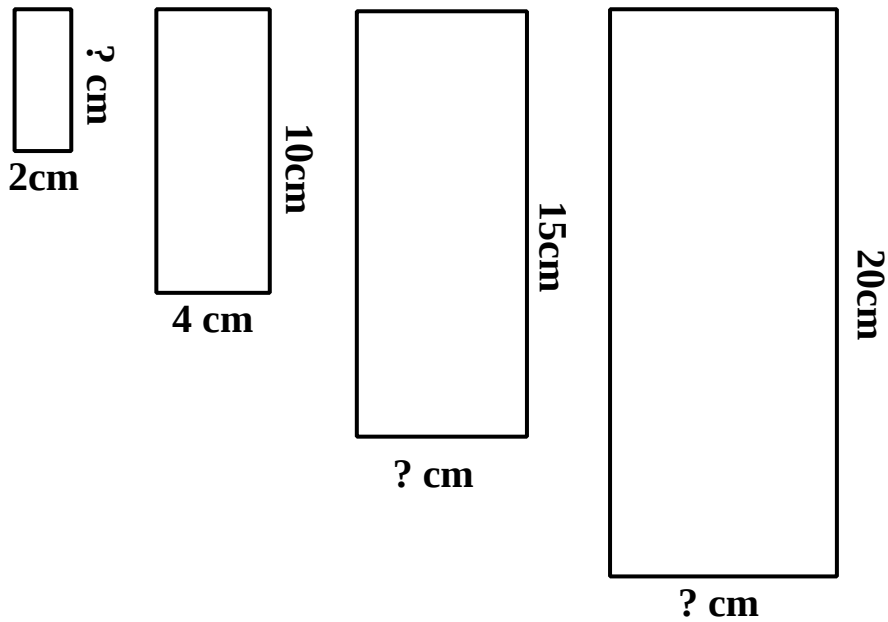
[1 mark]

(ii) What is the length of the side marked with a question mark ?

[1 mark]

Question 4

The four rectangles shown below are all similar to each other.
Find the lengths marked with a question mark.



[3 marks]

Question 5

Two rectangles are similar with length scale factor $\frac{11}{2}$.
The smaller rectangle measures 10 cm by 6 cm.
What are the measurements of the larger rectangle ?

[2 marks]

Question 6

A larger rectangle is $\frac{9}{7}$ times bigger than a smaller, similar rectangle.
The smaller rectangle measures 21 cm by 28 cm.
What are the measurements of the larger rectangle ?

[2 marks]

Question 7

An Investigation

Complete the following table without the use of any decimal fractions.

lsf = length scale factor.

asf = area scale factor.

Rectangle A length $\times$ breadth	Rectangle B length $\times$ breadth	Area A	Area B	lsf B from A	asf B from A
4×8	6×12				
3×9	4×12				
10×20	15×30				
20×20	50×50				
8×4	10×5				
6×9	8×12				

There is an important connection between an **area scale factor** and the **length scale factor** for the same pair of similar shapes.

Can you guess what this might be ?

[9 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

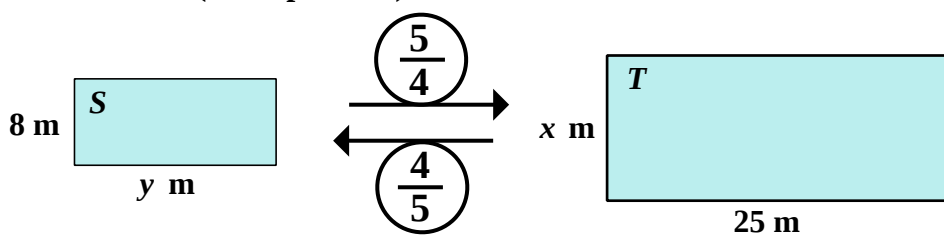
© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

1.4 Answers

GCSE Mathematics Ratio and Similarity

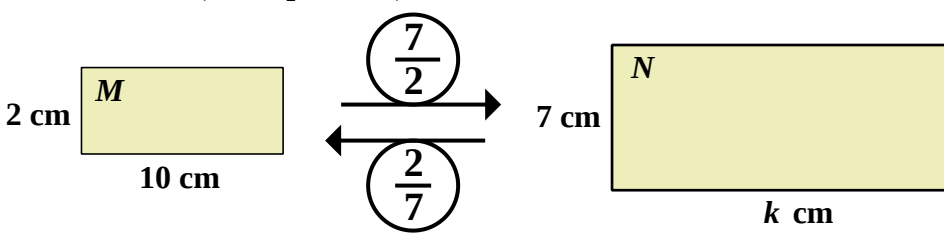
1.4.1 Solutions (Example N° 1)



$x = 8 \times \frac{5}{4} = 10 \text{ m}$
 $y = 25 \times \frac{4}{5} = 20 \text{ m}$

[2 marks]

1.4.2 Solutions (Example N° 2)

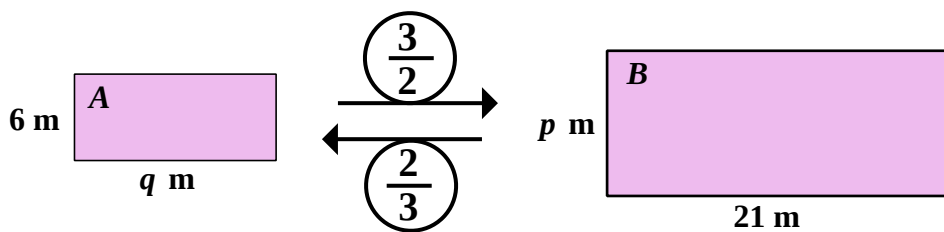


$k = 10 \times \frac{7}{2} = 35 \text{ cm}$

[2 marks]

1.5.2 Solutions (Exercise)

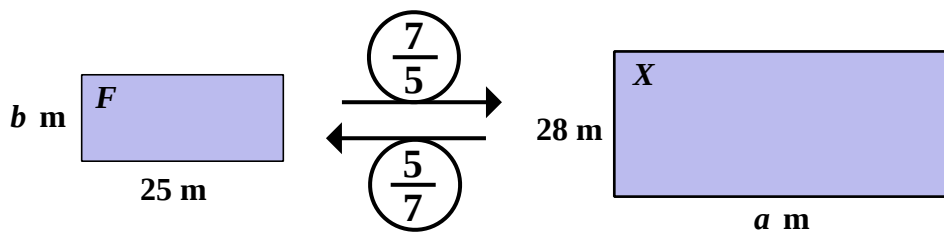
Answer 1



$p = 6 \times \frac{3}{2} = 9 \text{ m}$
 $q = 21 \times \frac{2}{3} = 14 \text{ m}$

[2 marks]

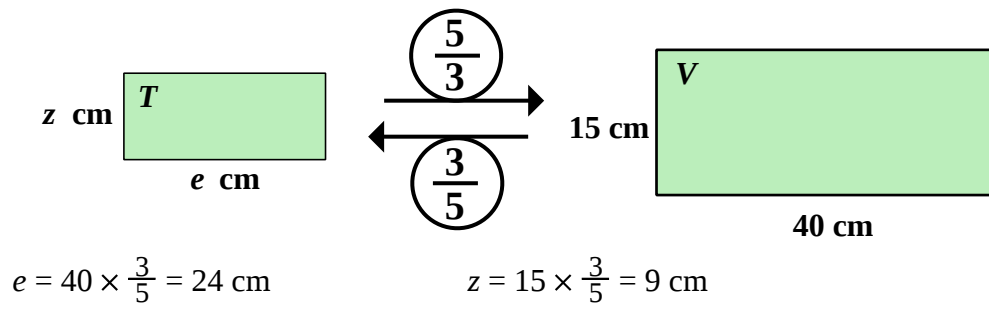
Answer 2



$a = 25 \times \frac{7}{5} = 35 \text{ m}$
 $b = 28 \times \frac{5}{7} = 20 \text{ m}$

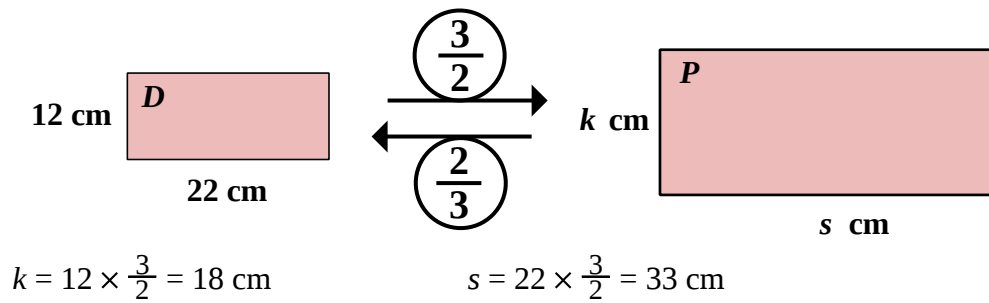
[2 marks]

Answer 3



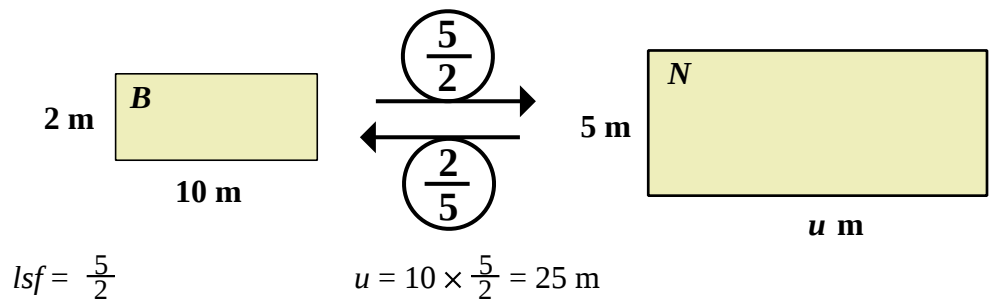
[2 marks]

Answer 4



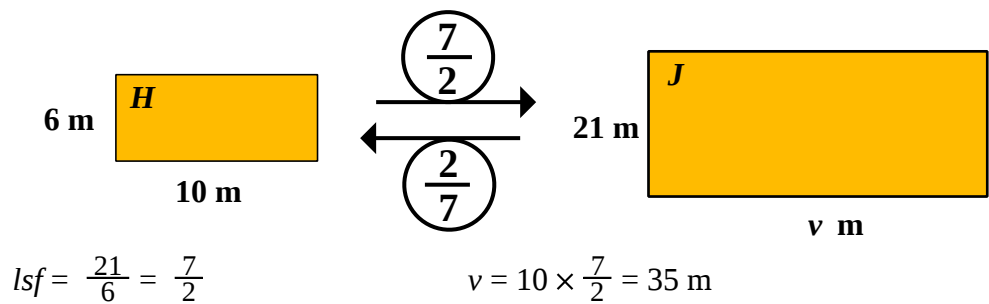
[2 marks]

Answer 5



[2 marks]

Answer 6



[2 marks]

Answer 7

$$9 \times \frac{7}{3} = 21 \text{ cm}$$

Answer 8

$$40 \times \frac{4}{5} = 32 \text{ cm}$$

Answer 9

44 cm by 99 cm

[2, 2, 2 marks]

Answer 10

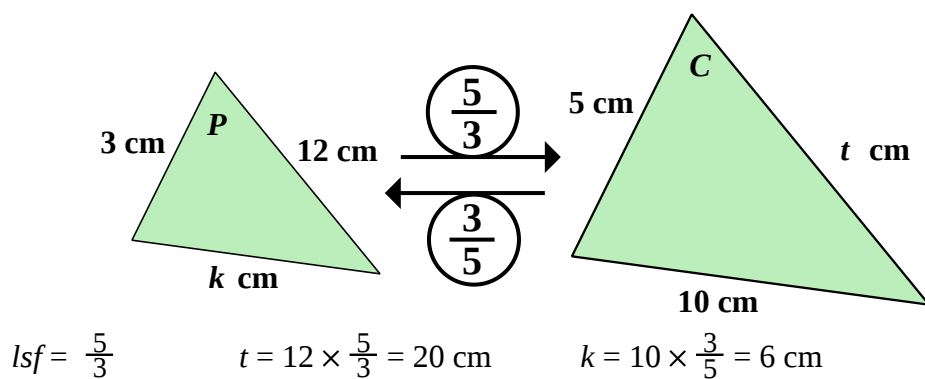
6 cm by 9 cm

Answer 11

$$\frac{25}{15} = \frac{5}{3}$$

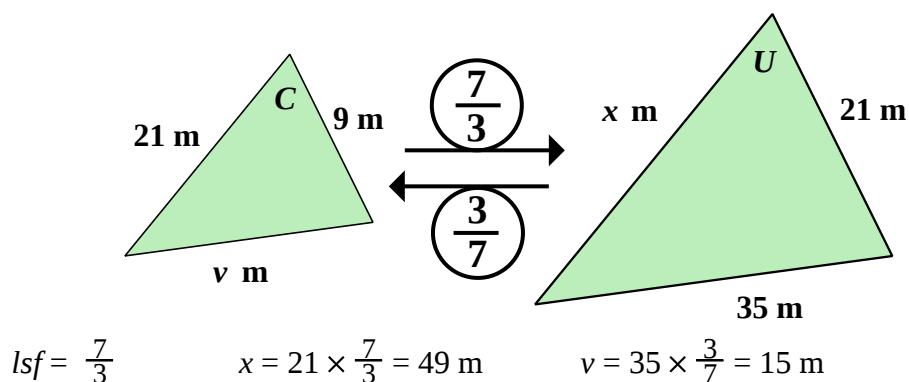
[2, 2 marks]

Answer 12



[3 marks]

Answer 13



[3 marks]

Answer 14

$$lsf = \frac{27}{6} = \frac{9}{2}$$

$$height = 4 \times \frac{9}{2} = 18 \text{ cm}$$

[2 marks]

Answer 15

(i) No (ii) $\frac{12}{8} \neq \frac{15}{9}$

[1, 1 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

1.5.3 Solutions (Homework)

GCSE Mathematics Ratio and Similarity

Answer 1

$$\frac{12}{16} = \frac{3}{4}$$

[1 mark]

Answer 2

$$15 \times \frac{8}{3} = 40 \text{ cm}$$

[1 mark]

Answer 3

(i) $\frac{15}{9} = \frac{5}{3}$

(ii) $21 \times \frac{5}{3} = 35\text{cm}$

[1, 1 marks]

Answer 4

5 cm, 6 cm and 8 cm

[3 marks]

Answer 5

$$10 \times \frac{11}{2} = 55 \text{ cm}$$

$$6 \times \frac{11}{2} = 33 \text{ cm}$$

[2 marks]

Answer 6

$$21 \times \frac{9}{7} = 27 \text{ cm}$$

$$28 \times \frac{9}{7} = 36 \text{ cm}$$

[2 marks]

Answer 7

Rectangle A length $\times$ breadth	Rectangle B length $\times$ breadth	Area A	Area B	lsf B from A	asf B from A
4×8	6×12	32	72	$\frac{3}{2}$	$\frac{9}{4}$
3×9	4×12	27	48	$\frac{4}{3}$	$\frac{16}{9}$
10×20	15×30	200	450	$\frac{3}{2}$	$\frac{9}{4}$
20×20	50×50	400	2500	$\frac{5}{2}$	$\frac{25}{4}$
8×4	10×5	32	50	$\frac{5}{4}$	$\frac{25}{16}$
6×9	8×12	54	96	$\frac{4}{3}$	$\frac{16}{9}$

[9 marks]

Important Result :

$$asf = (lsf)^2$$

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

Lesson 2

GCSE Mathematics Ratio and Similarity

2.1 Starter : Squaring Vulgar Fractions

Here are three examples to illustrate how to square vulgar fractions.

Study the three examples:

Example #1

With all the steps shown;

$$\begin{aligned}\left(\frac{7}{10}\right)^2 &= \left(\frac{7}{10}\right) \times \left(\frac{7}{10}\right) \\ &= \frac{7 \times 7}{10 \times 10} \\ &= \frac{7^2}{10^2} \\ &= \frac{49}{100}\end{aligned}$$

Example #2

Trying to do it faster by missing out some steps;

$$\begin{aligned}\left(\frac{3}{4}\right)^2 &= \frac{3^2}{4^2} \\ &= \frac{9}{16}\end{aligned}$$

Example #3

At speed : Doing it all mentally, just writing down the answer;

$$\left(\frac{5}{6}\right)^2 = \frac{25}{36}$$

For You To Do

Try to do these nine questions super quick without writing down any working;

$$(i) \left(\frac{4}{5}\right)^2 = \frac{\quad}{25} \quad (ii) \left(\frac{7}{3}\right)^2 = \frac{49}{\quad} \quad (iii) \left(\frac{6}{11}\right)^2 = \frac{\quad}{\quad}$$

$$(iv) \left(\frac{1}{8}\right)^2 = \frac{\quad}{\quad} \quad (v) \left(\frac{10}{9}\right)^2 = \frac{\quad}{\quad} \quad (vi) \left(\frac{5}{7}\right)^2 = \frac{\quad}{\quad}$$

$$(vii) \left(\frac{11}{6}\right)^2 = \frac{\quad}{\quad} \quad (viii) \left(\frac{3}{1}\right)^2 = \frac{\quad}{\quad} \quad (ix) \left(\frac{13}{14}\right)^2 = \frac{\quad}{\quad}$$

[9 marks]

2.2 Starter : Square-Rooting Vulgar Fractions

Here are two examples of how to square root vulgar fractions.

Study the two examples:

Example #1

With one step of working shown;

$$\begin{aligned}\sqrt{\left(\frac{81}{100}\right)} &= \frac{\sqrt{81}}{\sqrt{100}} \\ &= \frac{9}{10}\end{aligned}$$

Example #2

At speed : Doing it all mentally, just writing down the answer;

$$\sqrt{\left(\frac{9}{121}\right)} = \frac{3}{11}$$

For You To Do

Try to do these eight questions super quick without writing down any working;

$$\text{(i) } \sqrt{\left(\frac{16}{25}\right)} = \frac{\quad}{5} \qquad \text{(ii) } \sqrt{\left(\frac{49}{100}\right)} = \frac{7}{\quad}$$

$$\text{(iii) } \sqrt{\left(\frac{25}{36}\right)} = \frac{\quad}{\quad} \qquad \text{(iv) } \sqrt{\left(\frac{1}{9}\right)} = \frac{\quad}{\quad}$$

$$\text{(v) } \sqrt{\left(\frac{4}{1}\right)} = \frac{\quad}{\quad} \qquad \text{(vi) } \sqrt{\left(\frac{81}{16}\right)} = \frac{\quad}{\quad}$$

$$\text{(vii) } \sqrt{\left(\frac{400}{49}\right)} = \frac{\quad}{\quad} \qquad \text{(viii) } \sqrt{\left(\frac{196}{225}\right)} = \frac{\quad}{\quad}$$

[8 marks]

If you were good enough to get this far...

Challenge:

$$\left(\frac{4}{9}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$$

[2 marks]

2.3 The Connection between lsf and asf

Key Fact #1

To find the lsf if you know the asf

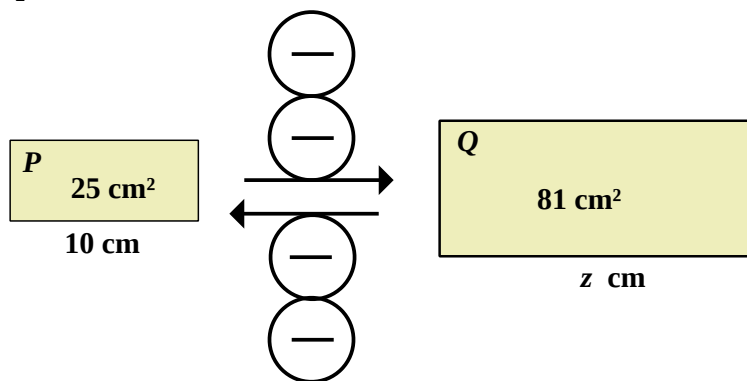
$$\text{length scale factor} = \sqrt{\text{area scale factor}}$$

Key Fact #2

To find the asf if you know the lsf

$$\text{area scale factor} = (\text{length scale factor})^2$$

2.4 Example

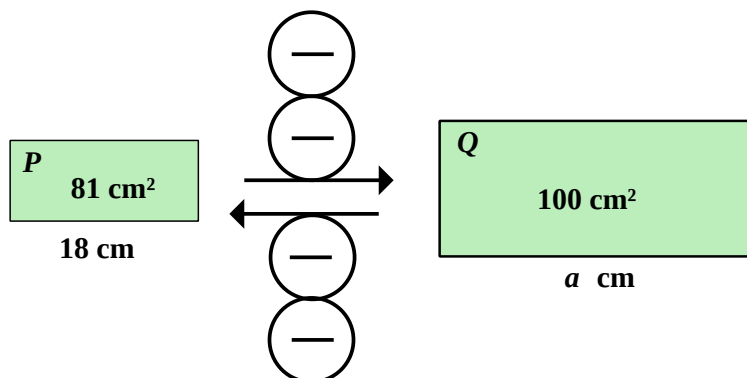


Rectangles P and Q are similar.
Find the length marked z

[3 marks]

2.5 Exercise

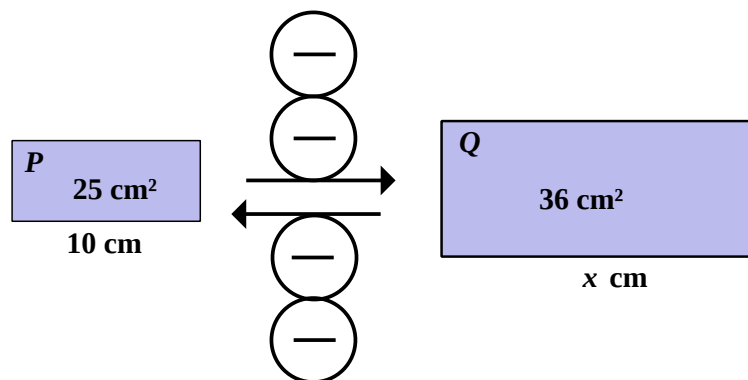
Question 1



Rectangles P and Q are similar.
Find the length marked a

[3 marks]

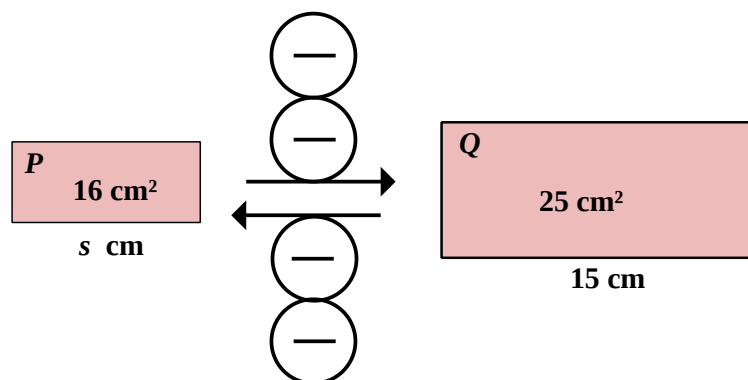
Question 2



Rectangles P and Q are similar.
Find the length marked x

[3 marks]

Question 3



Rectangles P and Q are similar.
Find the length marked s

[3 marks]

Question 4

Two similar shapes have an area scale factor of $\left(\frac{50}{32}\right)$.

Oliver has forgotten his calculator (again!) and cannot see how to square root the 50 or the 32 in order to get the length scale factor between the two similar shapes. However, there is a way of getting the length scale factor without using a calculator. Explain how.

[3 marks]

2.6 Exercise

Marks Available : 34

Question 1

(i)

$$\left(\frac{3}{8}\right)^2 = \underline{\hspace{2cm}}$$

(ii)

$$\left(\frac{5}{4}\right)^2 = \underline{\hspace{2cm}}$$

(iii)

$$\left(\frac{7}{9}\right)^2 = \underline{\hspace{2cm}}$$

(iv)

$$\sqrt{\frac{36}{49}} = \underline{\hspace{2cm}}$$

(v)

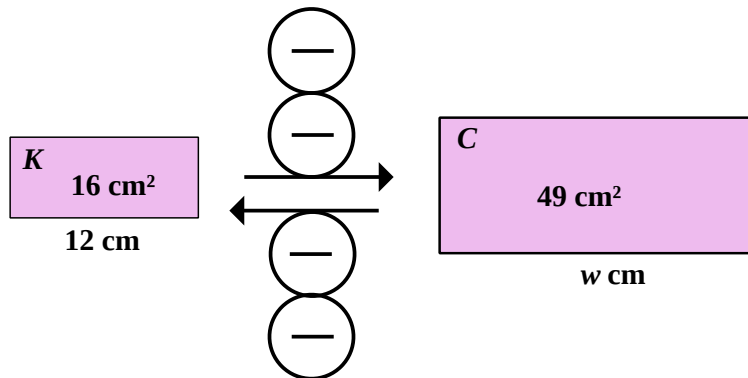
$$\sqrt{\frac{100}{9}} = \underline{\hspace{2cm}}$$

(vi)

$$\left(\frac{64}{81}\right)^{0.5} = \underline{\hspace{2cm}}$$

[6 marks]

Question 2



Rectangles *K* and *C* are similar.
Find the length marked *w*

[3 marks]

Question 3

Two similar shapes have a **length scale factor** of $\frac{6}{5}$
What is their **area scale factor** ?

[1 mark]

Question 4

Two similar shapes have an **area scale factor** of $\frac{9}{16}$
What is their **length scale factor** ?

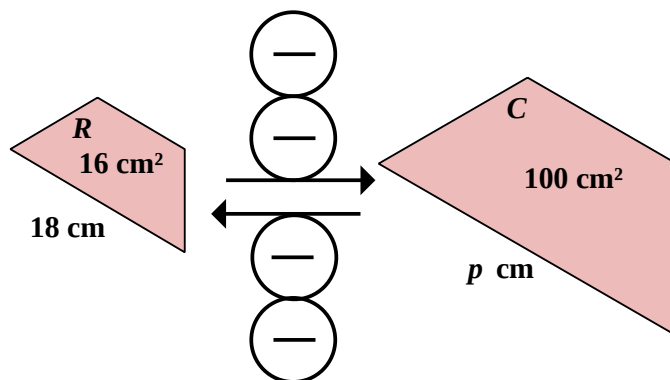
[1 mark]

Question 5

Two similar shapes have a **length scale factor** of $\frac{4}{9}$
What is their **area scale factor** ?

[1 mark]

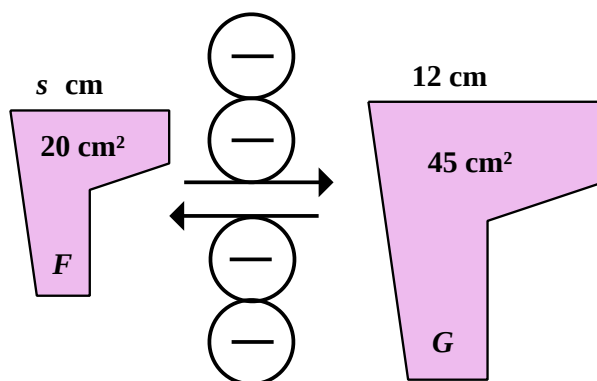
Question 6



The shapes R and C are similar.
Find the length marked p

[3 marks]

Question 7



The shapes F and G are similar.

- (i) What is the area scale factor (larger than 1) of the similarity ?
Give your answer as a fraction "cancelled down".

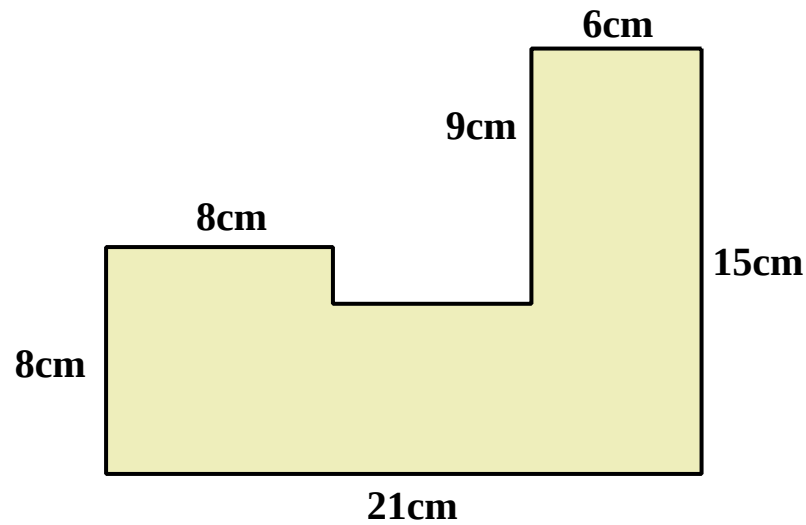
[1 mark]

- (ii) Find the length marked s

[2 marks]

Question 8

- (i) Work out the shaded area of the shape shown below.



[3 marks]

- (ii) In a larger similar shape, corresponding to the side of length 21 cm is a side of length 24 cm.

- (a) What is the **length scale factor** of the similarity ?

[1 mark]

- (b) What is the **area scale factor** of the similarity ?

[1 mark]

- (c) Use your part (i) answer and your part (ii) (b) answer to work out the area of the larger similar shape.

[2 marks]

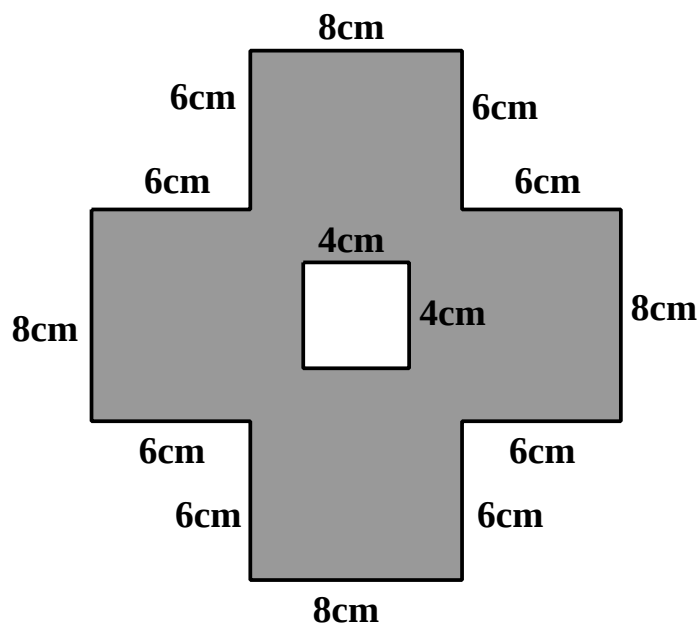
Question 9

- (i) (a) Work out the area of the white square in the shape below.

[1 mark]

- (b) Work out the area shown shaded below.

[2 marks]



- (ii) A similar, larger shape is to be drawn, using a *length scale factor* of $\frac{5}{4}$.

- (a) What will be the length, in the similar shape, of the 8cm sides ?

[1 mark]

- (b) What will be the length, in the similar shape, of the 6cm sides ?

[1 mark]

- (c) What will be the length, in the similar shape of the 2cm sides ?

[1 mark]

- (d) What will be the *area scale factor* of the similarity ?

[1 mark]

- (e) Use your part (i) (b) answer and your part (ii) (d) answer to work out the area of the larger, similar shape.

[2 marks]

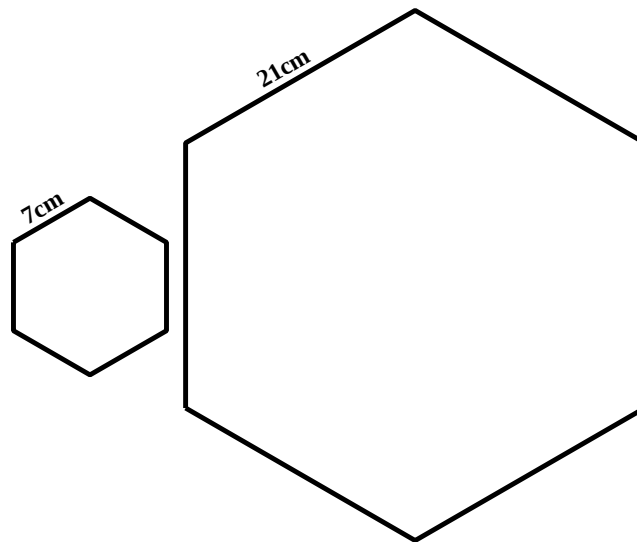
2.7 Homework

GCSE Mathematics Ratio and Similarity

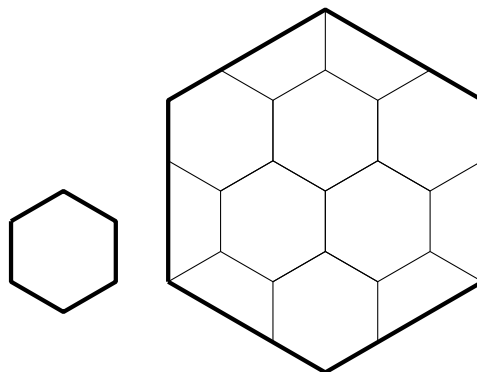
Marks Available : 26

Question 1

A hexagon of side length 7cm is similar to a larger hexagon of side length 21cm.



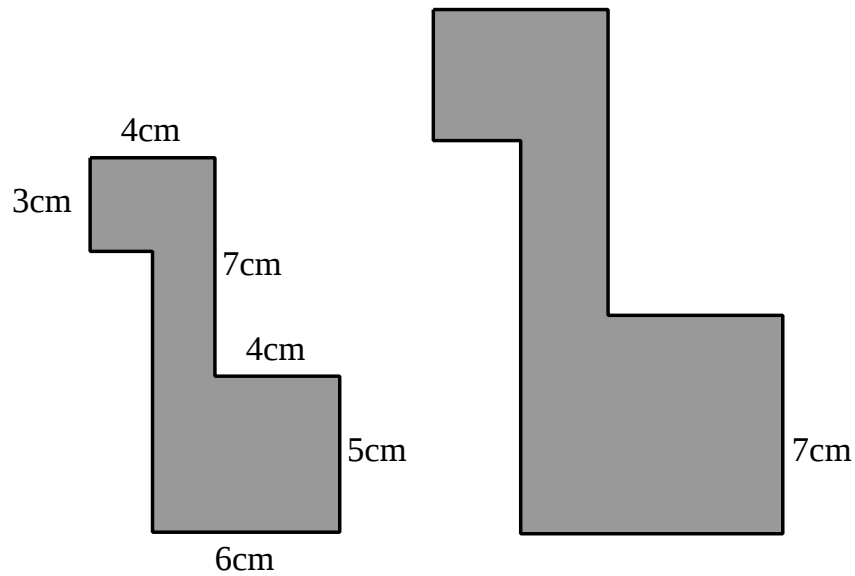
- (i) What is the **length** scale factor, greater than 1, of the similarity ?
[1 mark]
- (ii) What is the **area** scale factor, greater than 1, of the similarity ?
[1 mark]
- (iii) If the small hexagon has an area of 126cm^2 , what is the area of the larger ?
[2 marks]
- (iv) Explain how this diagram helps you understand your part (iii) answer.



[2 marks]

Question 2

The two shapes shown below are similar.



- (i) Work out the area of the left hand shape.

[3 marks]

- (ii) What is the *length scale factor*, greater than 1, of the similarity ?

[1 mark]

- (iii) What is the *area scale factor*, greater than 1 of the similarity ?

[1 mark]

- (iv) Use your part (iii) answer to work out the area of the right hand shape.

[2 marks]

Question 3

A larger rectangle has 16 times the *AREA* of a smaller, similar rectangle.

The smaller rectangle measures 3 cm by 2 cm.

(i) What are the measurements of the larger rectangle ?

[3 marks]

(ii) Draw full size the two rectangles.

[2 marks]

Question 4

A larger rectangle has 100 times the *AREA* of a smaller, similar rectangle.

The larger rectangle measures 26cm by 17cm.

What are the measurements of the smaller rectangle ?

[3 marks]

Question 5

A rectangle is 18cm in wide and 12cm high.

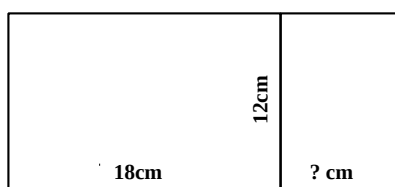
Another smaller but similar rectangle has a width of 12cm.

(i) What is its height ?

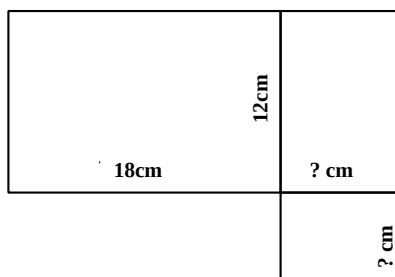
[1 mark]

The two rectangles are joined as shown below.

You've just worked out the value of the side marked with a question mark.



A third rectangle, similar to the first two is now added as shown below.



(ii) What are the measurements of this third rectangle ?
(Note : the answer is a fraction and not an integer)

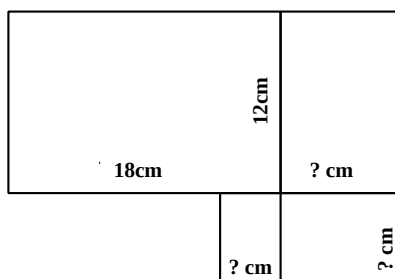
[2 marks]

Finally, a fourth rectangle is added as shown below.

This rectangle is similar to the other three.

What are the measurements of this fourth rectangle ?

(Note : once again, the answer is a fraction and not an integer)



[2 marks]

2.8 Answers

GCSE Mathematics Ratio and Similarity

2.8.1 Solutions to 2.1 Starter : Squaring Vulgar Fractions

$$(i) \left(\frac{4}{5}\right)^2 = \frac{16}{25} \quad (ii) \left(\frac{7}{3}\right)^2 = \frac{49}{9} \quad (iii) \left(\frac{6}{11}\right)^2 = \frac{36}{121}$$

$$(iv) \left(\frac{1}{8}\right)^2 = \frac{1}{64} \quad (v) \left(\frac{10}{9}\right)^2 = \frac{100}{81} \quad (vi) \left(\frac{5}{7}\right)^2 = \frac{25}{49}$$

$$(vii) \left(\frac{11}{6}\right)^2 = \frac{121}{36} \quad (viii) \left(\frac{3}{1}\right)^2 = \frac{9}{1} \quad (ix) \left(\frac{13}{14}\right)^2 = \frac{169}{196}$$

[9 marks]

2.8.2 Solutions to 2.2 Starter : Square-Rooting Vulgar Fractions

$$(i) \sqrt{\left(\frac{16}{25}\right)} = \frac{4}{5} \quad (ii) \sqrt{\left(\frac{49}{100}\right)} = \frac{7}{10}$$

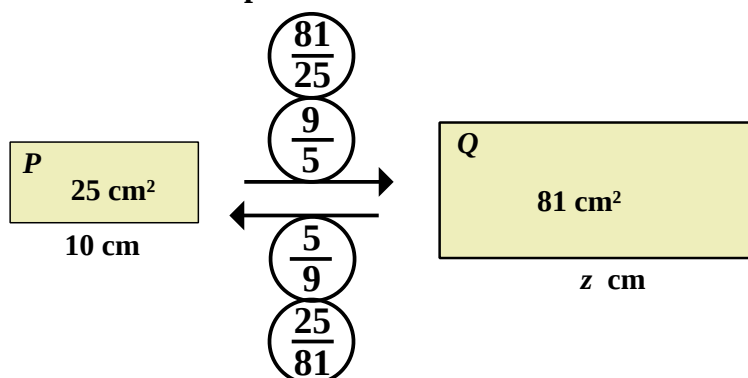
$$(iii) \sqrt{\left(\frac{25}{36}\right)} = \frac{5}{6} \quad (iv) \sqrt{\left(\frac{1}{9}\right)} = \frac{1}{3}$$

$$(v) \sqrt{\left(\frac{4}{1}\right)} = \frac{2}{1} \quad (vi) \sqrt{\left(\frac{81}{16}\right)} = \frac{9}{4}$$

$$(vii) \sqrt{\left(\frac{400}{49}\right)} = \frac{20}{7} \quad (viii) \sqrt{\left(\frac{196}{225}\right)} = \frac{14}{15}$$

Challenge: $\left(\frac{4}{9}\right)^{\frac{1}{2}} = \sqrt{\left(\frac{4}{9}\right)} = \frac{2}{3}$

2.8.3 Solution to 2.4 Example

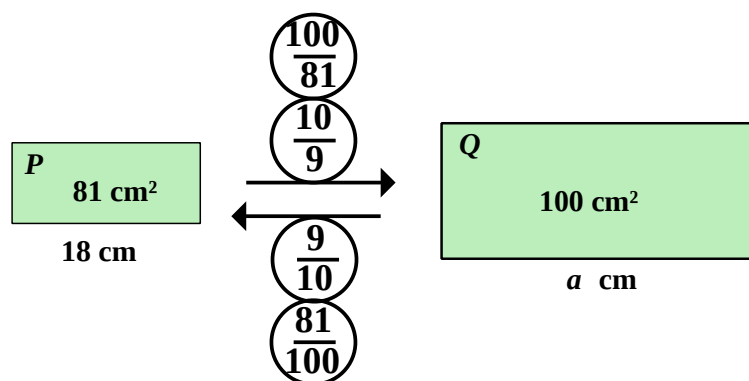


$$z = 10 \times \frac{9}{5} = 18 \text{ cm}$$

[3 marks]

2.8.4 Solutions to 2.5 Exercise

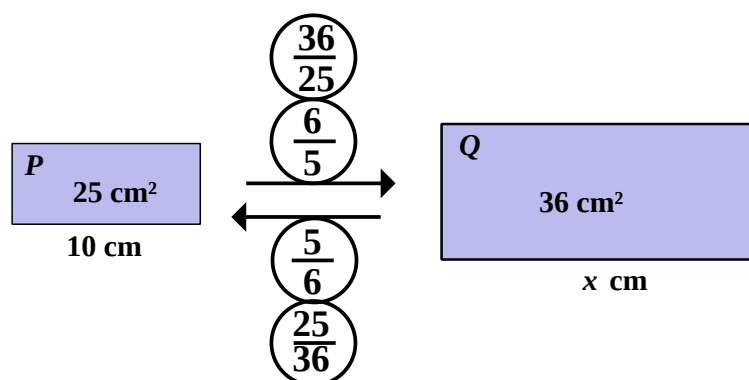
Answer 1



$$a = 18 \times \frac{10}{9} = 20 \text{ cm}$$

[3 marks]

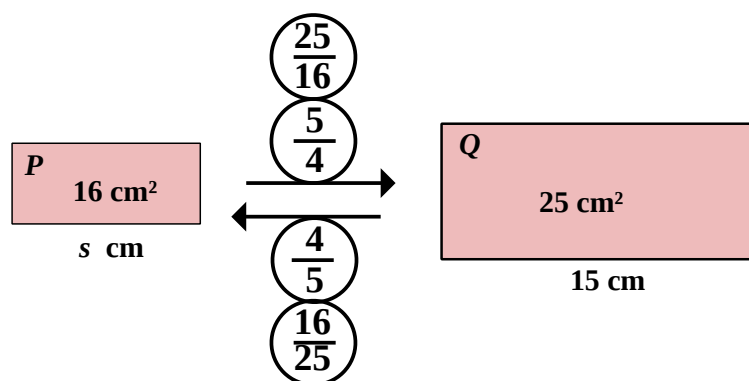
Answer 2



$$x = 10 \times \frac{6}{5} = 12 \text{ cm}$$

[3 marks]

Answer 3



$$s = 15 \times \frac{4}{5} = 12 \text{ cm}$$

[3 marks]

Answer 4

Cancel down the fraction, then square root.

$$\begin{aligned}
 asf &= \left(\frac{50}{32} \right) \\
 &= \left(\frac{25}{16} \right) \\
 lsf &= \sqrt{asf} \\
 &= \sqrt{\left(\frac{25}{16} \right)} \\
 &= \frac{5}{4}
 \end{aligned}$$

[3 marks]

2.8.5 Solutions to 2.6 Exercise**Answer 1**

(i) $\frac{9}{64}$

(ii) $\frac{25}{16}$

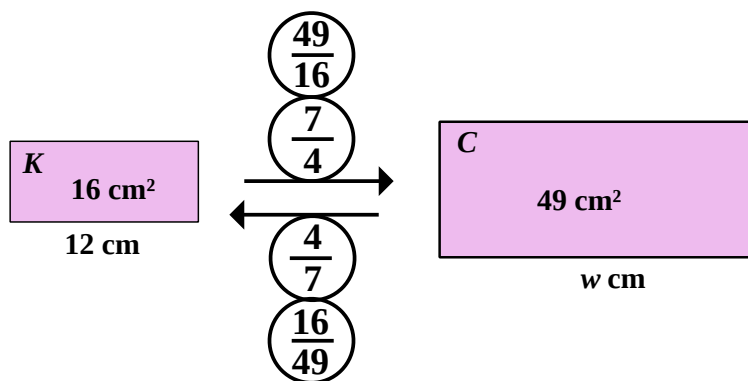
(iii) $\frac{49}{81}$

(iv) $\frac{6}{7}$

(v) $\frac{10}{3}$

(vi) $\frac{8}{9}$

[6 marks]

Answer 2

$$w = 12 \times \frac{7}{4} = 21 \text{ cm}$$

[3 marks]

Answer 3

$$\frac{36}{25}$$

Answer 4

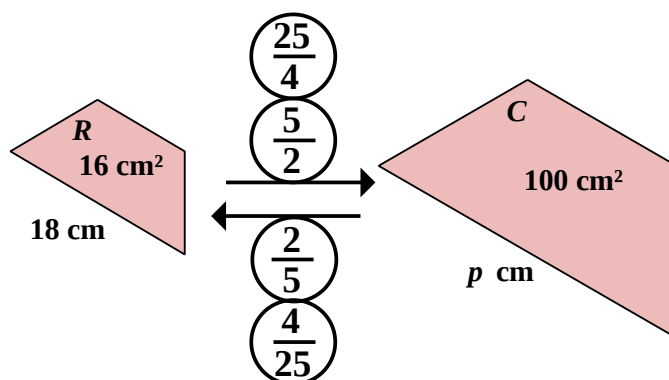
$$\frac{3}{4}$$

Answer 5

$$\frac{16}{81}$$

[1, 1, 1 marks]

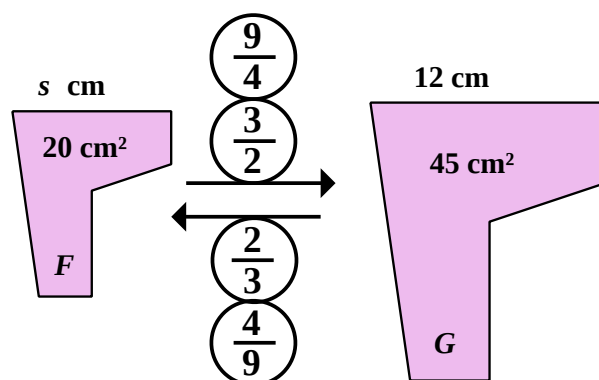
Answer 6



$$p = 18 \times \frac{5}{2} = 45 \text{ cm}$$

[3 marks]

Answer 7



(i) $asf = \frac{9}{4}$

[1 mark]

(ii) $s = 12 \times \frac{2}{3} = 8 \text{ cm}$

[2 marks]

Answer 8

(i) 196 cm²

[3 marks]

(ii) (a) $lsf = \frac{8}{7}$

[1 mark]

(b) $asf = \frac{64}{49}$

[1 mark]

(c) 256 cm²

[2 marks]

Answer 9

- | | | | |
|--------|-------|---------------------|-------------|
| (i) | (a) | 16 cm ² | [1 mark] |
| | (b) | 240 cm ² | [2 marks] |
| (ii) | (a) | 10 cm | [1 mark] |
| | (b) | 7.5 cm | [1 mark] |
| | (c) | 2.5 cm | [1 mark] |
| | (d) | $\frac{25}{16}$ | [1 mark] |
| | (e) | 375 cm ² | [2 marks] |

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

2.8.6 Solutions to 2.7 Homework

GCSE Mathematics Ratio and Similarity

Answer 1

- (i) 3 [1 mark]
- (ii) 9 [1 mark]
- (iii) 1134 cm^2 [2 marks]
- (iv) The lsf is 3 and the asf is 9 which illustrates that $asf = lsf^2$ [2 marks]

Answer 2

- (i) 50 cm^2 [3 marks]
- (ii) $lsf = \frac{7}{5}$ [1 mark]
- (iii) $asf = \frac{49}{25}$ [1 mark]
- (iv) Area = $50 \times \frac{49}{25} = 98 \text{ cm}^2$ [2 marks]

Answer 3

- (i) 12 cm by 8 cm [3 marks]
- (ii) Full size rectangles [2 marks]

Answer 4

2.6 cm by 1.7 cm [3 marks]

Answer 5

- (i) 8 cm [1 mark]
- (ii) $8 \times 5.333...$ [2 marks]
- (iii) $5.333... \times 3.555...$ [2 marks]
- $18 \times 12 \implies 12 \times 8 \implies 8 \times 5.333... \implies 5.333... \times 3.555...$

Squares and Cubes from 1 to 99

	Square	Cube
1	1	1
2	4	8
3	9	27
4	16	64
5	25	125
6	36	216
7	49	343
8	64	512
9	81	729
10	100	1000
11	121	1331
12	144	1728
13	169	2197
14	196	2744
15	225	3375
16	256	4096
17	289	4913
18	324	5832
19	361	6859
20	400	800
21	441	9261
22	484	10648
23	529	12167
24	576	13824
25	625	15625
26	676	17576
27	729	19683
28	784	21952
29	841	24389
30	900	27000
31	961	29791
32	1024	32768
33	1089	35937

	Square	Cube
34	1156	39304
35	1225	42875
36	1296	46656
37	1369	50653
38	1444	54872
39	1521	59319
40	1600	64000
41	1681	68921
42	1764	74088
43	1849	79507
44	1936	85184
45	2025	91125
46	2116	97336
47	2209	103823
48	2304	110592
49	2401	117649
50	2500	125000
51	2601	132651
52	2704	140608
53	2809	148877
54	2916	157464
55	3025	166375
56	3136	175616
57	3249	185193
58	3364	195112
59	3481	205379
60	3600	216000
61	3721	226981
62	3844	238328
63	3969	250047
64	4096	262144
65	4225	274625
66	4356	287496

	Square	Cube
67	4489	300763
68	4624	314432
69	4761	328509
70	4900	343000
71	5041	357911
72	5184	373248
73	5329	389017
74	5476	405224
75	5625	421875
76	5776	438976
77	5929	456533
78	6084	474552
79	6241	493039
80	6400	512000
81	6561	531441
82	6724	551368
83	6889	571787
84	7056	592704
85	7225	614125
86	7396	636056
87	7569	658503
88	7744	681472
89	7921	704969
90	8100	729000
91	8281	753571
92	8464	778688
93	8649	804357
94	8836	830584
95	9025	857375
96	9216	884736
97	9409	912673
98	9604	941192
99	9801	970299

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

Lesson 3

GCSE Mathematics Ratio and Similarity

Non Calculator

3.1 Start Up

Use the table of *Squares and Cubes from 1 to 99* to determine;

(i)

$$\left(\frac{21}{26}\right)^2 = \frac{441}{\quad}$$

(ii)

$$\left(\frac{49}{34}\right)^2 = \frac{\quad}{1156}$$

(iii)

$$\left(\frac{32}{91}\right)^2 = \frac{\quad}{\quad}$$

(iv)

$$\left(\frac{17}{31}\right)^3 = \frac{4913}{\quad}$$

(v)

$$\left(\frac{7}{29}\right)^3 = \frac{\quad}{24389}$$

(vi)

$$\left(\frac{63}{50}\right)^3 = \frac{\quad}{\quad}$$

(vii)

$$\left(\frac{324}{625}\right)^{0.5} = \frac{18}{\quad}$$

(viii)

$$\left(\frac{196}{4356}\right)^{0.5} = \frac{\quad}{66}$$

(ix)

$$\left(\frac{6241}{9801}\right)^{0.5} = \frac{\quad}{\quad}$$

(x)

$$\left(\frac{81}{25}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$$

(xi)

$$\left(\frac{1}{100}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$$

(xii)

$$\left(\frac{2116}{2601}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$$

(xiii)

$$\left(\frac{8}{27}\right)^{\frac{1}{3}} = \frac{\quad}{\quad}$$

(xiv)

$$\left(\frac{4096}{24389}\right)^{\frac{1}{3}} = \frac{\quad}{\quad}$$

(xv)

$$\left(\frac{857375}{884736}\right)^{\frac{1}{3}} = \frac{\quad}{\quad}$$

[15 marks]

3.2 Volume Scale Factor (vsf)

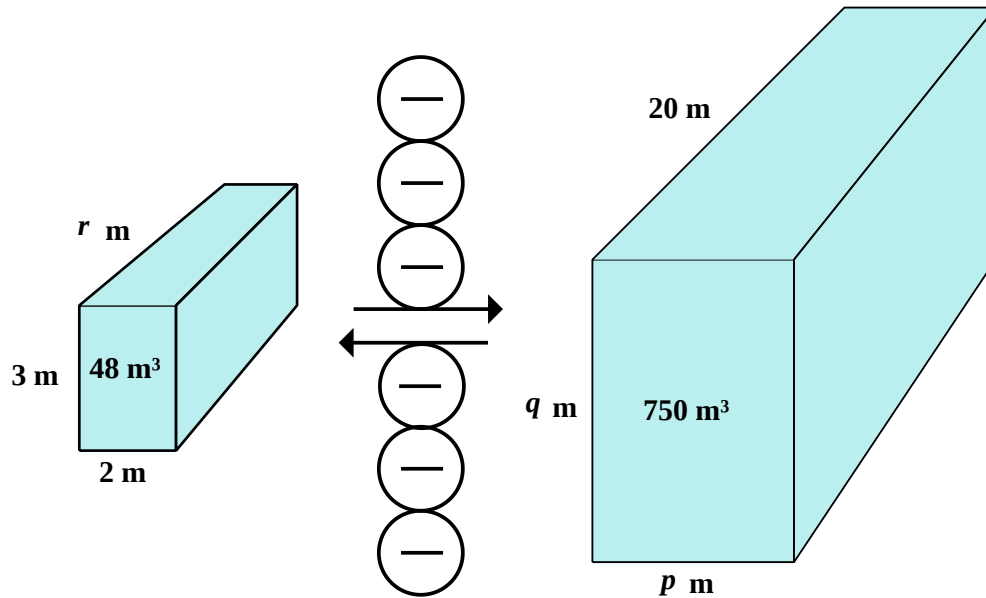
For any two similar solids:

$$\text{volume scale factor} = (\text{length scale factor})^3$$

which can also be expressed as:

$$\text{length scale factor} = \sqrt[3]{\text{volume scale factor}}$$

3.3 Example



The above two similar cuboids are shown with the same orientation.

(i) Find the lengths marked p , q and r .

[3 marks]

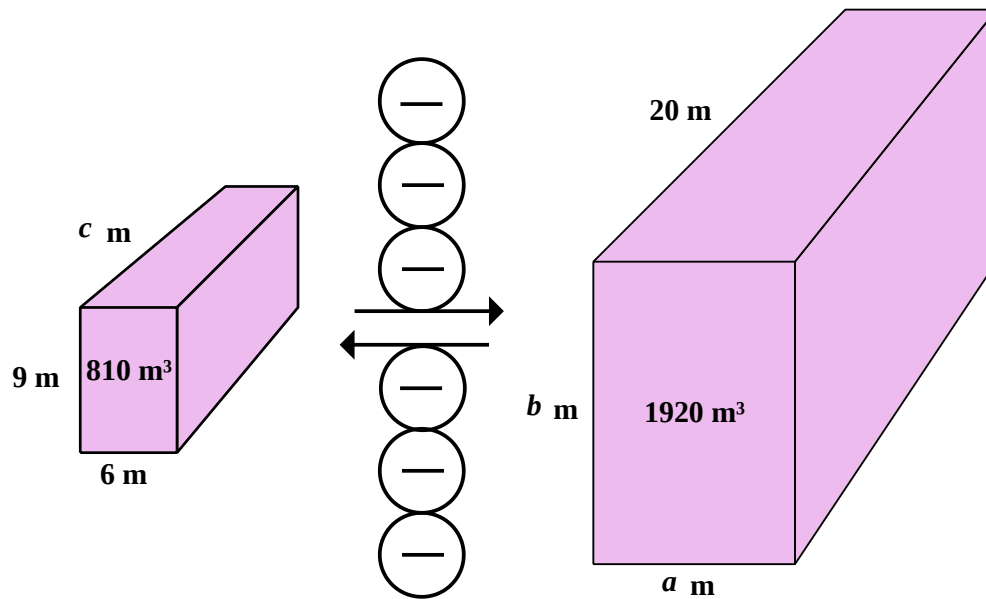
(ii) How many times more surface area has the larger cuboid than the smaller ?

[1 mark]

3.4 Exercise

Marks Available : 56

Question 1



The above two similar cuboids are shown with the same orientation.

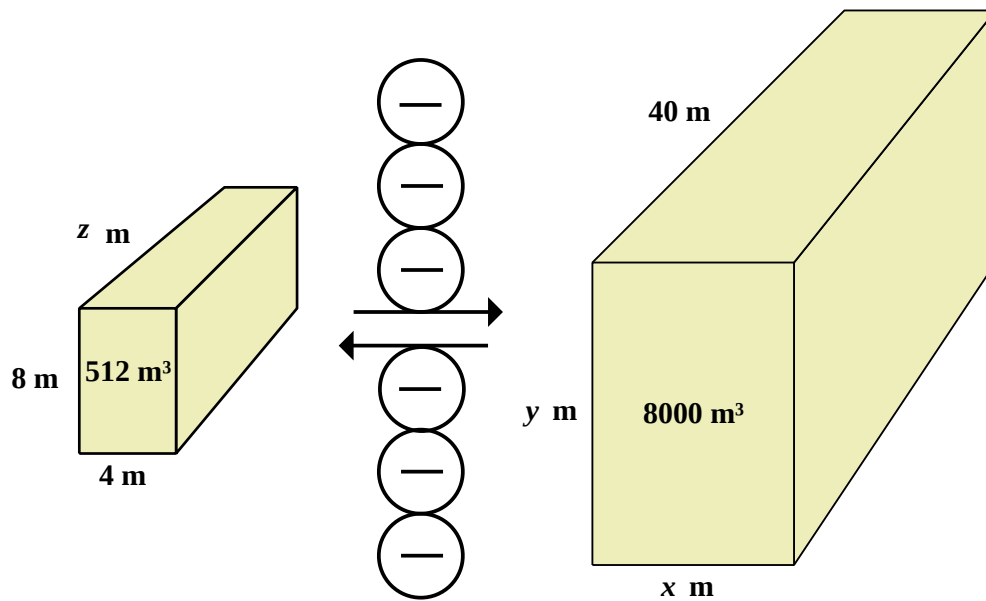
- (i) Find the lengths marked a , b and c .

[3 marks]

- (ii) How many times more surface area has the larger cuboid than the smaller ?

[2 marks]

Question 2



The above two similar cuboids are shown with the same orientation.

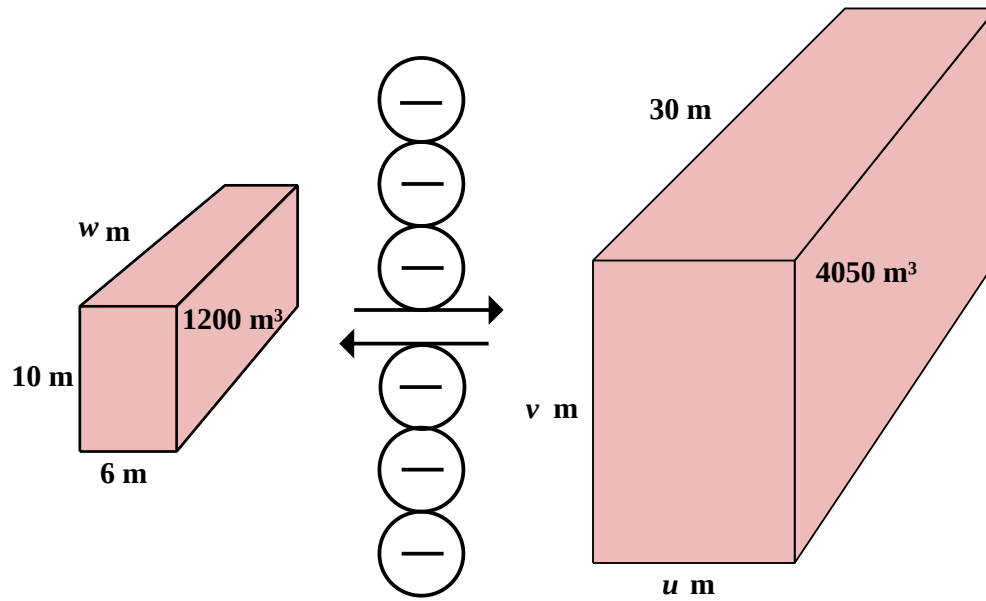
- (i) Find the lengths marked x , y and z .

[3 marks]

- (ii) How many times more surface area has the larger cuboid than the smaller ?

[2 marks]

Question 3



The above two similar cuboids are shown with the same orientation.

- (i) Find the lengths marked u , v and w .

[3 marks]

- (ii) How many times more surface area has the larger cuboid than the smaller ?

[2 marks]

Question 4

- (i) Are all squares similar ? YES / NO
In other words, *Are all squares the same shape ?*

[1 mark]

- (ii) A smaller square has an area of 27cm^2 .
A larger square has a side $\frac{5}{3}$ times greater than the small square.
What is the area of the larger square ?

$$\text{Hint : } lsf = \frac{5}{3} \quad asf = (lsf)^2 \quad A_{BIG} = A_{SMALL} \times asf$$

[3 marks]

Question 5

Cuboid *G* measures 14cm by 21cm by 28cm.

Cuboid *H* measures 4cm by 6cm by 8cm.

- (i) Complete the following to show that the two cuboids similar.

$$\frac{14}{6} = \frac{\quad}{\quad} = \frac{\quad}{\quad} \quad \text{All cancel down to } \frac{\quad}{\quad}$$

[2 marks]

- (ii) What is the **length scale factor**, greater than 1, of the similarity ?

$$lsf = \frac{\quad}{\quad}$$

[1 mark]

- (iii) What is the **area scale factor** of, greater than 1, of the similarity ?

$$asf = \frac{\quad}{\quad}$$

[1 mark]

- (iv) What is the **volume scale factor**, greater than 1, of the similarity ?

$$vsf = \frac{\quad}{\quad}$$

[1 mark]

- (v) Calculate;

(a) V_{BIG}

[1 mark]

(b) V_{SMALL}

[1 mark]

(c) $V_{SMALL} \times vsf$

[1 mark]

(d) Comment

[1 mark]

Question 6

Are all rectangles similar ?

YES / NO

In other words, *Are all rectangles the same shape ?*

[1 mark]

Question 7

(i) Are all spheres similar ?

YES / NO

[1 mark]

(ii) A smaller sphere has a volume of 32cm^3 .

A larger sphere has a radius $\frac{5}{2}$ times greater than the small sphere.

What is the volume of the larger sphere ?

$$\text{Hint : } lsf = \frac{5}{2} \quad vsf = (lsf)^3 \quad V_{BIG} = V_{SMALL} \times vsf$$

[3 marks]

Question 8

A larger cuboid has lengths that are $\frac{4}{3}$ times longer than a similar smaller cuboid.

The smaller cuboid measures 60cm by 66cm by 42cm.

What are the measurements of the larger cuboid ?

_____ by _____ by _____

[2 marks]

Question 9

A larger cuboid has lengths that are $\frac{7}{4}$ times longer than a similar smaller cuboid.

The smaller cuboid measures 8 cm by 40 cm by 44 cm.

What are the measurements of the larger cuboid ?

_____ by _____ by _____

[2 marks]

Question 10

(i) Are all triangles similar ?

YES / NO

[1 mark]

(ii) Are all right angled triangles similar ?

YES / NO

[1 mark]

(iii) Are all equilateral triangles similar ?

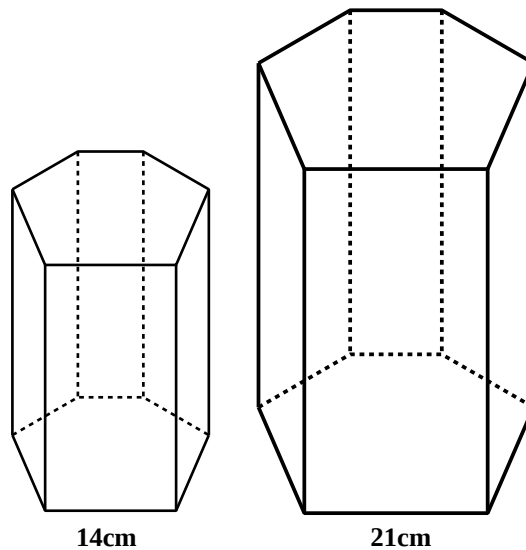
YES / NO

[1 mark]

Question 11

Two similar hexagonal prisms are shown below.

An edge of 14cm on the smaller corresponds to an edge of length 21cm on the larger.



- (i) What is the **length scale factor**, greater than 1, of the similarity ?

$$lsf = \text{———}$$

[1 mark]

- (ii) What is the **area scale factor**, greater than 1, of the similarity ?

$$asf = \text{———}$$

[1 mark]

- (iii) What is the **volume scale factor**, greater than 1, of the similarity ?

$$vsf = \text{———}$$

[1 mark]

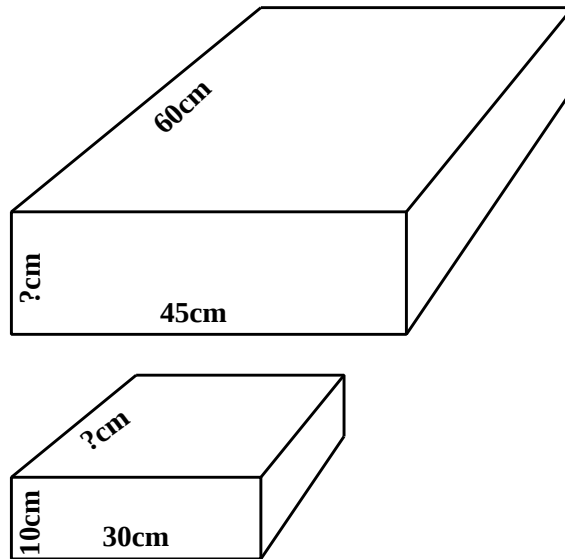
- (iv) The volume of the smaller hexagonal prism is 40 cm^3 .

Calculate the volume of the larger hexagonal prism.

[2 marks]

Question 12

The two cuboids shown below are similar.



- (i) What is the **length scale factor**, greater than 1, of the similarity ?

$lsf = \text{———}$

[1 mark]

- (ii) Find the height of the upper cuboid, marked with a question mark.

[1 mark]

- (iii) Find the missing length on the lower cuboid, marked with a question mark.

[1 mark]

Question 13

Each face of a smaller cube has an area of 36 cm^2

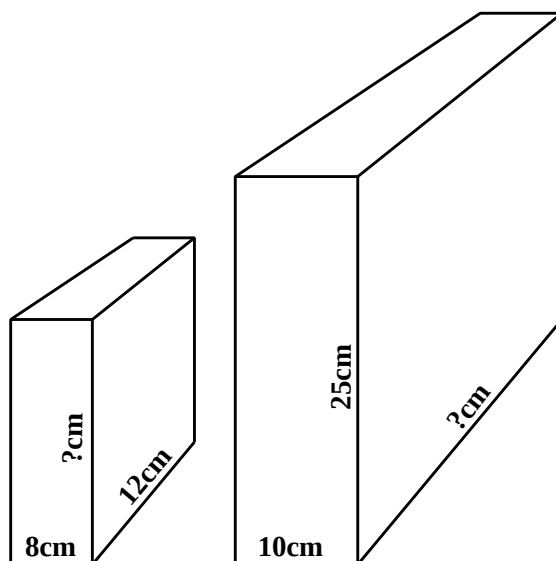
A larger cube has edges that are 10 times longer.

What is the volume of the larger cube ?

[3 marks]

Question 14

The two cuboids shown below are similar.



- (i) What is the **length scale factor**, greater than 1, of the similarity ?

$lsf = \text{———}$

[1 mark]

- (ii) Find the unknown length of the right cuboid, marked with a question mark.

[1 mark]

- (iii) Find the unknown height of the left cuboid, marked with a question mark.

[1 mark]

Question 15

A 250 ml can of coke is similar to a 500 ml can of coke.

Explain why radius of the larger can is NOT double that of the smaller.

[3 marks]

3.5 Answers

GCSE Mathematics Ratio and Similarity

3.5.1 Solutions (3.1 Warm up)

(i)

$$\frac{441}{676}$$

(ii)

$$\frac{2401}{1156}$$

(iii)

$$\frac{1024}{8281}$$

(iv)

$$\frac{4913}{29791}$$

(v)

$$\frac{343}{34389}$$

(vi)

$$\frac{250047}{125000}$$

(vii)

$$\frac{18}{25}$$

(viii)

$$\frac{14}{66}$$

(ix)

$$\frac{79}{99}$$

(x)

$$\frac{9}{5}$$

(xi)

$$\frac{1}{10}$$

(xii)

$$\frac{46}{51}$$

(xiii)

$$\frac{2}{3}$$

(xiv)

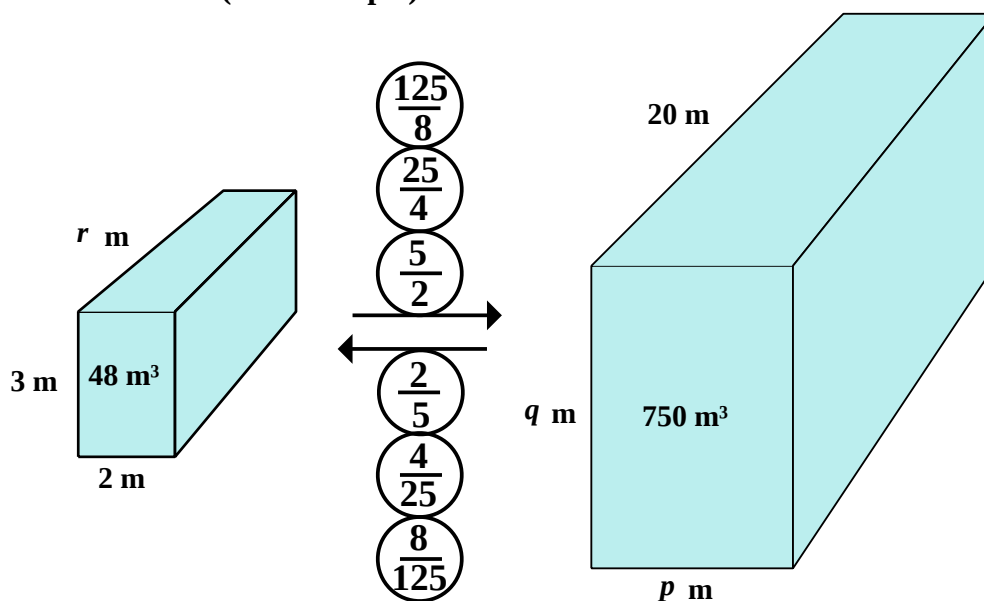
$$\frac{16}{29}$$

(xv)

$$\frac{95}{96}$$

[15 marks]

3.5.2 Solutions (3.3 Example)



(i)

$$p = 2 \times \frac{5}{2} = 5 \text{ m}$$

$$q = 3 \times \frac{5}{2} = 7.5 \text{ m}$$

$$r = 20 \times \frac{2}{5} = 8 \text{ m}$$

[3 marks]

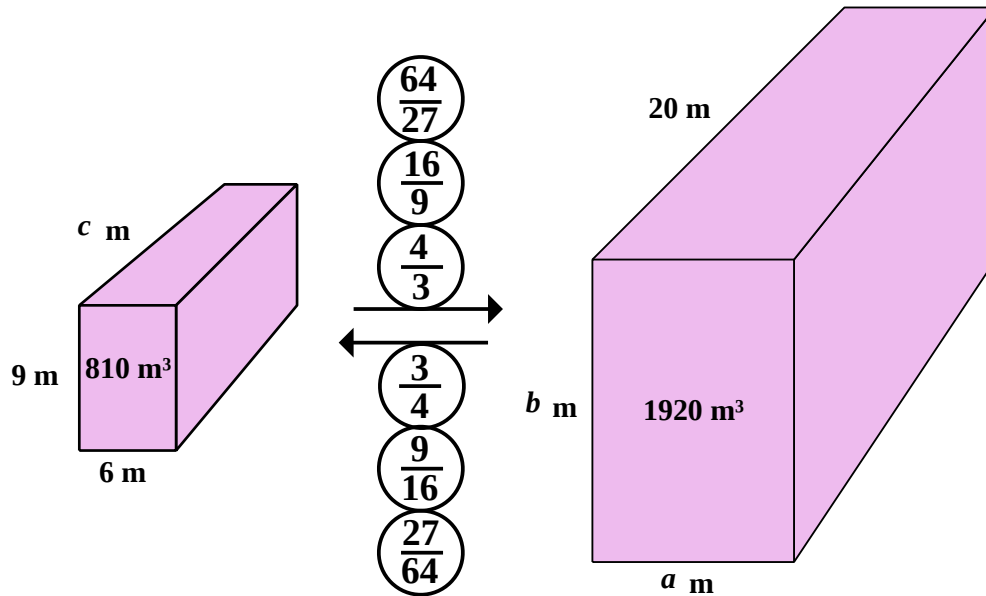
(ii)

$$\frac{25}{4} \quad \text{or} \quad 6.25$$

[2 marks]

3.5.3 Solutions (3.4 Exercise)

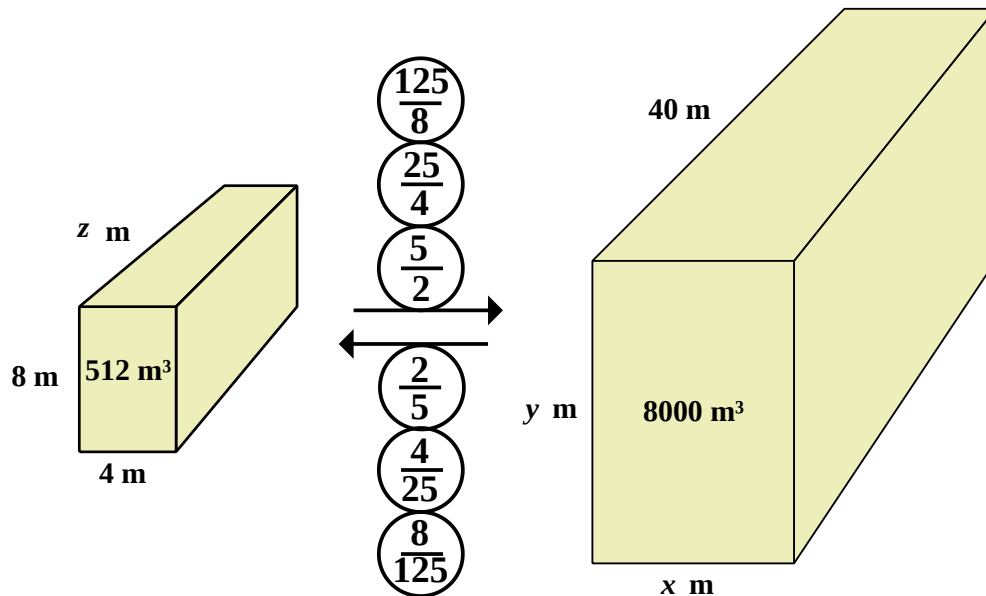
Answer 1



(i) $a = 6 \times \frac{4}{3} = 8 \text{ m}$ $b = 9 \times \frac{4}{3} = 12 \text{ m}$ $r = 20 \times \frac{3}{4} = 15 \text{ m}$
[3 marks]

(ii) $\frac{16}{9}$
[2 marks]

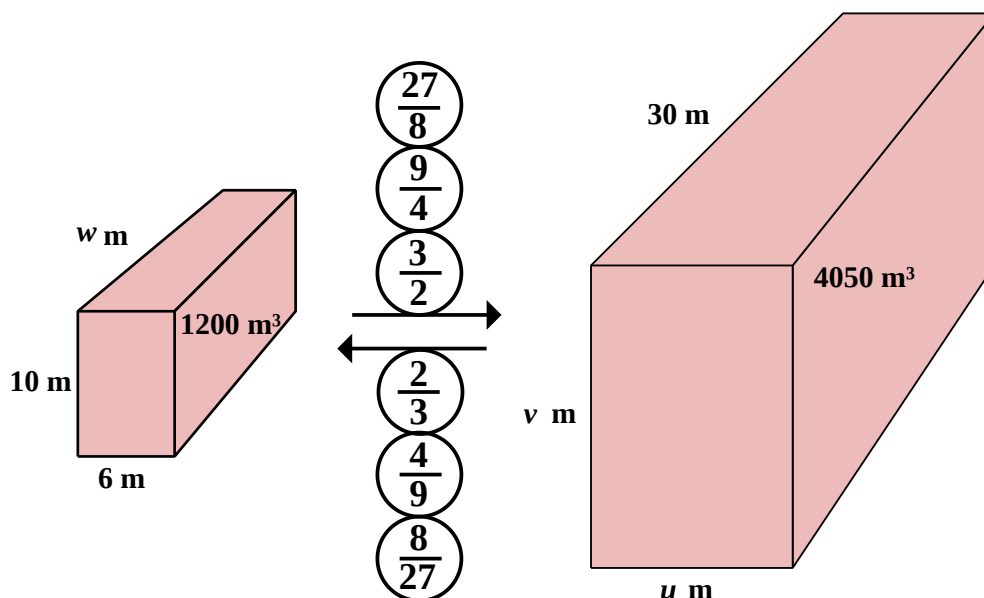
Answer 2



(i) $x = 4 \times \frac{5}{2} = 10 \text{ m}$ $y = 8 \times \frac{5}{2} = 20 \text{ m}$ $z = 40 \times \frac{2}{5} = 16 \text{ m}$
[3 marks]

(ii) $\frac{25}{4}$
[2 marks]

Answer 3



(i) $u = 6 \times \frac{3}{2} = 9 \text{ m}$ $v = 10 \times \frac{3}{2} = 15 \text{ m}$ $w = 30 \times \frac{2}{3} = 20 \text{ m}$
[3 marks]

(ii) $\frac{9}{4}$
[2 marks]

Answer 4

(i) YES
[1 mark]

(ii) 75 cm^3
[3 marks]

Answer 5

(i) $\frac{14}{4} = \frac{21}{6} = \frac{28}{8}$ All cancel down down to $\frac{7}{2}$
[2 marks]

(ii) (iii) (iv)
 $lsf = \frac{7}{2}$ $asf = \frac{49}{4}$ $vsf = \frac{343}{8}$
[1, 1, 1 marks]

(v) (a) 8232
(b) 192
(c) 8232
(d) $= V_{BIG}$
[1, 1, 1, 1 marks]

Answer 6

NO

Answer 7

(i) YES
(ii) 500 cm^3

Answer 8

$80 \text{ cm} \times 88 \text{ cm} \times 56 \text{ cm}$

[1, 1, 3, 2 marks]

Answer 9

$$14 \text{ cm} \times 70 \text{ cm} \times 77 \text{ cm}$$

Answer 10

- (i) NO
 (ii) NO
 (iii) YES

[2, 3 marks]

Answer 11

(i) $lsf = \frac{3}{2}$ (ii) $asf = \frac{9}{4}$ (iii) $vsf = \frac{27}{8}$

[1, 1, 1 mark]

(iv) 135 cm^3

[2 marks]

Answer 12

(i) $\frac{3}{2}$

[1 mark]

(ii) 15 cm

[1 mark]

(iii) 40 cm

[1 mark]

Answer 13

Edge length smaller cube is 6cm.

$$\therefore V_{SMALL} = 6^3 = 216$$

$$\therefore V_{LARGE} = 10^3 \times 216 = 216\,000 \text{ cm}^3$$

[3 marks]

Answer 14

(i) $\frac{5}{4}$

[1 mark]

(ii) 15 cm

[1 mark]

(iii) 20 cm

[1 mark]

Answer 15

$$lsf = \sqrt[3]{2}$$

[3 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

Lesson 4

GCSE Mathematics Ratio and Similarity

Non Calculator

Time : 5 minutes

4.1 Start Up

Cancel down these fractions as far as possible by repeated division of the numerator and denominator by 2, 3, 5 or 10.

(i) $\frac{10}{4}$

(ii) $\frac{55}{15}$

(iii) $\frac{21}{12}$

(iv) $\frac{50}{100}$

(v) $\frac{300}{40}$

(vi) $\frac{125}{20}$

(vii) $\frac{180}{100}$

(viii) $\frac{39}{24}$

(ix) $\frac{27}{21}$

(x) $\frac{35}{25}$

(xi) $\frac{180}{100}$

(xii) $\frac{72}{20}$

(xiii) $\frac{600}{480}$

(xiv) $\frac{640}{220}$

(xv) $\frac{102}{84}$

(xvi) $\frac{520}{360}$

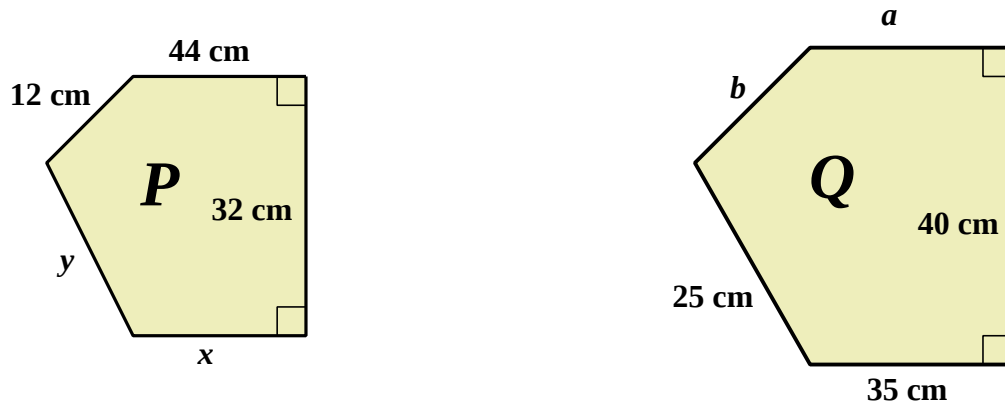
[16 marks]

If you got all 16 correct, have a bonus mark !

[1 mark]

4.2 Exam Style Questions involving Length Scale Factor

Pentagon P is mathematically similar to pentagon Q .
Calculate the lengths of the sides marked a , b , x , and y .



[4 marks]

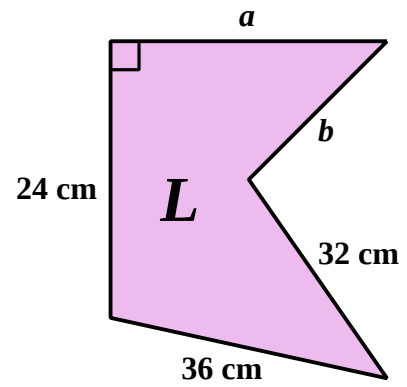
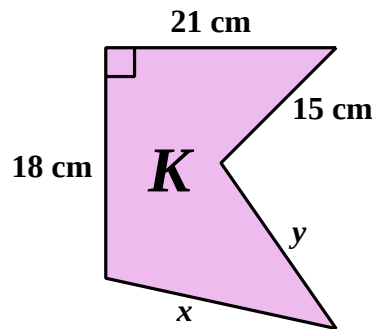
4.3 Exercise

Marks Available : 27

Question 1

Pentagon K is mathematically similar to pentagon L .

Calculate the lengths of the sides marked a , b , x , and y .

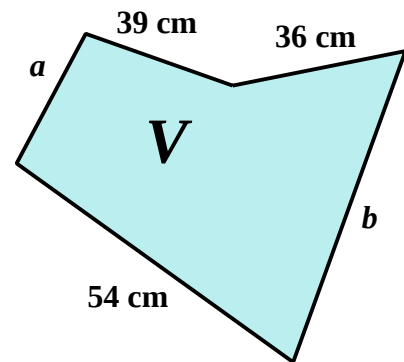
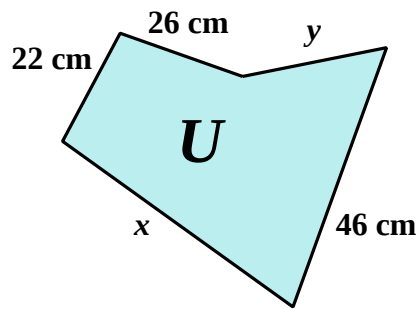


[4 marks]

Question 2

Pentagon U is mathematically similar to pentagon V .

Calculate the lengths of the sides marked a , b , x , and y .

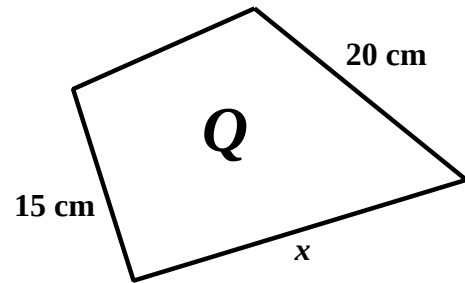
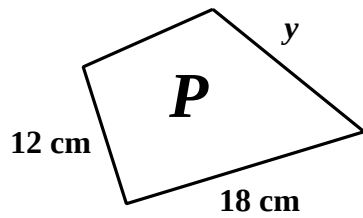


[4 marks]

Question 3

You may use a calculator

Diagram NOT accurately drawn



Quadrilateral P is mathematically similar to quadrilateral Q .

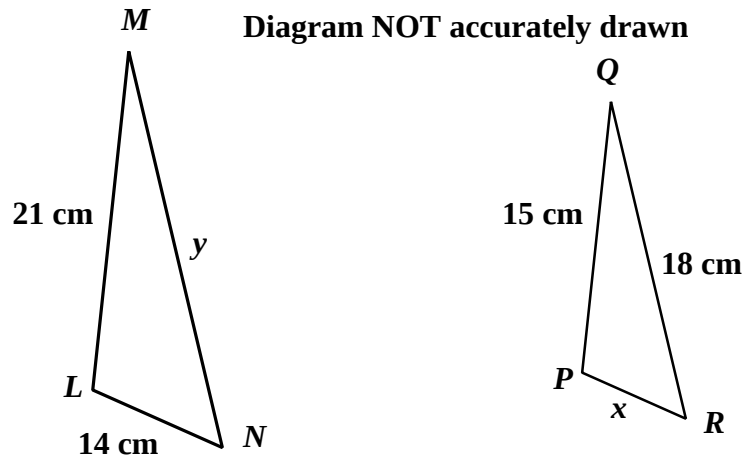
- (a) Calculate the value of x .
- (b) Calculate the value of y .

[4 marks]

Question 4

You may use a calculator

Here are two similar triangles.



LM corresponds to PQ .

MN corresponds to QR .

(a) Find the value of x .

(b) Find the value of y .

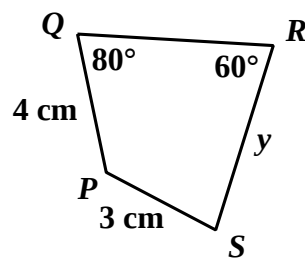
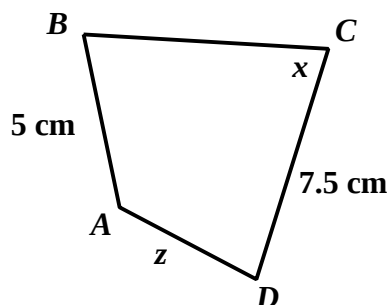
[4 marks]

Question 5

You may use a calculator

$ABCD$ and $PQRS$ are two similar quadrilaterals.

Diagram NOT accurately drawn



AB corresponds to PQ .

BC corresponds to QR .

CD corresponds to RS .

Find the value of

(a) x ,

(b) y ,

(c) z .

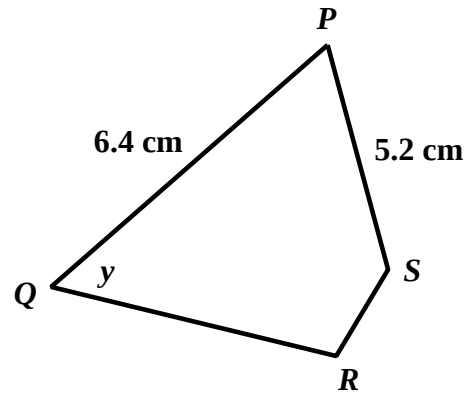
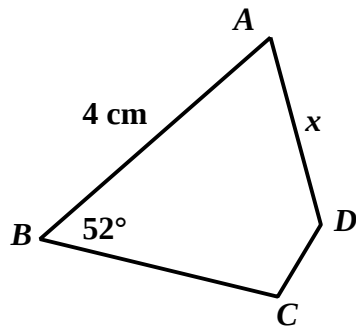
[5 marks]

Question 6

You may use a calculator

Quadrilaterals $ABCD$ and $PQRS$ are similar.

Diagram NOT accurately drawn



AB corresponds to PQ .

BC corresponds to QR .

CD corresponds to RS .

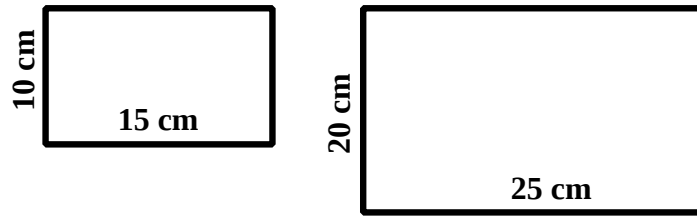
Find the value of

(a) x ,

(b) y ,

[3 marks]

Question 7



Are the two rectangles mathematically similar ?

Tick (✓) the appropriate box.

You must show working to justify your answer.

Yes

☐

No

☐

[3 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

4.4 Homework

GCSE Mathematics Ratio and Similarity

Marks Available : 40

Question 1

Do not use a calculator

(i)

$$\left(\frac{3}{2}\right)^2 = \frac{9}{\quad}$$

(ii)

$$\left(\frac{8}{13}\right)^2 = \frac{\quad}{169}$$

(iii)

$$\left(\frac{5}{6}\right)^2 = \frac{\quad}{\quad}$$

(iv)

$$\left(\frac{2}{3}\right)^3 = \frac{8}{\quad}$$

(v)

$$\left(\frac{5}{7}\right)^3 = \frac{\quad}{343}$$

(vi)

$$\left(\frac{7}{4}\right)^3 = \frac{\quad}{\quad}$$

(vii)

$$\left(\frac{25}{4}\right)^{0.5} = \frac{5}{\quad}$$

(viii)

$$\left(\frac{49}{196}\right)^{0.5} = \frac{\quad}{14}$$

(ix)

$$\left(\frac{36}{121}\right)^{0.5} = \frac{\quad}{\quad}$$

(x)

$$\left(\frac{9}{64}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$$

(xi)

$$\left(\frac{1}{144}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$$

(xii)

$$\left(\frac{196}{169}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$$

(xiii)

$$\left(\frac{8}{27}\right)^{\frac{1}{3}} = \frac{\quad}{\quad}$$

(xiv)

$$\left(\frac{1}{1000}\right)^{\frac{1}{3}} = \frac{\quad}{\quad}$$

(xv)

$$\left(\frac{64}{125}\right)^{\frac{1}{3}} = \frac{\quad}{\quad}$$

(xvi)

$$\left(\frac{40}{9}\right)^2 = \frac{\quad}{\quad}$$

(xvii)

$$\left(\frac{5}{4}\right)^3 = \frac{\quad}{\quad}$$

(xviii)

$$\left(\frac{5}{6}\right)^0 = \frac{\quad}{\quad}$$

[18 marks]

Question 2

To square root the following fractions, first cancel down by repeated division of the numerator and denominator by 2, 3, 5 or 10.

Example

$$\sqrt{\frac{484}{64}} = \sqrt{\frac{242}{32}} = \sqrt{\frac{121}{16}} = \frac{11}{4}$$

Do not use a calculator

(i)

$$\sqrt{\frac{27}{12}} = \sqrt{\frac{\quad}{\quad}} = \frac{\quad}{\quad}$$

Hint : Divide by 3

[2 marks]

(ii)

$$\sqrt{\frac{98}{50}} = \sqrt{\frac{\quad}{\quad}} = \frac{\quad}{\quad}$$

[2 marks]

(iii)

$$\sqrt{\frac{980}{720}} = \sqrt{\frac{\quad}{\quad}} = \sqrt{\frac{\quad}{\quad}} = \frac{\quad}{\quad}$$

Hint : First, divide by 10

[2 marks]

(iv)

$$\sqrt{\frac{45}{80}} = \sqrt{\frac{\quad}{\quad}} = \frac{\quad}{\quad}$$

[2 marks]

(v)

$$\sqrt{\frac{3630}{750}} = \sqrt{\frac{\quad}{\quad}} = \sqrt{\frac{\quad}{\quad}} = \frac{\quad}{\quad}$$

[2 marks]

(vi)

$$\sqrt{\frac{882}{162}} = \sqrt{\frac{\quad}{\quad}} = \sqrt{\frac{\quad}{\quad}} = \sqrt{\frac{\quad}{\quad}} = \frac{\quad}{\quad}$$

[2 marks]

Question 3

You may use a calculator

Here are two similar triangles.

AB corresponds to PQ .

BC corresponds to QR .

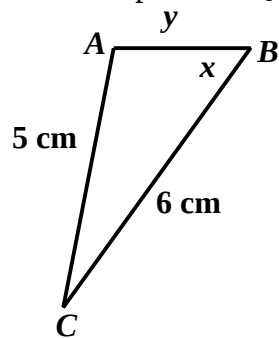
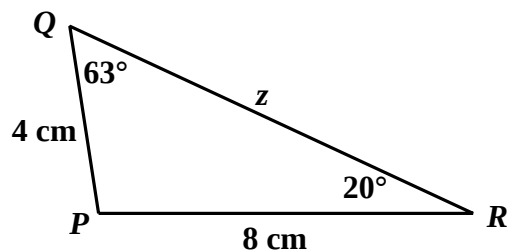


Diagram NOT accurately drawn



Find the value of

(a) x

(b) y

(c) z

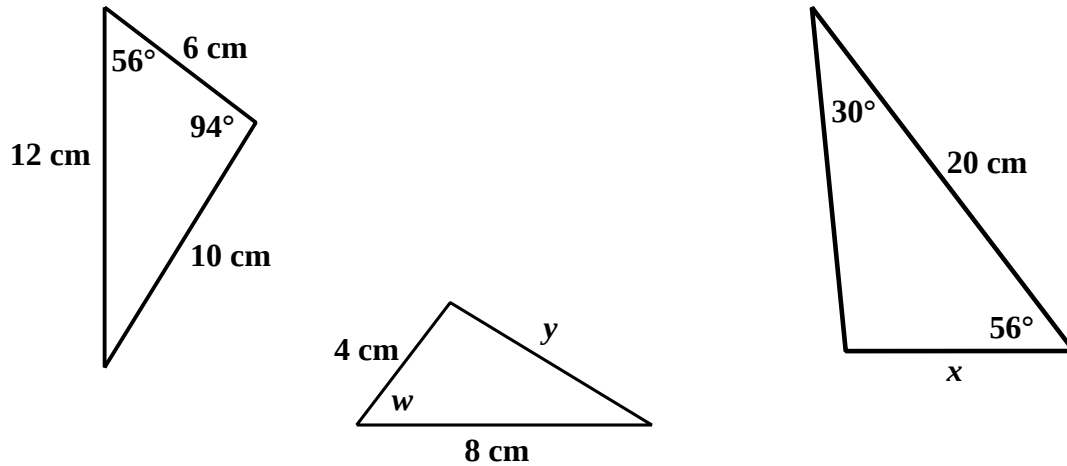
[5 marks]

Question 4

You may use a calculator

Here are three similar triangles.

Diagram NOT accurately drawn



Find the value of

(a) w

(b) x

(c) y

[5 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

4.5 Answers

GCSE Mathematics Ratio and Similarity

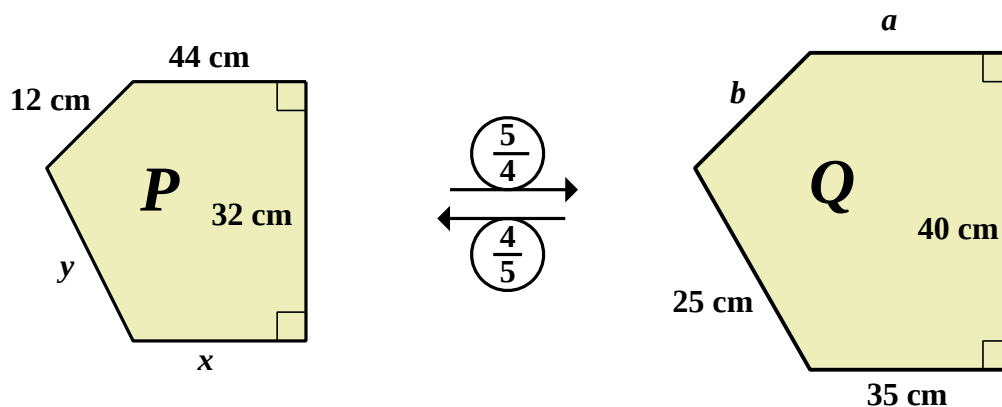
4.5.1 Solutions (4.1 Start Up)

(i) $\frac{5}{2}$	(ii) $\frac{11}{3}$	(iii) $\frac{7}{4}$	(iv) $\frac{1}{2}$
(v) $\frac{15}{2}$	(vi) $\frac{25}{4}$	(vii) $\frac{9}{5}$	(viii) $\frac{13}{8}$
(ix) $\frac{9}{7}$	(x) $\frac{7}{5}$	(xi) $\frac{9}{5}$	(xii) $\frac{18}{5}$
(xiii) $\frac{5}{4}$	(xiv) $\frac{32}{11}$	(xv) $\frac{17}{14}$	(xvi) $\frac{13}{9}$

[16 marks]

[1 mark bonus if all 16 correct]

4.5.2 Solution (4.2 Example)

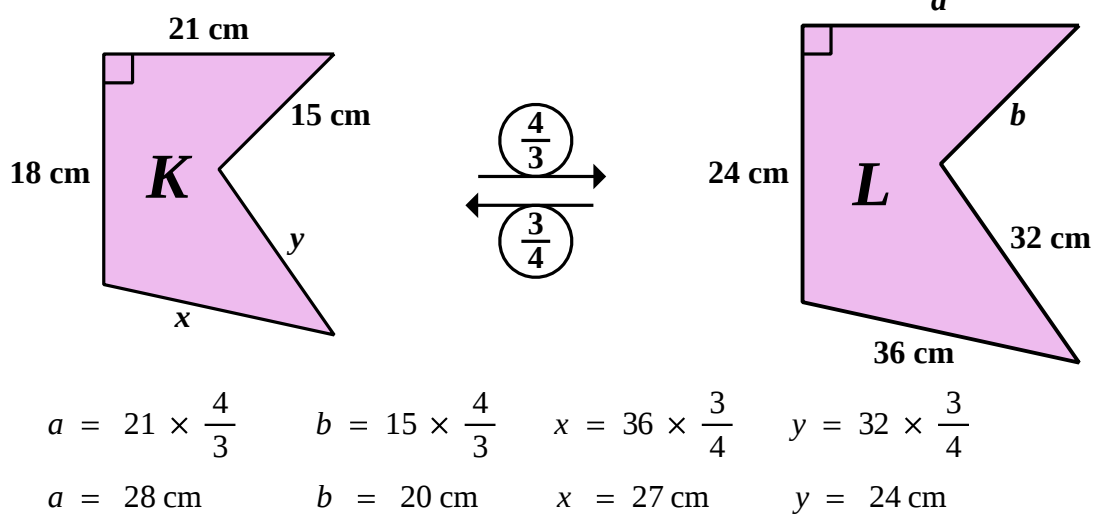


$$\begin{aligned}
 a &= 44 \times \frac{5}{4} & b &= 12 \times \frac{5}{4} & x &= 35 \times \frac{4}{5} & y &= 25 \times \frac{4}{5} \\
 a &= 55 \text{ cm} & b &= 15 \text{ cm} & x &= 28 \text{ cm} & y &= 20 \text{ cm}
 \end{aligned}$$

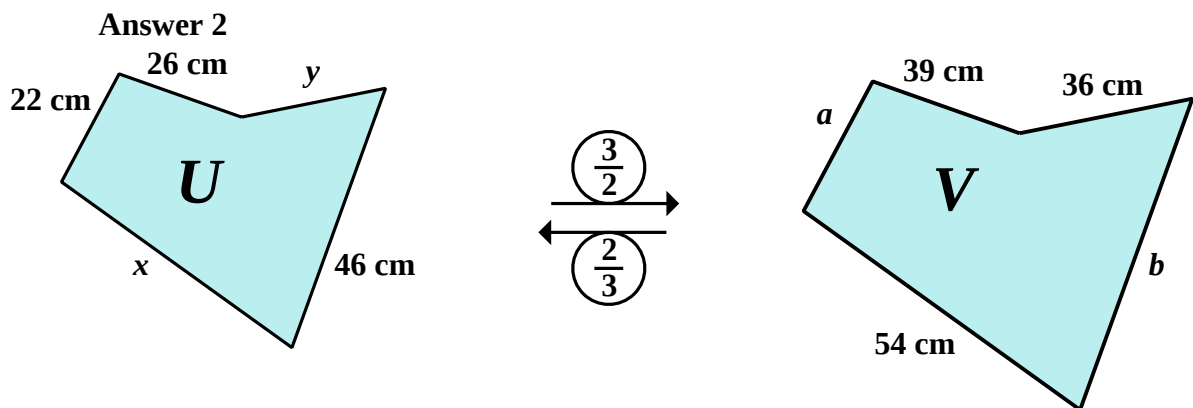
[4 marks]

4.5.3 Solutions (4.3 Exercise)

Answer 1

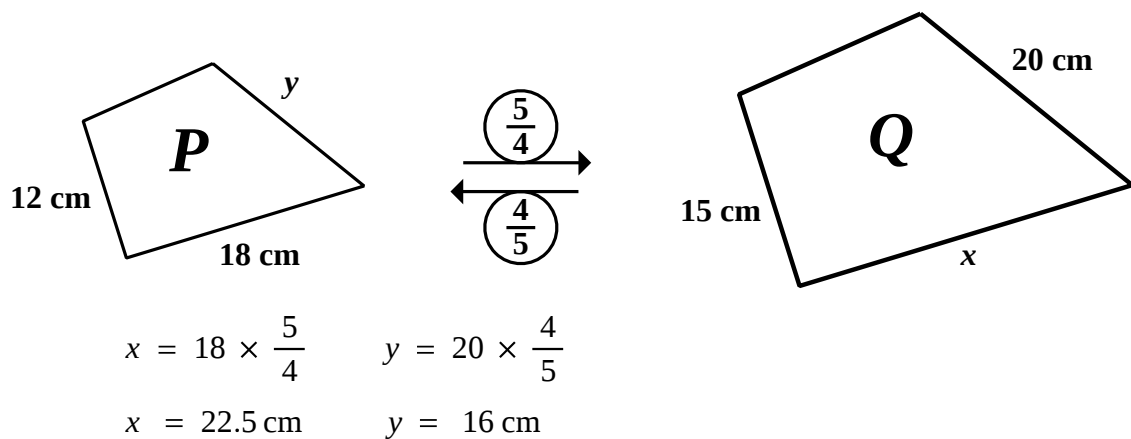


[4 marks]



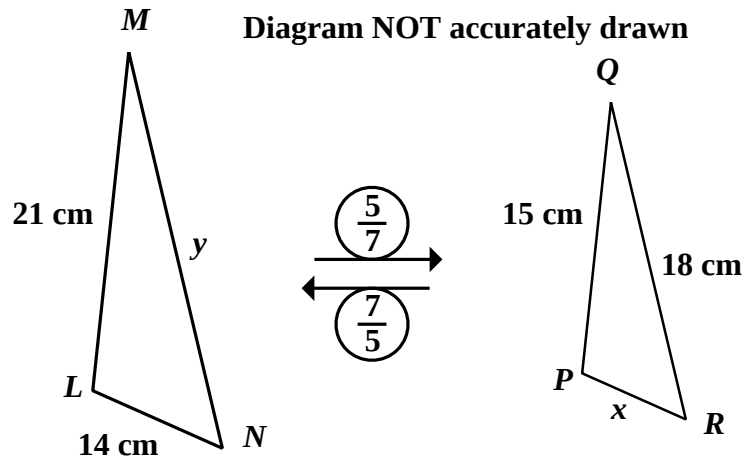
[4 marks]

Answer 3



[4 marks]

Answer 4

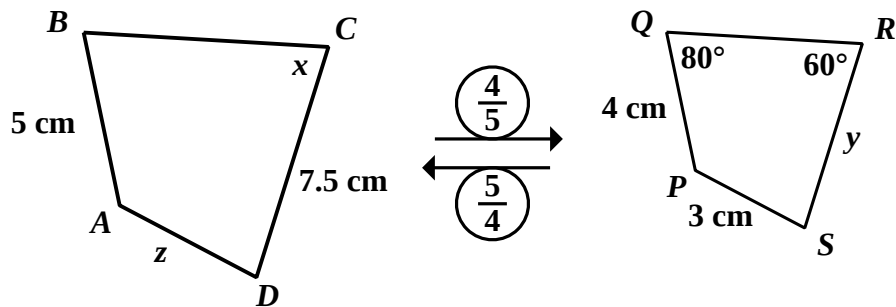


$$x = 14 \times \frac{5}{7} \quad y = 18 \times \frac{7}{5}$$

$$x = 10 \text{ cm} \quad y = 25.2 \text{ cm}$$

[4 marks]

Answer 5

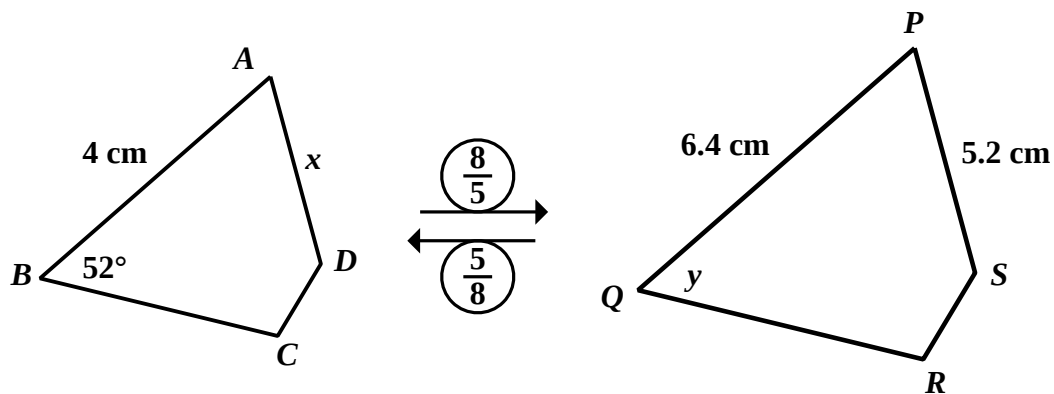


$$x = 60^\circ \quad y = 7.5 \times \frac{4}{5} \quad z = 3 \times \frac{5}{4}$$

$$y = 6 \text{ cm} \quad z = 3.75 \text{ cm}$$

[5 marks]

Answer 6



$$x = 5.2 \times \frac{5}{8} \quad y = 52^\circ$$

$$x = 3.25 \text{ cm}$$

[3 marks]

Answer 7

Yes

☐

No

☒

Not similar because $\frac{\text{long side right rectangle}}{\text{long side left rectangle}} \neq \frac{\text{short side right rectangle}}{\text{short side left rectangle}}$
i.e. $\frac{25}{15} \neq \frac{20}{10}$

[3 marks]

4.5.4 Solutions (4.4 Homework)

GCSE Mathematics Ratio and Similarity

Question 1

(i)

$$\frac{9}{4}$$

(ii)

$$\frac{64}{169}$$

(iii)

$$\frac{25}{36}$$

(iv)

$$\frac{8}{27}$$

(v)

$$\frac{125}{343}$$

(vi)

$$\frac{343}{64}$$

(vii)

$$\frac{5}{2}$$

(viii)

$$\frac{7}{14}$$

(ix)

$$\frac{6}{11}$$

(x)

$$\frac{3}{8}$$

(xi)

$$\frac{1}{12}$$

(xii)

$$\frac{14}{13}$$

(xiii)

$$\frac{2}{3}$$

(xiv)

$$\frac{1}{10}$$

(xv)

$$\frac{4}{5}$$

(xvi)

$$\frac{1600}{81}$$

(xvii)

$$\frac{125}{64}$$

(xviii)

$$1$$

[18 marks]

Question 2

(i)

$$\frac{3}{2}$$

(ii)

$$\frac{7}{5}$$

(iii)

$$\frac{7}{6}$$

(iv)

$$\frac{3}{4}$$

(v)

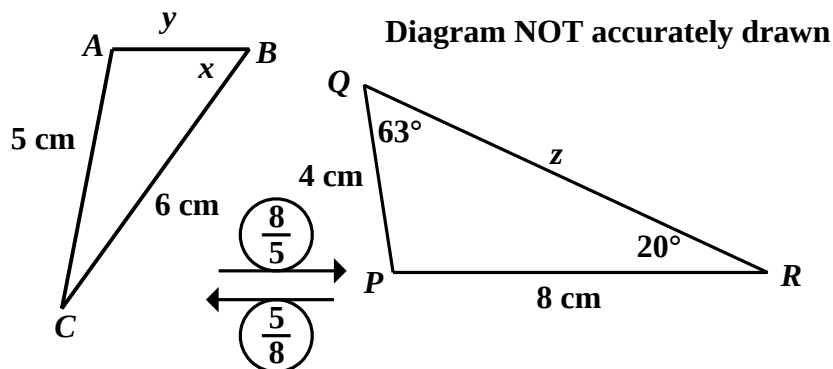
$$\frac{11}{25}$$

(vi)

$$\frac{7}{3}$$

[12 marks]

Answer 3

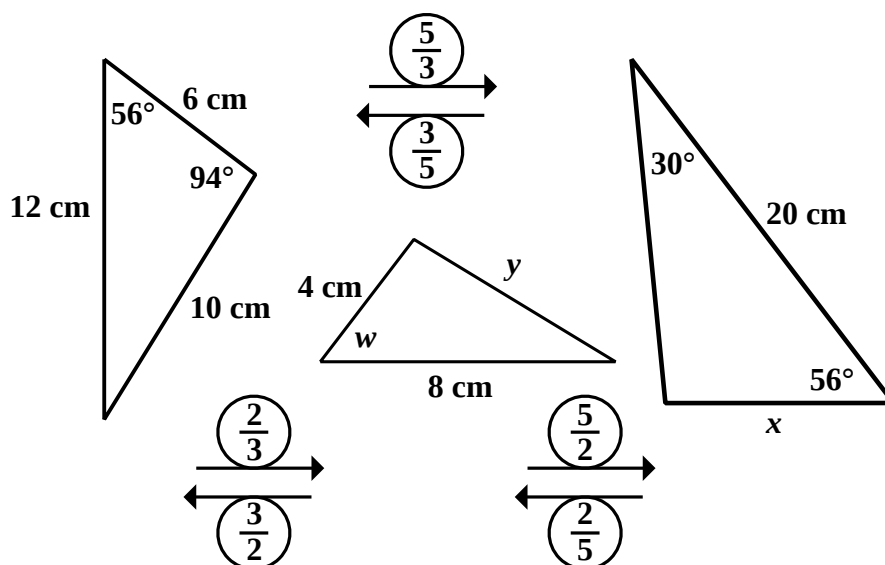


$$x = 63^\circ \quad y = 4 \times \frac{5}{8} \quad z = 6 \times \frac{8}{5}$$

$$y = 2.5 \text{ cm} \quad z = 9.6 \text{ cm}$$

[5 marks]

Answer 4



- (a) $w = 56^\circ$
 (b) $x = \frac{5}{3} \times 6 = 10 \text{ cm}$
 (c) $y = \frac{2}{5} \times 20 = 6 \frac{2}{5} \text{ cm}$

[5 marks]

5.1 Congruent Shapes

Geometric figures with both the same *shape* and *size* are said to be **CONGRUENT**.

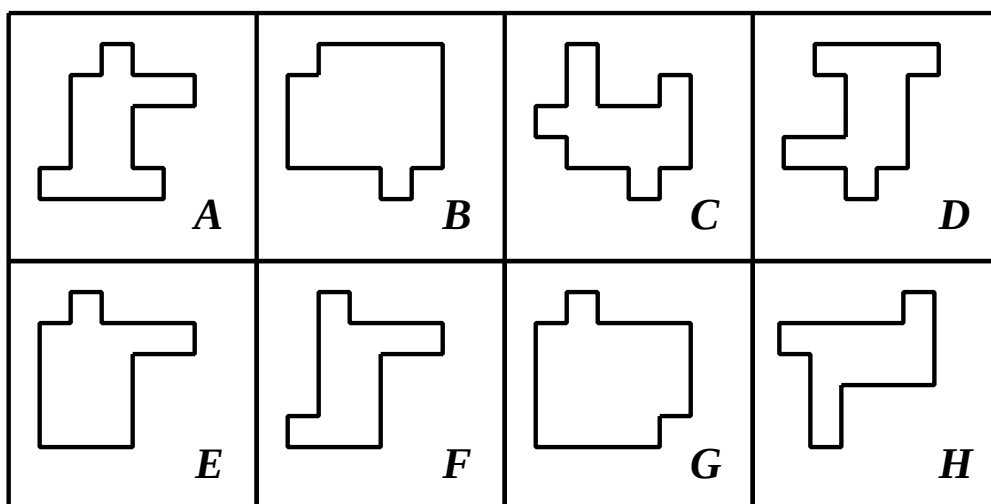
If two shapes are *congruent* then it will be possible to transform one on top of the other by means of translation, rotation and reflection.

If one copy of a shape can be translated (slid) across the page and then rotated as necessary to exactly cover another, the two shapes are **DIRECTLY congruent**.

If a reflection (or flip) has to be used, the two shapes are **INDIRECTLY congruent**.

Example

Consider the box of shapes.



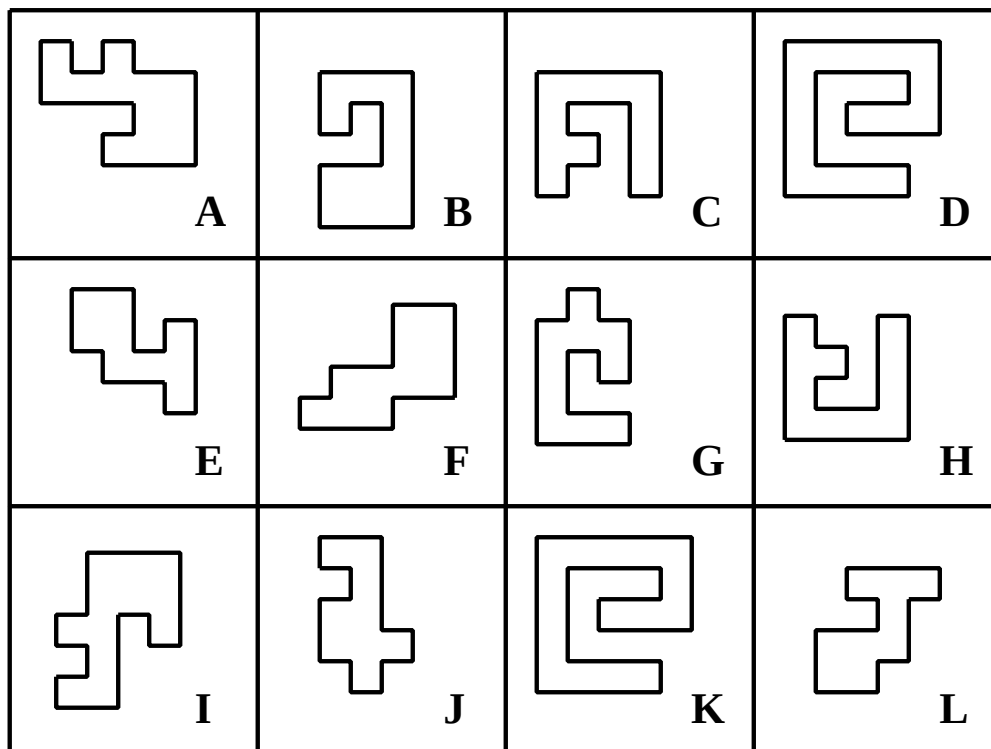
- (i) Which shape is *directly congruent* with *A* ?
Shade in this pair of shapes the same colour.
[2 marks]
- (ii) Which shape is *indirectly congruent* with *H* ?
Shade in this pair of shapes a different same colour.
[2 marks]
- (iii) Two other shapes are *directly congruent*. Which two ?
Shade in this pair of shapes, both in the same colour used in part (i).
[2 marks]

5.2 Exercise

Marks Available : 6

Question 1

For the following shapes, shade in those that are **directly congruent** in one colour and, in a different colour, those that are **indirectly congruent**.



[6 marks]

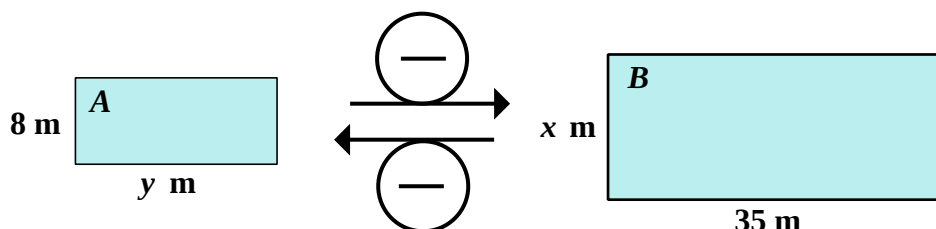
5.3 Exercise : Test Revision

Marks Available : 42

You may use a calculator

Question 1

For the similar rectangles A and B, shown below, find the lengths marked x and y given that the length scale factor (greater than 1) of the similarity is $\frac{7}{4}$



[2 marks]

Question 2

An elastic band of length 15 cm is stretched with length scale factor $\frac{9}{3}$.
What is the length of the stretched band ?

[2 marks]

Question 3

When made wet a 55 cm piece of string shrinks with length scale factor $\frac{3}{5}$.
What is the length of the shrunk string ?

[2 marks]

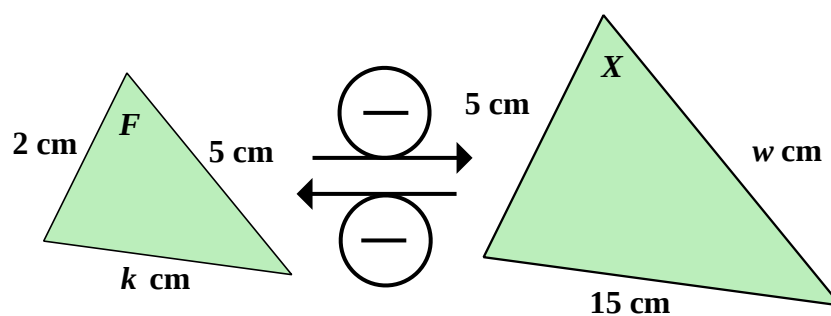
Question 4

Two rectangles are similar with length scale factor $\frac{13}{4}$.
The smaller measures 8 cm by 12 cm.
What are the measurements of the larger ?

[2 marks]

Question 5

For the similar triangles F and X , shown below, find the length scale factor (greater than 1) of the similarity and also the lengths marked w and k (Your answers may involve decimals !)



[3 marks]

Question 6

Cancel down these fractions as far as possible by repeated division of the numerator and denominator by 2, 3, 5 or 10.

(i)

$$\frac{14}{4}$$

(ii)

$$\frac{35}{15}$$

(iii)

$$\frac{21}{15}$$

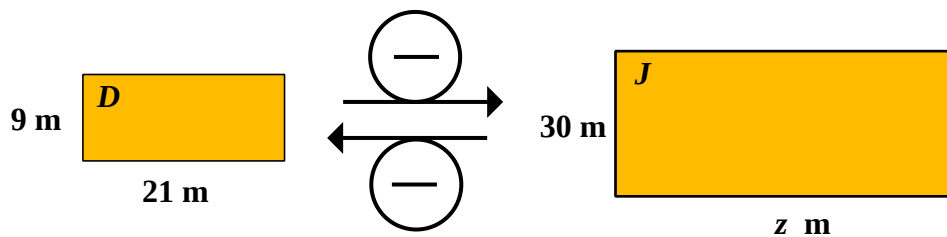
(iv)

$$\frac{28}{84}$$

[4 marks]

Question 7

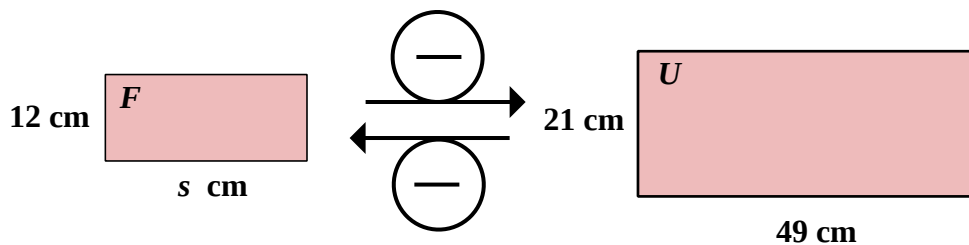
For the similar rectangles D and J , shown below, find the length scale factor (greater than 1) of the similarity (cancel down the fraction) and also the length marked z



[3 marks]

Question 8

For the similar rectangles F and U , shown below, find the length scale factor (greater than 1) of the similarity (cancel down the fraction) and also the length marked s



[3 marks]

Question 9

Simplify each of the following

(i)

$$\left(\frac{7}{5}\right)^2 = \text{---}$$

(ii)

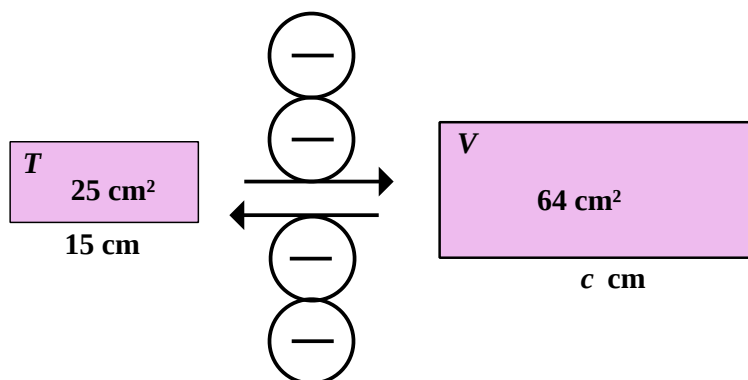
$$\sqrt{\frac{100}{49}} = \text{---}$$

(iii)

$$\left(\frac{9}{4}\right)^{0.5} = \text{---}$$

[3 marks]

Question 10

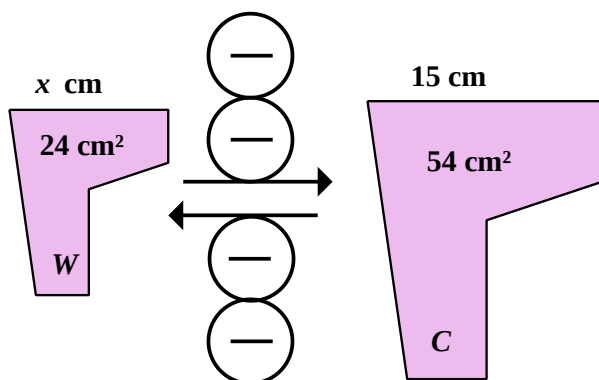


Rectangles T and V are similar.

Find the length marked c

[3 marks]

Question 11

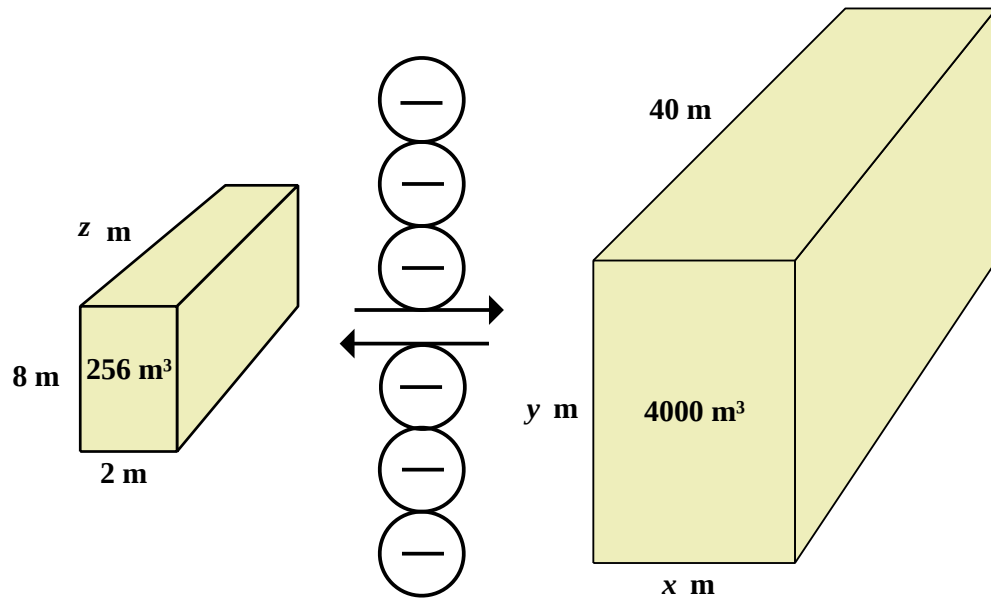


The shapes W and C are similar.

Find the length marked x

[3 marks]

Question 12



The above two similar cuboids are shown with the same orientation.

- (i) Find the lengths marked x , y and z .

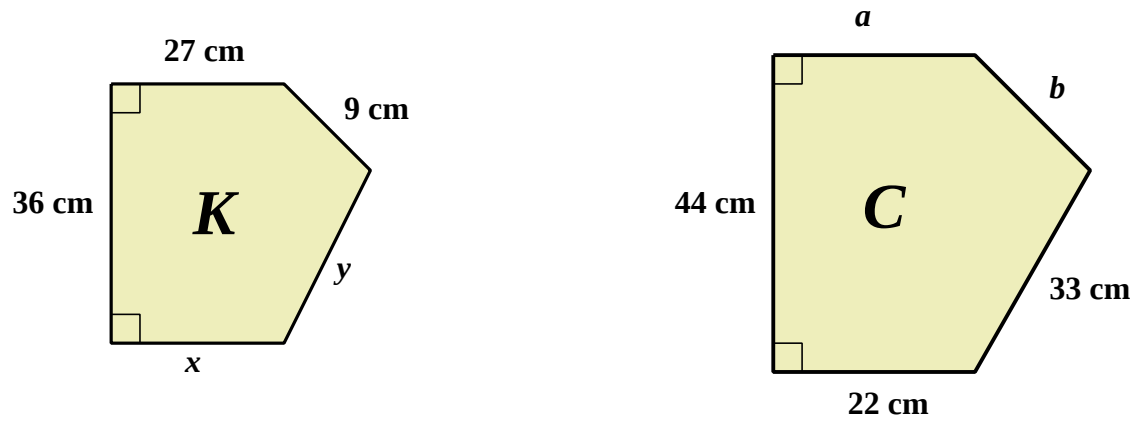
[3 marks]

- (ii) How many times more surface area has the larger cuboid than the smaller ?

[1 mark]

Question 13

Pentagon K is mathematically similar to pentagon C .
Calculate the lengths of the sides marked a , b , x , and y .

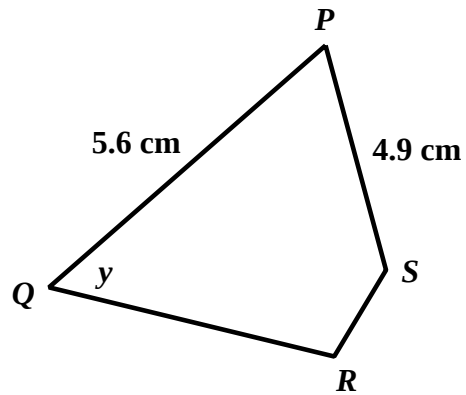
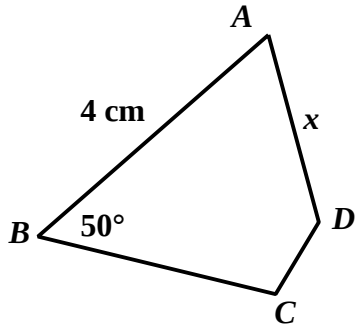


[4 marks]

Question 14

Quadrilaterals $ABCD$ and $PQRS$ are similar.

Diagram NOT accurately drawn



AB corresponds to PQ .

BC corresponds to QR .

CD corresponds to RS .

Find the value of

(a) x ,

(b) y ,

[3 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

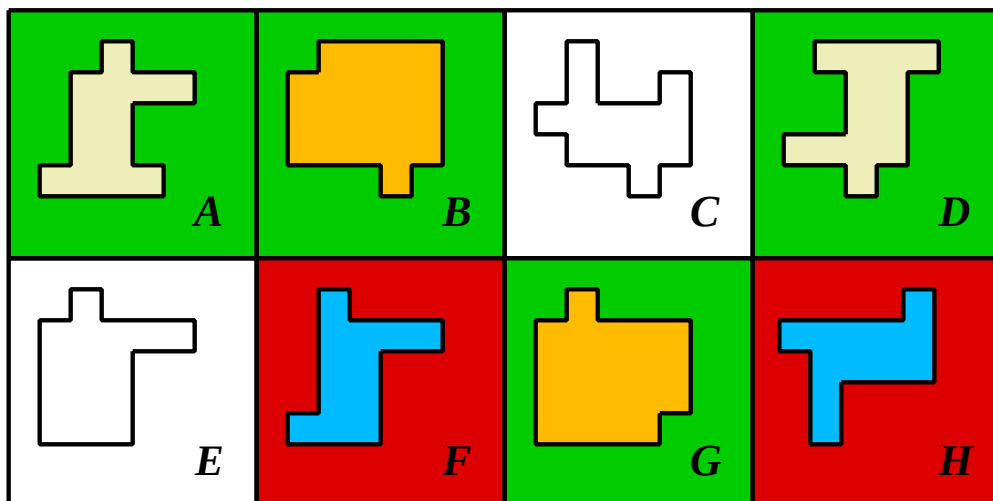
© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

5.4 Answers

GCSE Mathematics Ratio and Similarity

5.4.1 Solutions (5.1 Congruent Shapes)

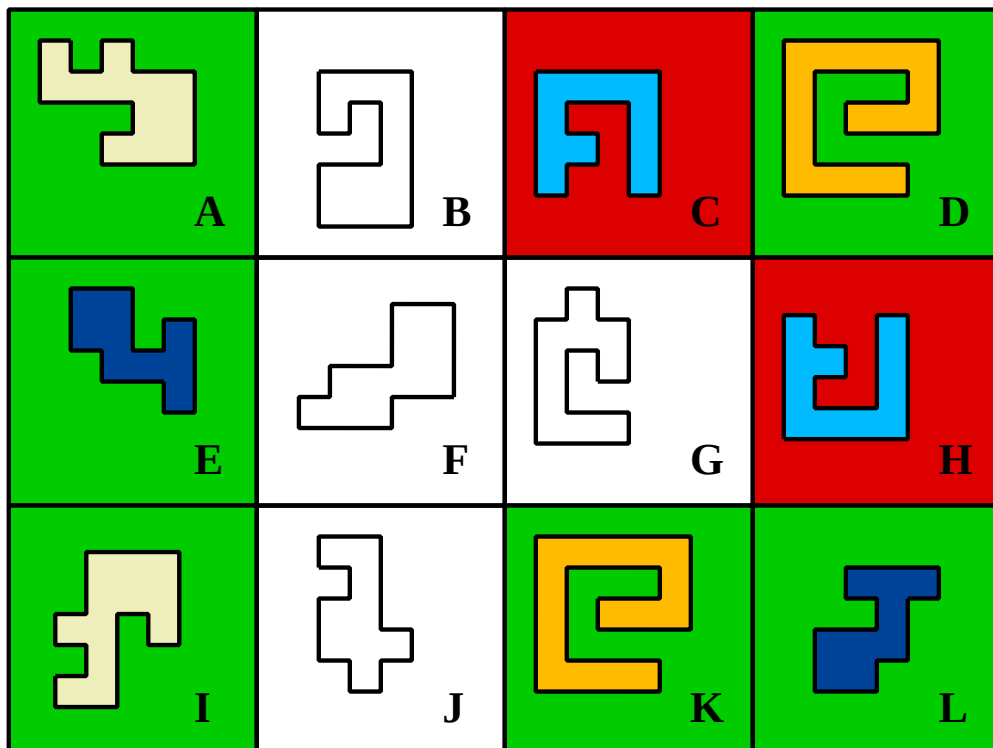


- (i) A and D are directly congruent
- (ii) H and F are indirectly congruent.
- (iii) B and G are directly congruent

[6 marks]

5.4.2 Solutions (5.2 Exercise)

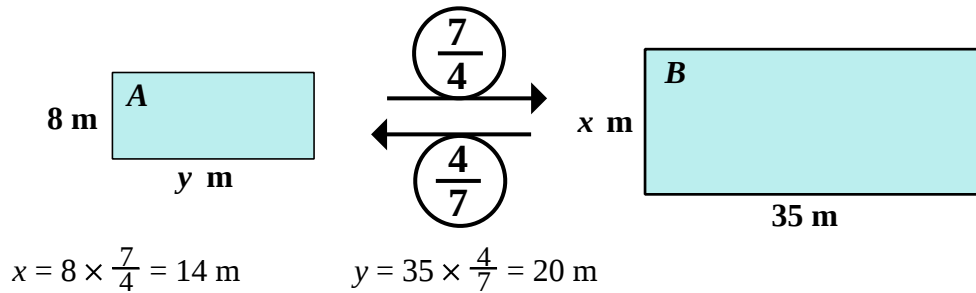
Answer 1



[6 marks]

5.4.3 Solutions (5.3 Test Revision)

Answer 1



[2 marks]

Answer 2

$$15 \times \frac{9}{3} = 45 \text{ cm}$$

Answer 3

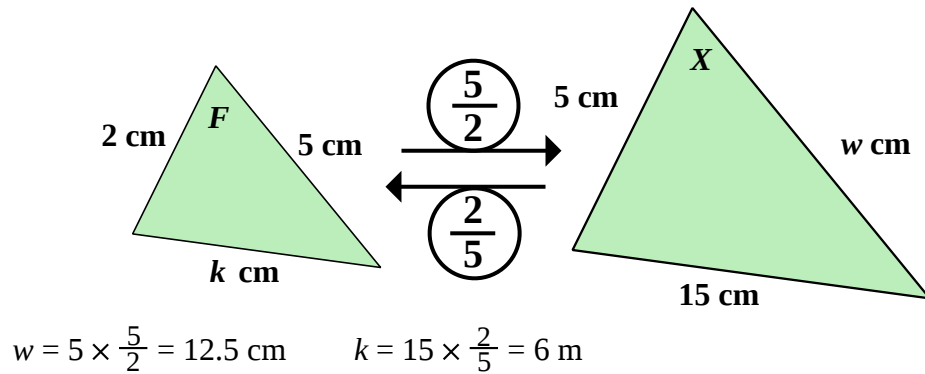
$$55 \times \frac{3}{5} = 33 \text{ m}$$

Answer 4

26 cm by 39 cm

[2, 2, 2 marks]

Answer 5



[3 marks]

Answer 6

(i) $\frac{7}{2}$

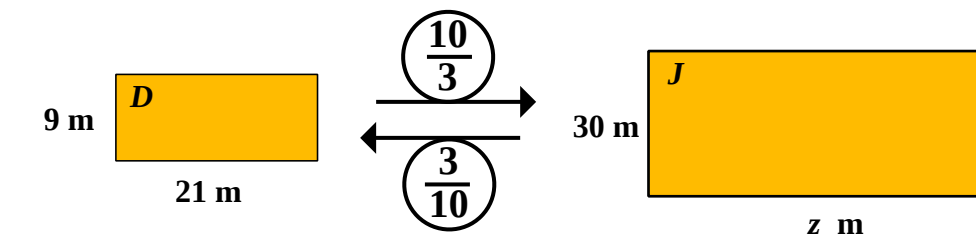
(ii) $\frac{7}{3}$

(iii) $\frac{7}{5}$

(iv) $\frac{1}{3}$

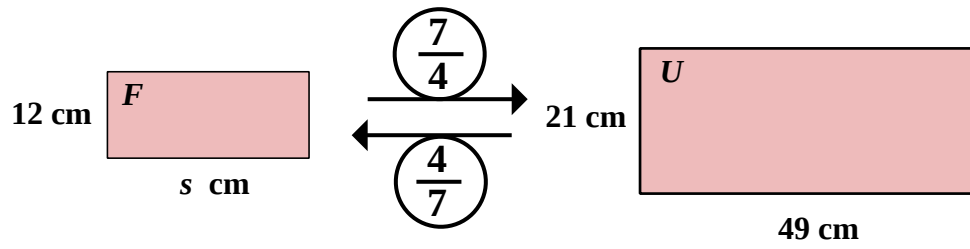
[4 marks]

Answer 7



[3 marks]

Answer 8



$$s = 49 \times \frac{4}{7} = 28 \text{ cm}$$

[3 marks]

Answer 9

(i)

$$\frac{49}{25}$$

(ii)

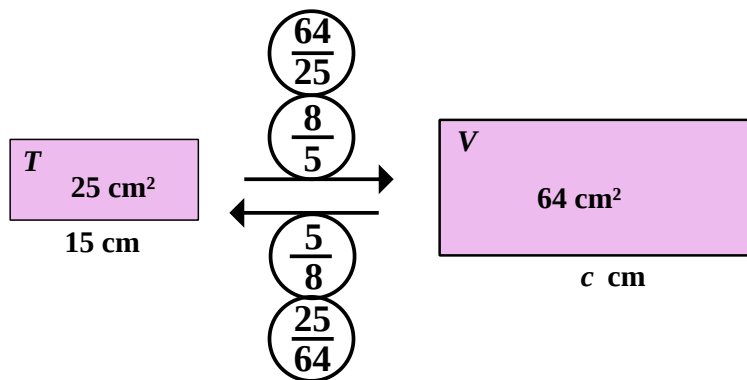
$$\frac{10}{7}$$

(iii)

$$\frac{3}{2}$$

[3 marks]

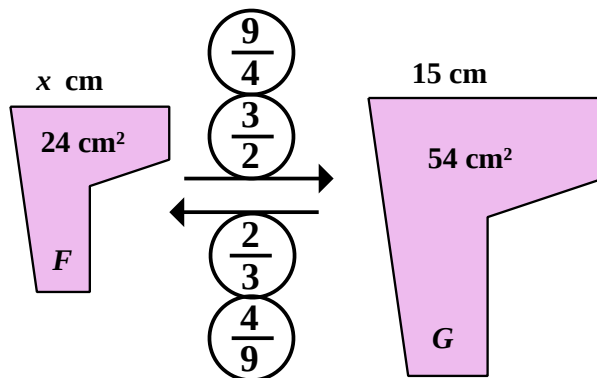
Answer 10



$$c = 15 \times \frac{8}{5} = 24 \text{ cm}$$

[3 marks]

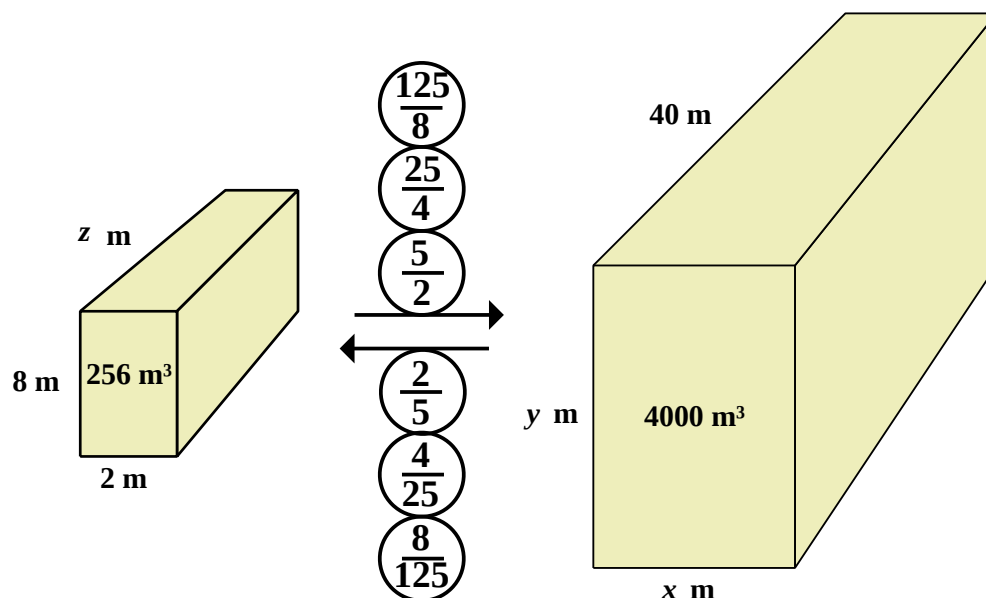
Answer 11



$$x = 15 \times \frac{2}{3} = 10 \text{ cm}$$

[3 marks]

Answer 12



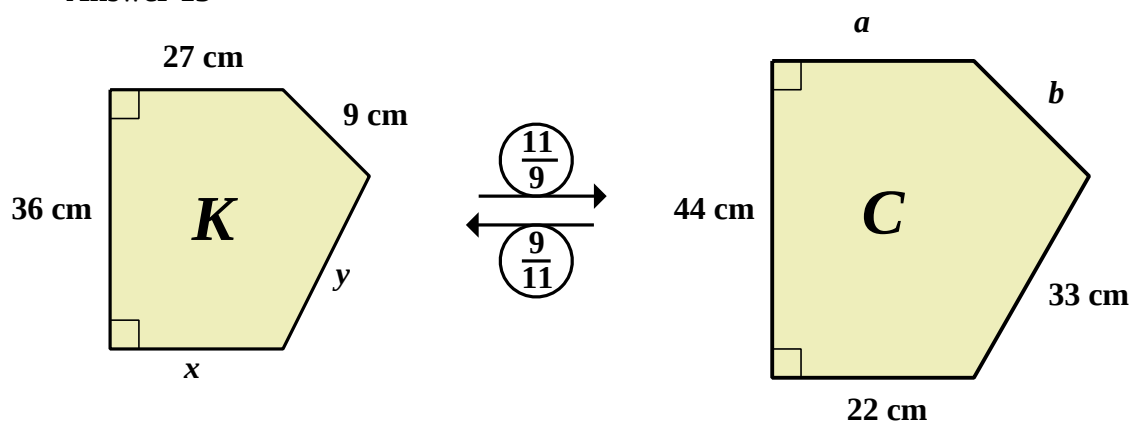
(i) $x = 2 \times \frac{5}{2} = 5 \text{ m}$ $y = 8 \times \frac{5}{2} = 20 \text{ m}$ $z = 40 \times \frac{2}{5} = 16 \text{ m}$

[3 marks]

(ii) $\frac{25}{4}$

[1 mark]

Answer 13

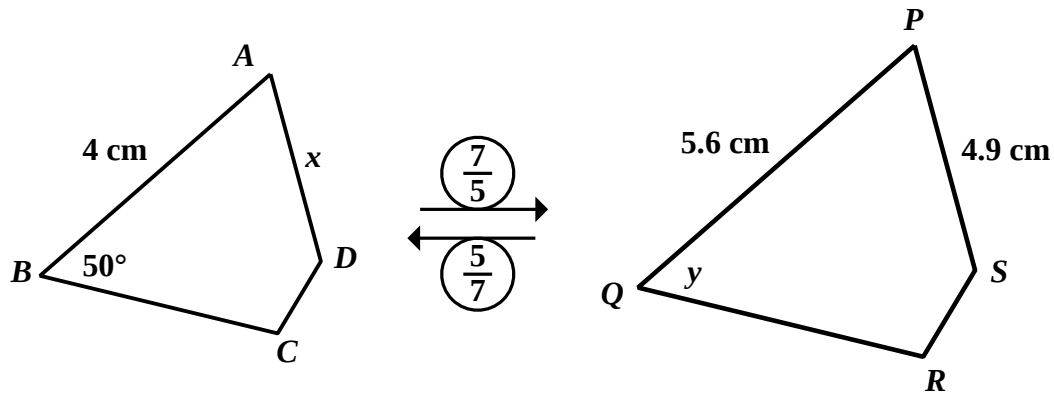


$a = 27 \times \frac{11}{9}$ $b = 9 \times \frac{11}{9}$ $x = 22 \times \frac{9}{11}$ $y = 33 \times \frac{9}{11}$

$a = 33 \text{ cm}$ $b = 11 \text{ cm}$ $x = 18 \text{ cm}$ $y = 27 \text{ cm}$

[4 marks]

Answer 14



$$x = 4.9 \times \frac{5}{7} \quad y = 50^\circ$$
$$x = 3.5 \text{ cm}$$

[3 marks]

[3 marks]

Lesson 6

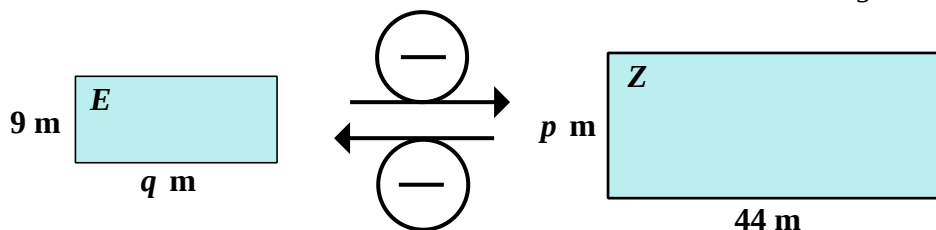
GCSE Mathematics Ratio and Similarity

6.1 Test

Marks Available : 44
You may use a calculator

Question 1

For the similar rectangles E and Z , shown below, find the lengths marked p and q given that the length scale factor (greater than 1) of the similarity is $\frac{4}{3}$



[2 marks]

Question 2

An elastic band of length 28 cm is stretched with length scale factor $\frac{7}{4}$
What is the length of the stretched band ?

[2 marks]

Question 3

When made wet a 90 cm piece of string shrinks with length scale factor $\frac{7}{15}$
What is the length of the shrunk string ?

[2 marks]

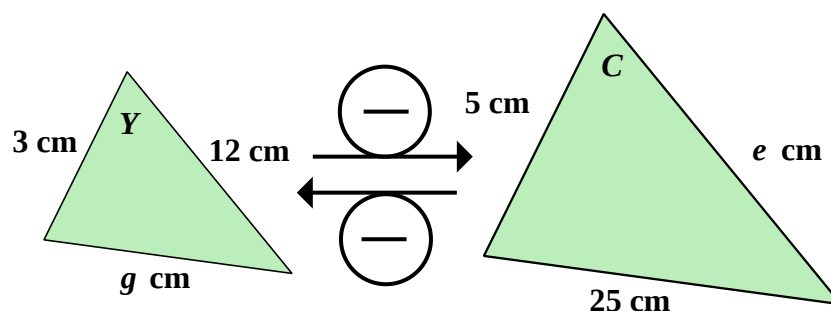
Question 4

Two rectangles are similar with length scale factor $\frac{5}{4}$
The smaller measures 24 m by 30 m.
What are the measurements of the larger ?

[2 marks]

Question 5

For the similar triangles Y and C , shown below, find the length scale factor (greater than 1) of the similarity and also the lengths marked e and g



[3 marks]

Question 6

Cancel down these fractions as far as possible by repeated division of the numerator and denominator by 2, 3, 5 or 7.

(i) $\frac{18}{4}$

(ii) $\frac{35}{21}$

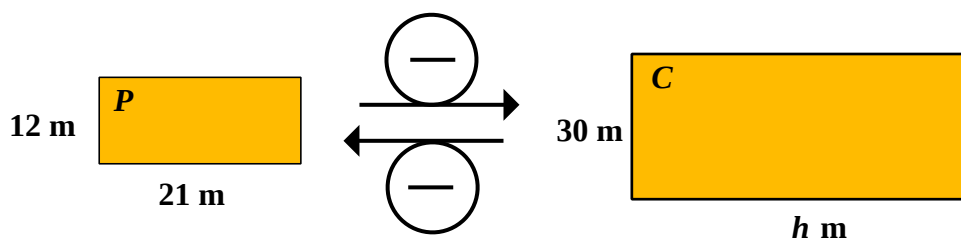
(iii) $\frac{21}{9}$

(iv) $\frac{27}{81}$

[4 marks]

Question 7

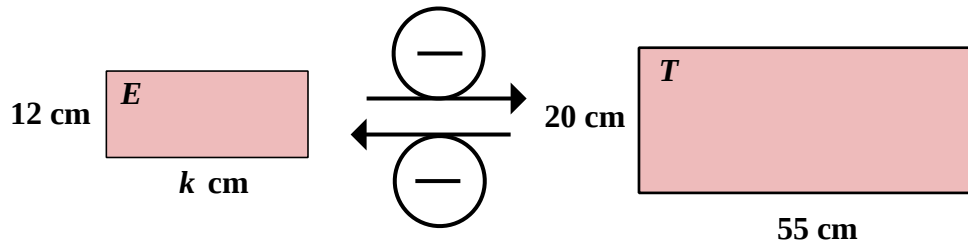
For the similar rectangles P and C , shown below, find the length scale factor (greater than 1) of the similarity (cancel down the fraction) and also the length marked h



[2 marks]

Question 8

For the similar rectangles E and T , shown below, find the length scale factor (greater than 1) of the similarity (cancel down the fraction) and also the length marked k



[2 marks]

Question 9

Simplify each of the following

(i)

$$\left(\frac{7}{6}\right)^2 = \text{---}$$

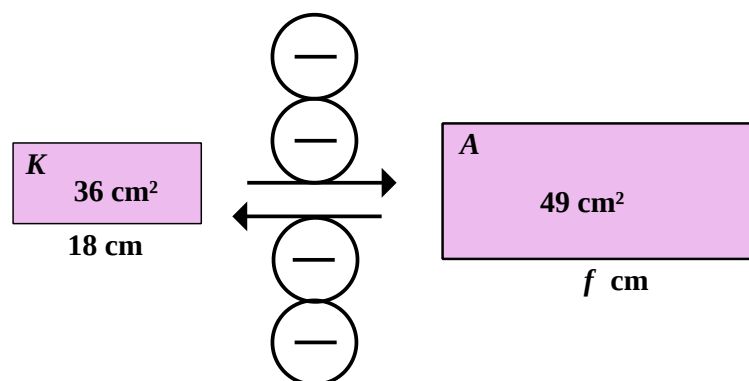
(ii)

$$\sqrt{\frac{64}{25}} = \text{---}$$

(iii)

$$\left(\frac{16}{9}\right)^{0.5} = \text{---}$$

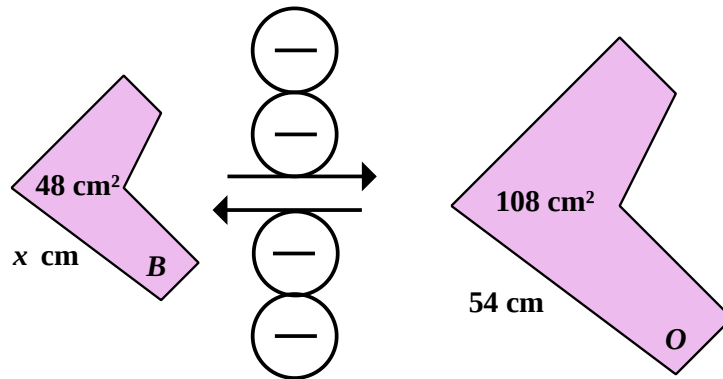
[3 marks]

Question 10

Rectangles K and A are similar.
Find the length marked f

[3 marks]

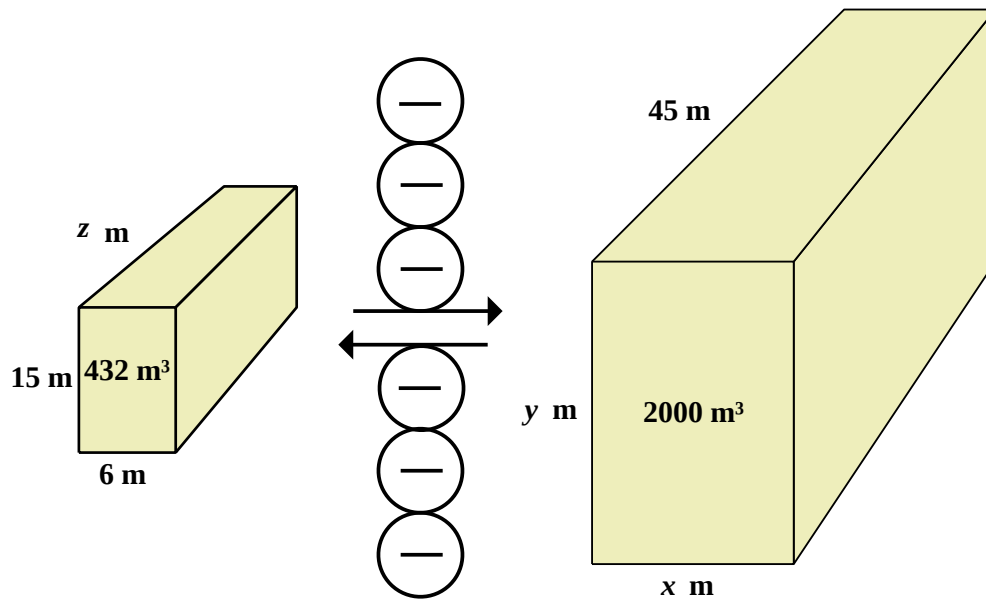
Question 11



The shapes B and O are similar.
Find the length marked x

[3 marks]

Question 12

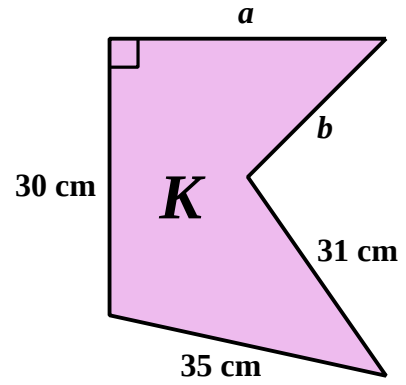
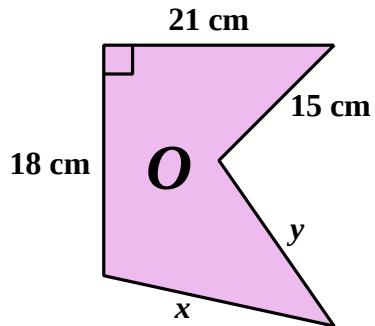


The above two similar cuboids are shown with the same orientation.
Find the lengths marked x , y and z .

[3 marks]

Question 13

Pentagon O is mathematically similar to pentagon K .
Calculate the lengths of the sides marked a , b , x , and y .

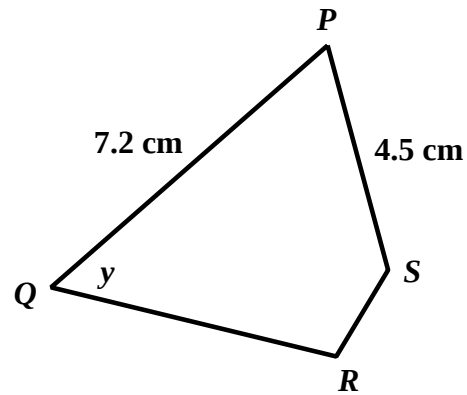
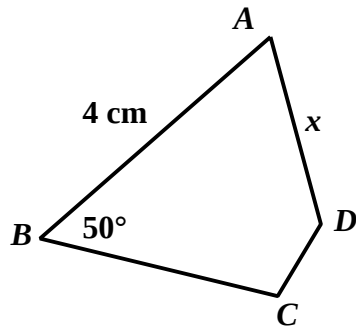


[4 marks]

Question 14

Quadrilaterals $ABCD$ and $PQRS$ are similar.

Diagram NOT accurately drawn



AB corresponds to PQ .

BC corresponds to QR .

CD corresponds to RS .

Find the value of

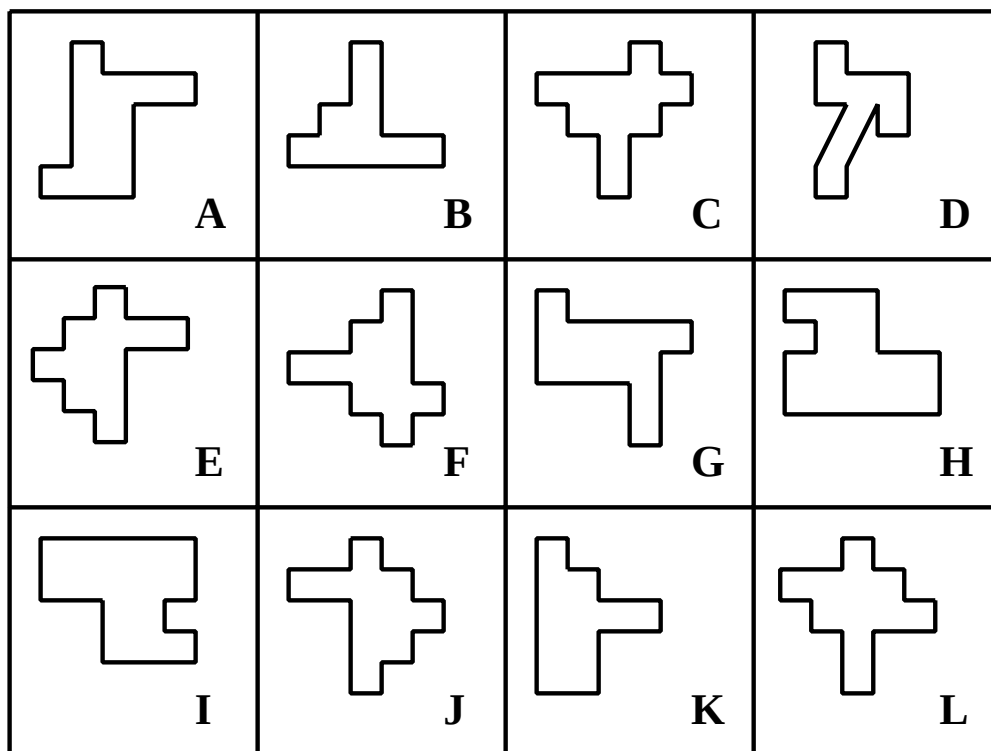
(a) x ,

(b) y ,

[3 marks]

Question 15

For the following shapes, shade in those that are ***directly congruent*** in one colour and, in a different colour, those that are ***indirectly congruent***.



[6 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

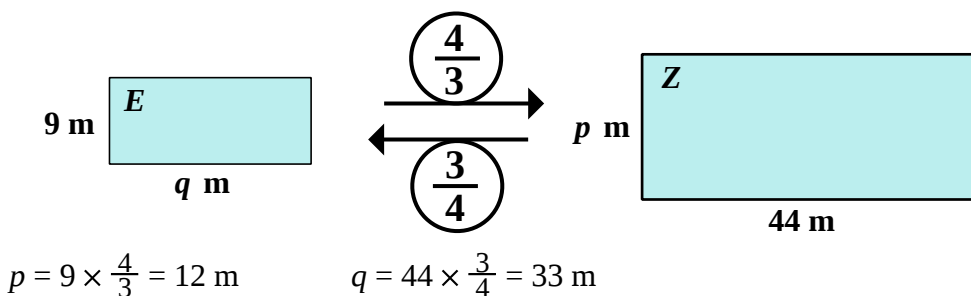
© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

6.2 Answers

GCSE Mathematics Ratio and Similarity

Answer 1



$$p = 9 \times \frac{4}{3} = 12 \text{ m}$$

$$q = 44 \times \frac{3}{4} = 33 \text{ m}$$

[2 marks]

Answer 2

$$28 \times \frac{7}{4} = 49 \text{ cm}$$

Answer 3

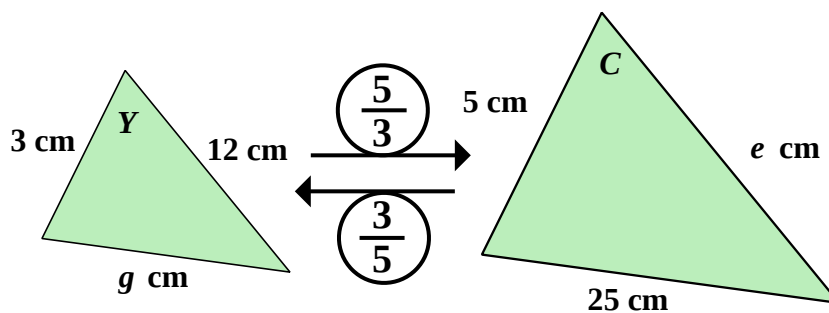
$$90 \times \frac{7}{15} = 42 \text{ cm}$$

Answer 4

$$30 \text{ m by } 37.5 \text{ m}$$

[2, 2, 2 marks]

Answer 5



$$e = 12 \times \frac{5}{3} = 20 \text{ cm}$$

$$g = 25 \times \frac{3}{5} = 15 \text{ cm}$$

[3 marks]

Answer 6

(i) $\frac{9}{2}$

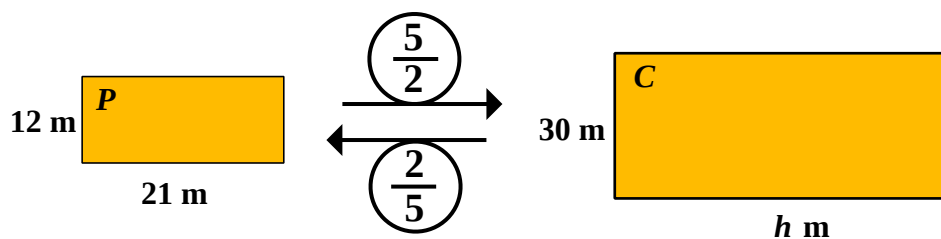
(ii) $\frac{5}{3}$

(iii) $\frac{7}{3}$

(iv) $\frac{1}{3}$

[4 marks]

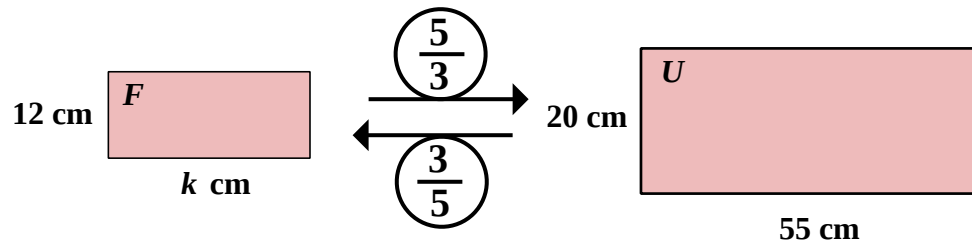
Answer 7



$$h = 21 \times \frac{5}{2} = 52.5 \text{ m}$$

[2 marks]

Answer 8



$$k = 55 \times \frac{3}{5} = 33 \text{ cm}$$

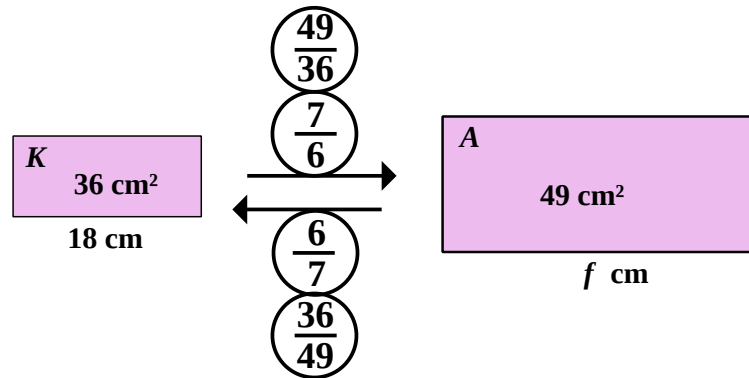
[2 marks]

Answer 9

(i) $\frac{49}{36}$ (ii) $\frac{8}{5}$ (iii) $\frac{4}{3}$

[3 marks]

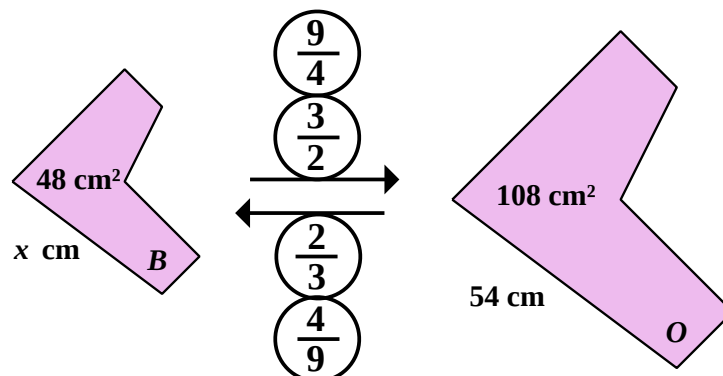
Answer 10



$$f = 18 \times \frac{7}{6} = 21 \text{ cm}$$

[3 marks]

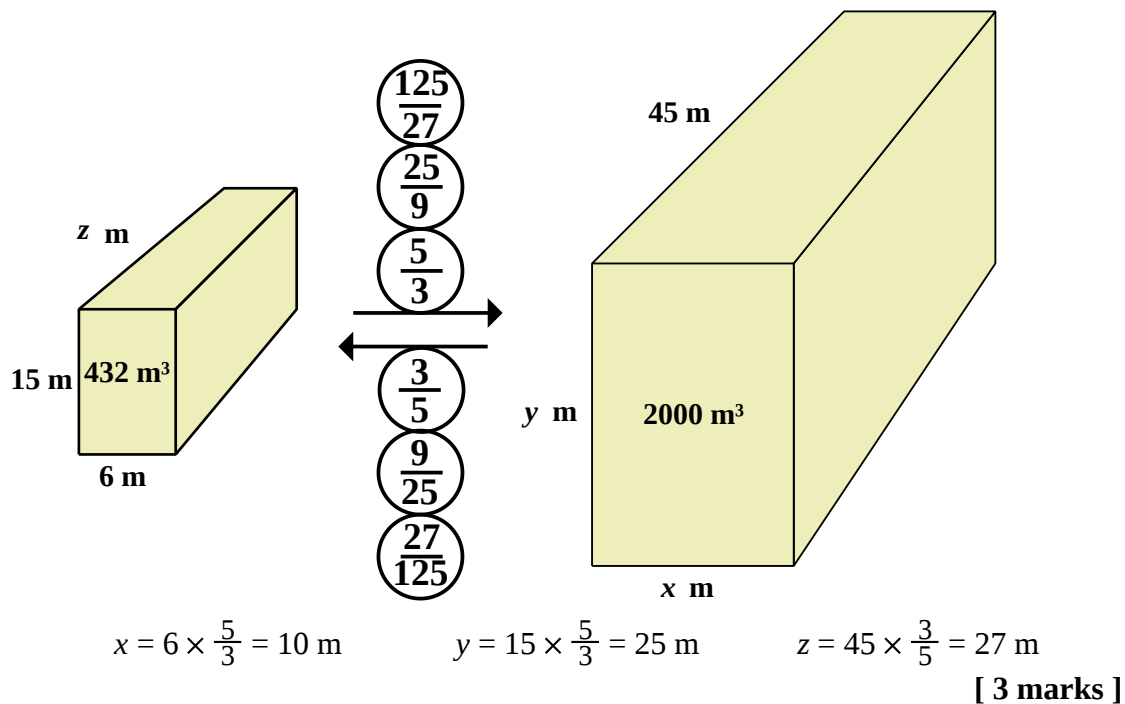
Answer 11



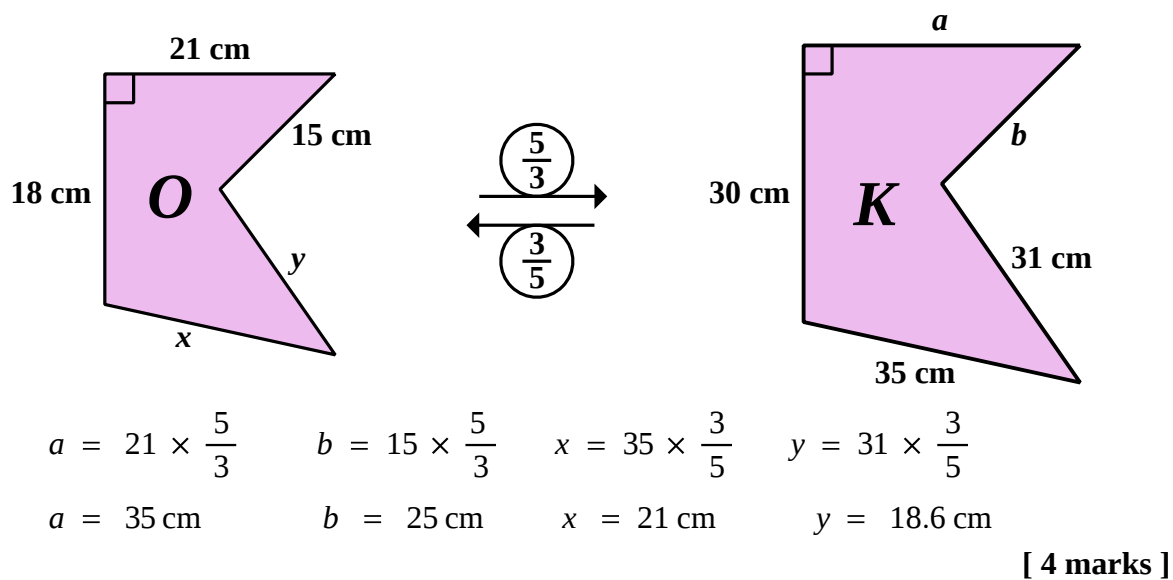
$$x = 54 \times \frac{2}{3} = 36 \text{ cm}$$

[3 marks]

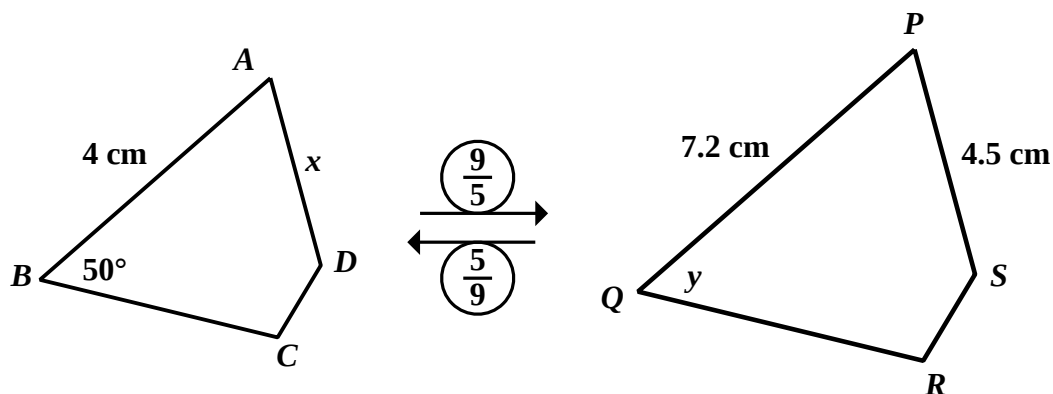
Answer 12



Answer 13



Answer 14

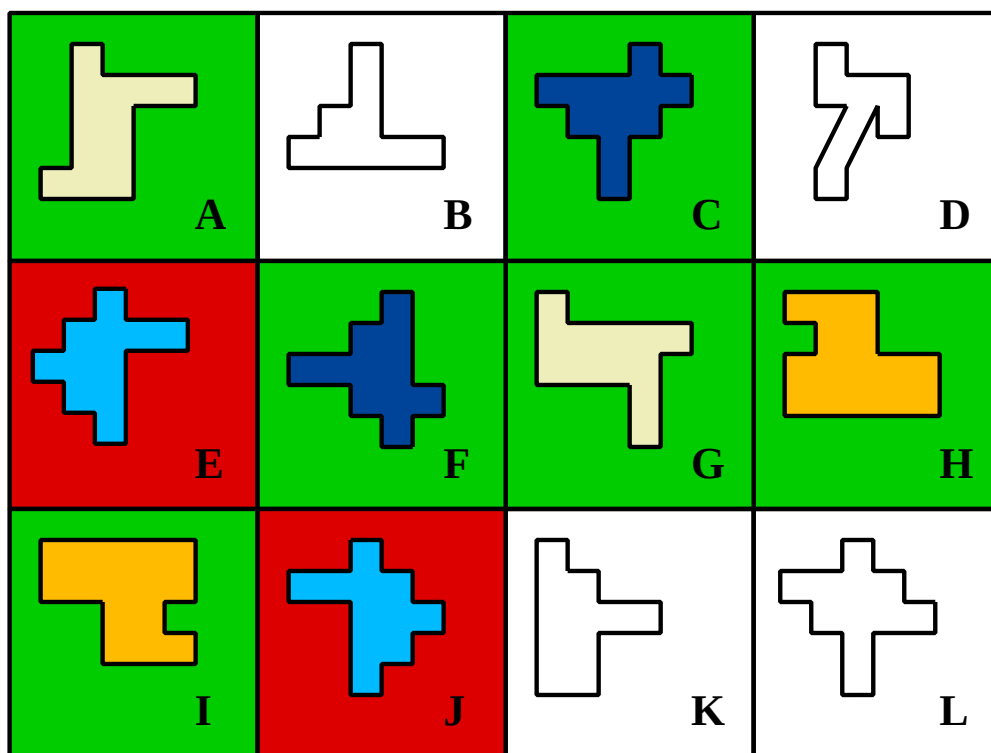


$$x = 4.5 \times \frac{5}{9} \quad y = 50^\circ$$

$$x = 2.5 \text{ cm}$$

[3 marks]

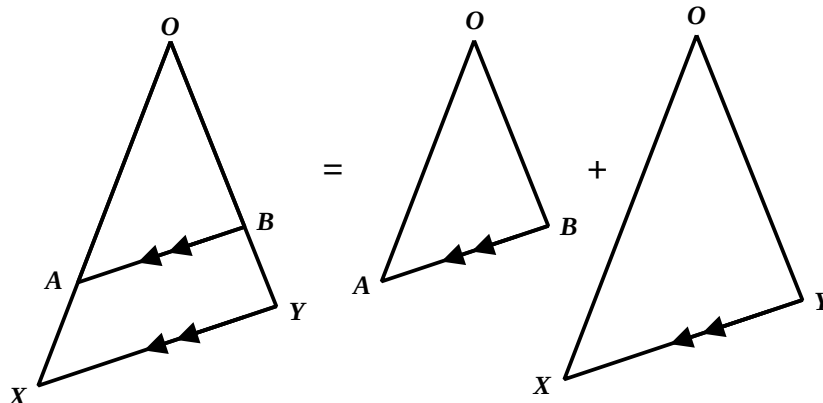
Answer 15



[6 marks]

7.1 Superimposed Triangles

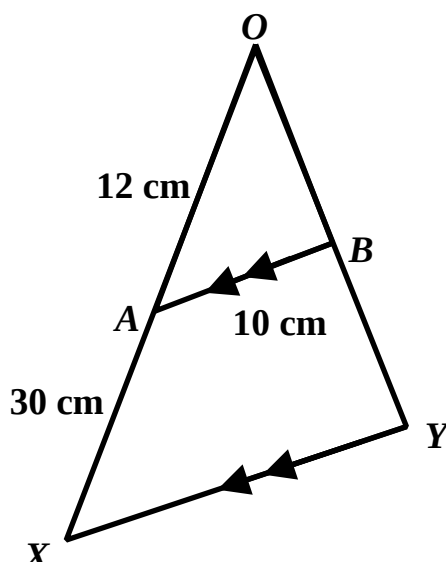
Similar triangles are often encountered in situations where one triangle is on top of the other. In the following diagram, the left hand figure can be thought of as being made up from the two triangles $\triangle OAB$ and $\triangle OXY$ placed one upon the other.



The two separated triangles are **similar** because AB is parallel to XY . So although they are of different sizes, they have the same shape. In fact $\triangle OXY$ is an enlargement of $\triangle OAB$.

Example

Let $OA = 12$ cm, $AX = 30$ cm and $AB = 10$ cm.
 AB is parallel with XY .
 Find the length of XY .

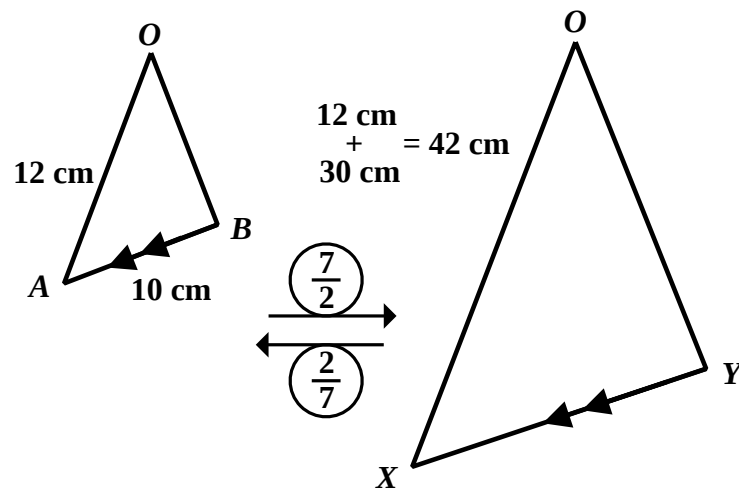


The trap for the unaware in this question is to think that the length scale factor between the two similar triangles is $\frac{30}{12}$ or $\frac{6}{5}$. It isn't !
 This is because the length of the larger triangle's longest side is not 30 cm.

What is the length of the larger triangles longest side ?

[1 mark]

Having turned the page, I hope you first answered, 42 cm.



$$\text{length scale factor} = \frac{42}{12} = \frac{21}{6} = \frac{7}{2}$$

$$\therefore \text{length } XY = 10 \times \frac{7}{2} = 35\text{ cm}$$

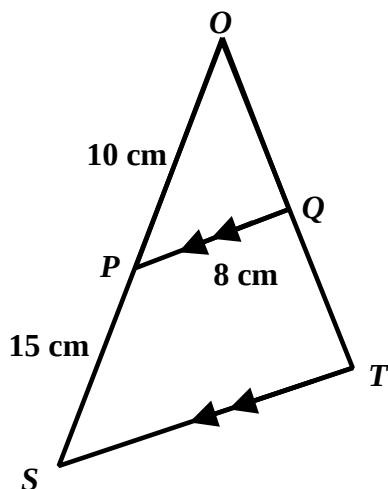
[3 marks]

7.2 Exercise

Marks Available : 40

Question 1

Let $OP = 10\text{ cm}$, $PS = 15\text{ cm}$ and $PQ = 8\text{ cm}$.
 PQ is parallel with ST .



- (i) Draw the two superimposed triangles separately in the space above.

[2 marks]

- (ii) Find the length scale factor, greater than 1, between the two triangles.

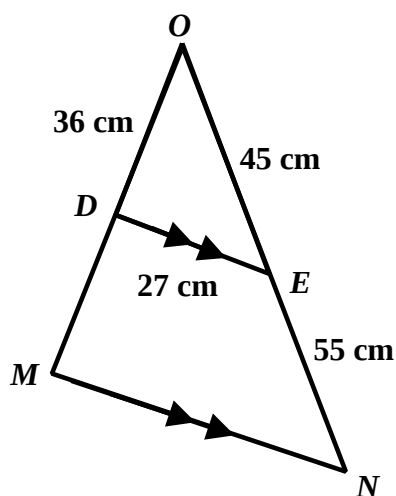
[2 marks]

- (iii) Find the length of ST .

[2 marks]

Question 2

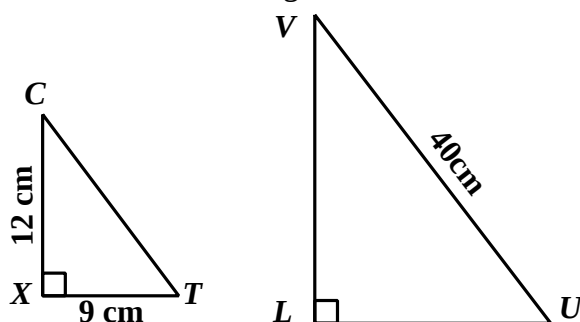
Let $OD = 36$ cm, $OE = 45$ cm, $DE = 27$ cm and $EN = 55$ cm.
 DE is parallel with MN .



- (i) Draw the two superimposed triangles separately in the space above. [2 marks]
- (ii) Find the length scale factor, greater than 1, between the two triangles. [2 marks]
- (iii) Find the length of MN . [1 mark]
- (iv) Find the length of OM . [1 mark]
- (v) Find the length of DM . [1 mark]

Question 3

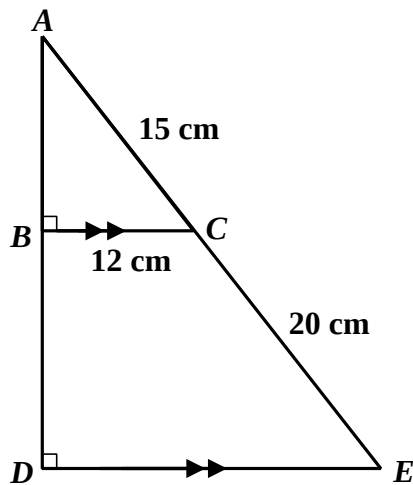
$\triangle XTC$ and $\triangle LUV$ are similar with length LU shorter than length LV .



- (i) Use the theorem of Pythagoras to find the length of side TC in $\triangle XTC$. [2 marks]
- (ii) Hence find lengths LU and LV in $\triangle LUV$. [2 marks]

Question 4

Let $AC = 15$ cm, $BC = 12$ cm, and $CE = 20$.
 BC is parallel with DE .



- (i) Draw the two superimposed triangles separately in the space above. [2 marks]

- (ii) Use the Theorem of Pythagoras to calculate length AB .
Think : If your answer is more than the 15 cm hypotenuse you've done something wrong !

[2 marks]

- (iii) What is the length scale factor, greater than 1, between the two triangles ?

[2 marks]

- (iv) What is the area scale factor, greater than 1, between the two triangles ?

[1 mark]

- (v) What is the area of $\triangle ABC$?

[1 mark]

- (vi) What is the area of $\triangle ADE$?

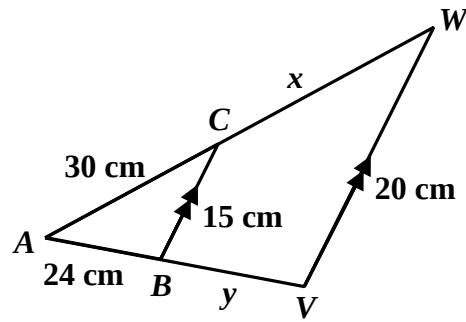
[1 mark]

- (vii) What is the area of the trapezium $BDEC$?

[2 marks]

Question 5

Find x and y .



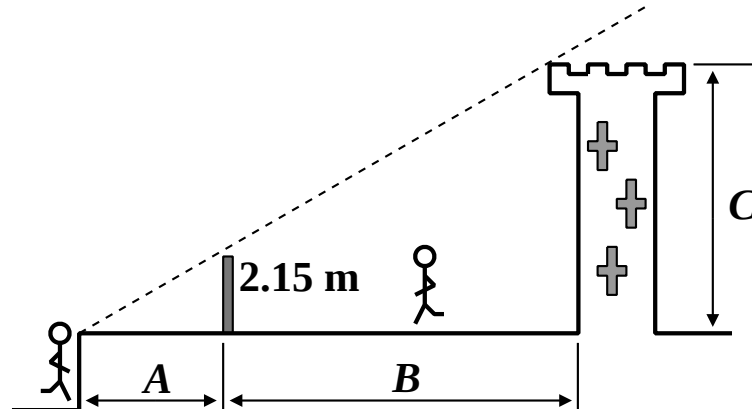
[6 marks]

Question 6

Sid and Fred are having an argument.

Sid says that the castle tower is more than 100m high.

Fred says it's less than 100m high.



The castle tower is a ruin and locked. So Sid and Fred can't get to the top of it to dangle a rope to the ground and simply measure the length of the rope.

With a £250 bet riding on the outcome they offer to pay a well known mathematician, (that's you by the way!) £50 to answer the question, "Is the Tower more or less than 100 metres high?"

You advise them to place a stick in the flat, level ground such that when viewed from a ditch, the top of the stick and the top of the tower line up as shown in the diagram.

Everything is now measured carefully with you, Sid and Fred agreeing on the measurements taken. These are;

Top of stick is precisely 2.15 metres above the ground.

Distance A is 2.5 metres exactly.

Distance B is 115.5 metres without any doubt what-so-ever.

So, is the Tower more or less than 100 metres high?

You will need to provide clear working otherwise Sid and Fred will continue to argue.

[6 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

7.3 Answers

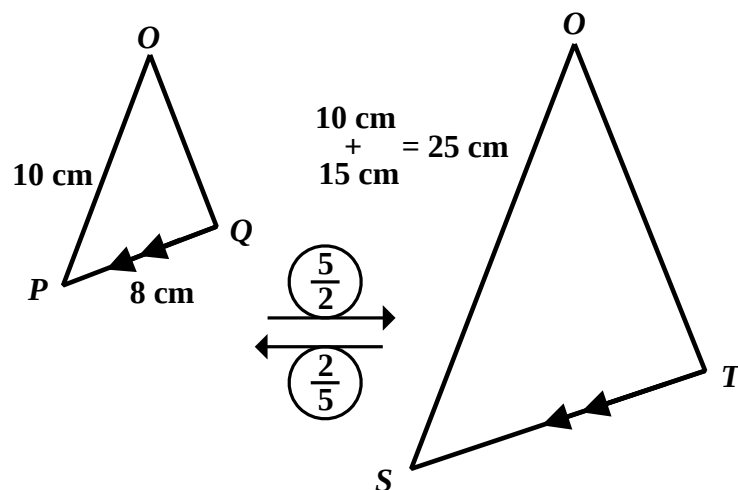
GCSE Mathematics Ratio and Similarity

7.3.1 Solutions to 7.2 Exercise

Answer 1

- (i) Two triangles, drawn separately.

[2 marks]



(ii) $lsf = \frac{25}{10} = \frac{5}{2}$

[2 marks]

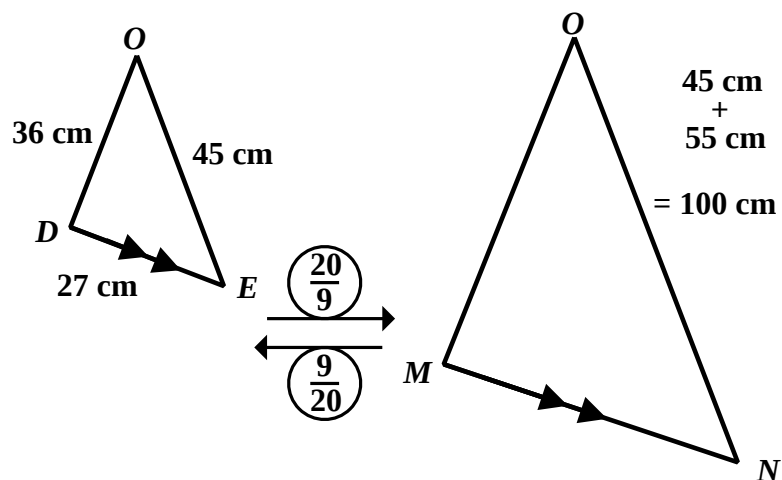
(iii) $length\ ST = 8 \times \frac{5}{2}$
 $= 20\text{ cm}$

[2 marks]

Answer 2

- (i) Two triangles, drawn separately.

[2 marks]



(ii) $\text{length scale factor} = \frac{100}{45} = \frac{20}{9}$

[2 marks]

(iii) $\text{length } MN = 27 \times \frac{20}{9} = 60\text{ cm}$

[1 mark]

(iv) $\text{length } OM = 36 \times \frac{20}{9} = 80\text{ cm}$

[1 mark]

(v) $\text{length } DM = 80 - 36 = 44\text{ cm}$

[1 mark]

Answer 3

- (i) By Pythagoras' Theorem, Length $TC = 15\text{ cm}$

[2 marks]

(ii) Therefore, the length scale factor $= \frac{40}{15} = \frac{8}{3}$

Length $LU = \frac{8}{3} \times 9 = 24\text{ cm}$

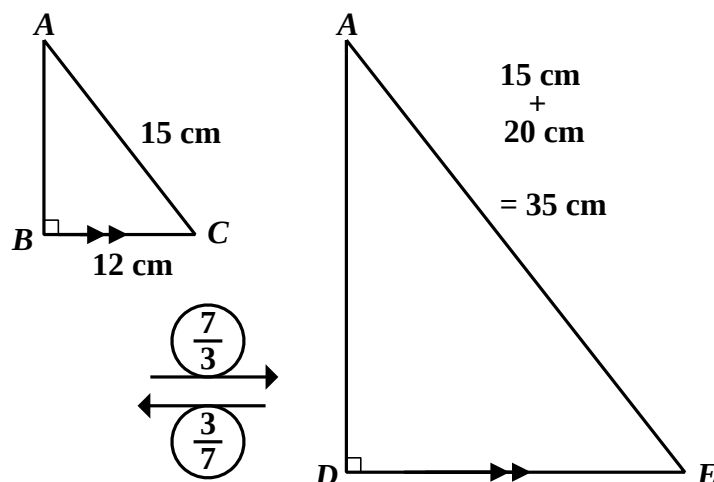
Length $LV = \frac{8}{3} \times 12 = 32\text{ cm}$

[2 marks]

Answer 4

- (i) Two triangles, drawn separately.

[2 marks]



- (ii) $AB = 9 \text{ cm}$

[2 marks]

- (iii) $lsf = \frac{7}{3}$

[2 marks]

- (iv) $asf = \frac{49}{9}$

[1 mark]

- (v) $\text{Area } \triangle ABC = 54 \text{ cm}^2$

[1 mark]

- (vi) $\text{Area } \triangle ADE = \frac{49}{9} \times 54 = 294 \text{ cm}^2$

[1 mark]

- (vii) $\text{Area trapezium } BDEC = 294 - 54 = 240 \text{ cm}^2$

[2 marks]

Answer 5

$$x = 10 \text{ cm} \quad y = 8 \text{ cm}$$

[6 marks]

Answer 6

Designed so that using the 115.5 instead of $115.5 + 2.5$ gets the wrong answer.

[6 marks]

Lesson 8

GCSE Mathematics Ratio and Similarity

8.1 Harder Similarity Area Problems

Example

GCSE Examination Question from 2013, paper 4H, Q17 (Edexcel)

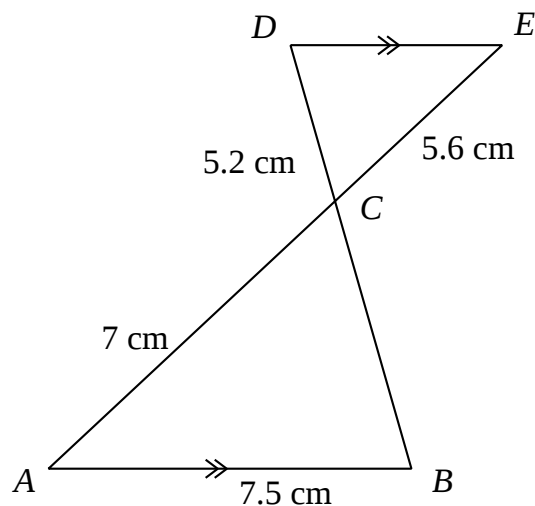


Diagram **NOT**
accurately drawn

AB is parallel to DE

The lines AE and BD intersect at C

$AB = 7.5$ cm, $AC = 7$ cm, $CD = 5.2$ cm, $CE = 5.6$ cm

(a) Calculate the length of BC

[2 marks]

(b) Calculate the length of DE

[2 marks]

(c) The area of triangle ABC is 21 cm^2
Calculate the area of triangle EDC

[3 marks]

8.2 Exercise

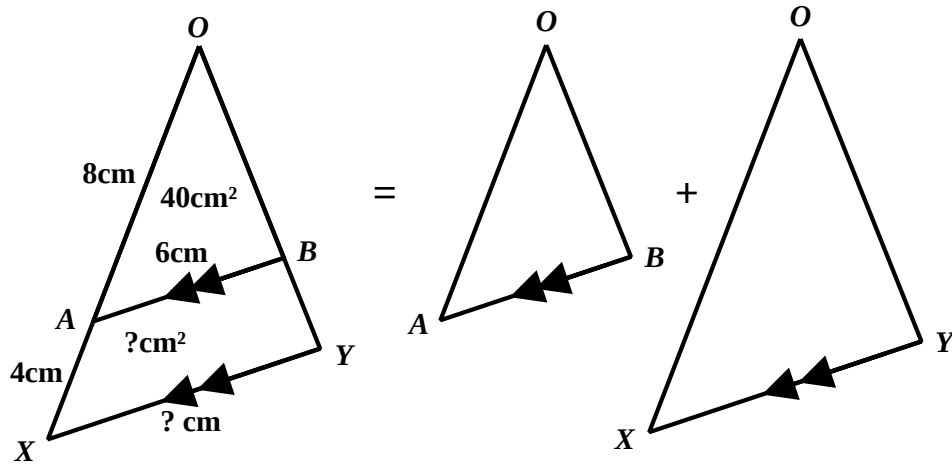
Marks Available : 40

Question 1

Let $OA = 8\text{ cm}$, $AX = 4\text{ cm}$ and $AB = 6\text{ cm}$

$\triangle OAB$ has an area of 40 cm^2

Find the length of XY and the area of the trapezium $AXYB$



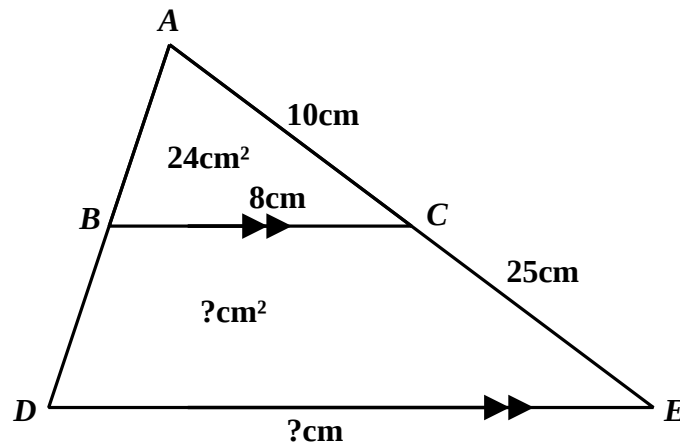
[6 marks]

Question 2

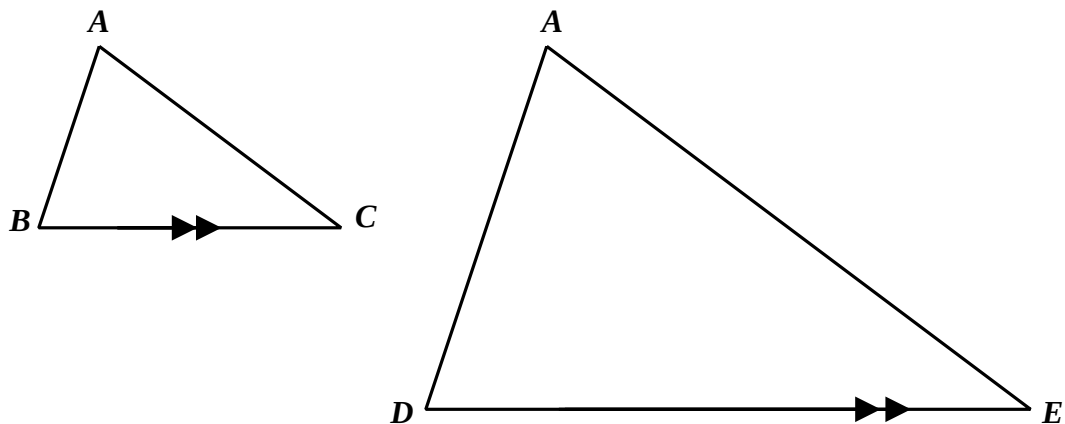
In the diagram below, $AC = 10\text{ cm}$, $BC = 8\text{ cm}$ and $CE = 25\text{ cm}$.

The area of $\triangle ABC$ is 24 cm^2 .

BC is parallel to DE .



- (i) Transfer the relevant measurements from the above diagram onto the one below which shows the two similar triangles separated.



[2 marks]

- (ii) Find the length of DE and the area of the trapezium $BDEC$

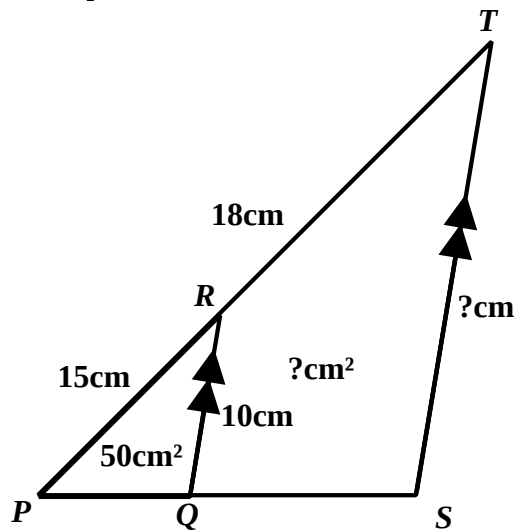
[4 marks]

Question 3

In the diagram below, $PR = 15\text{ cm}$, $RT = 18\text{ cm}$ and $QR = 10\text{ cm}$.

The area of $\triangle PQR$ is 50 cm^2

QR is parallel to ST



Find the length of ST and the area of the trapezium $QRST$.

[6 marks]

Question 4

In this question give your answers in the form $\frac{p}{q}$ in as simple a form as possible where p and q are integers and $q \neq 0$

What is the **length scale factor** that maps;

(i) A length of 12 cm onto a length of 15 cm ?

[1 mark]

(ii) A length of 21 cm onto a length of 24 cm ?

[1 mark]

(iii) A length of 45 cm onto a length of 63 cm ?

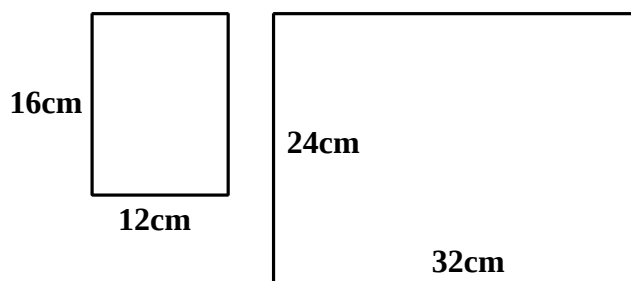
[1 mark]

Question 5

The following two rectangles are similar.

What is the length scale factor between them ?

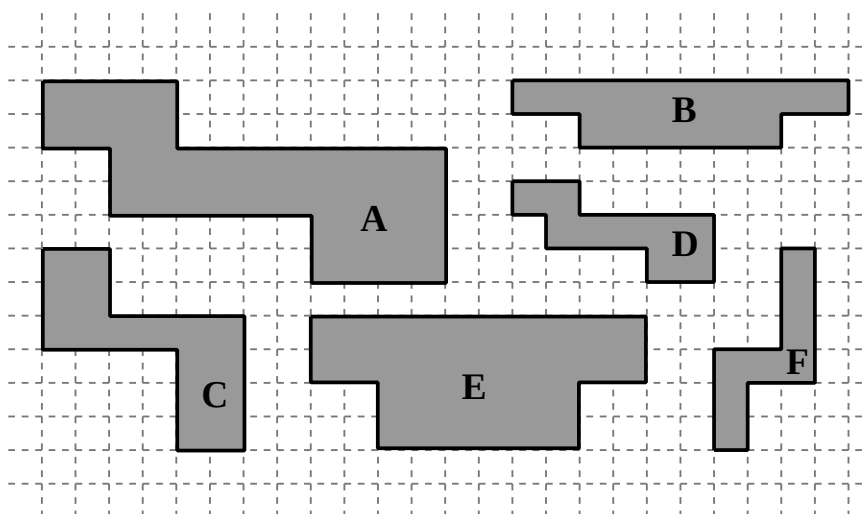
HINT : Be careful !



[2 marks]

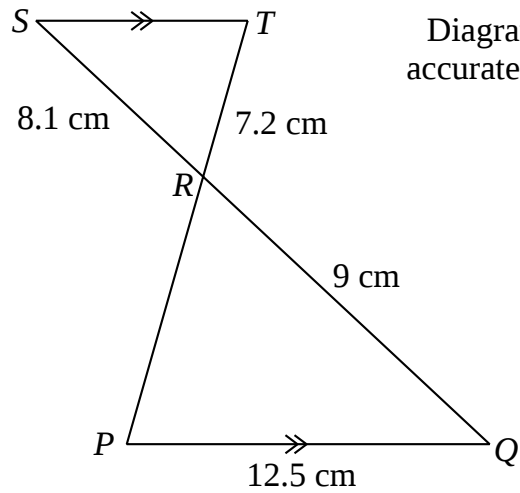
Question 6

Which two of the following shapes are similar ?



[2 marks]

Question 7



PQ is parallel to ST

The lines PT and QS intersect at R

$PQ = 12.5$ cm, $QR = 9$ cm, $SR = 8.1$ cm, $TR = 7.2$ cm

(a) Calculate the length of PR

[2 marks]

(b) Calculate the length of ST

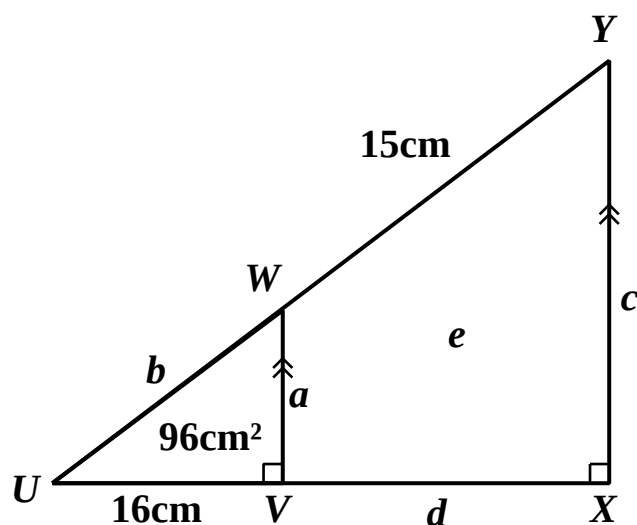
[2 marks]

(c) The area of triangle PQR is 36 cm^2
Calculate the area of triangle RTS

[3 marks]

Question 8

In the diagram below, $UV = 16\text{ cm}$, and $WY = 15\text{ cm}$
 The area of $\triangle UVW$, which is right angled, is 96 cm^2
 VW is parallel to XY



- (i) Find the length of VW , UW , XY then VX

[4 marks]

- (ii) Find the area of the trapezium $VWYX$
 Good luck with this A* grade question.

[4 marks]

8.3 Answers

GCSE Mathematics Ratio and Similarity

8.3.1 Solution to 8.1 Example

Look at alternate angles (Z angles) to see that;

$$lsf = \frac{5.6}{7} \text{ or } \frac{4}{5}$$

(a) 6.5 cm

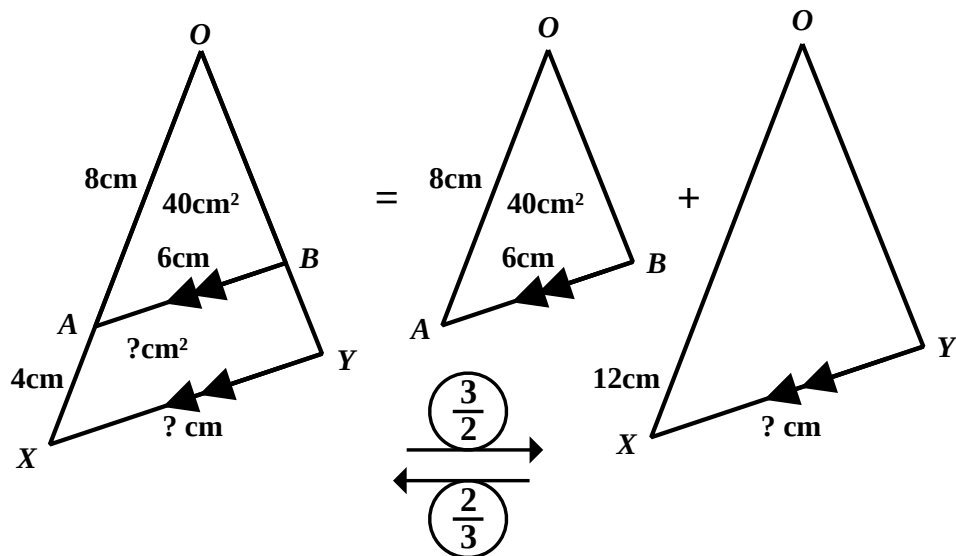
(b) 6 cm

(c) 13.4 cm²

[2, 2, 3 marks]

8.3.2 Solutions to 8.2 Exercise

Answer 1



$$XY = 6 \times \frac{3}{2} = 9\text{ cm} \quad asf = \frac{9}{4}$$

$$\begin{aligned} \text{Area } \triangle OXY &= \frac{9}{4} \times 40 \\ &= 90\text{ cm}^2 \end{aligned}$$

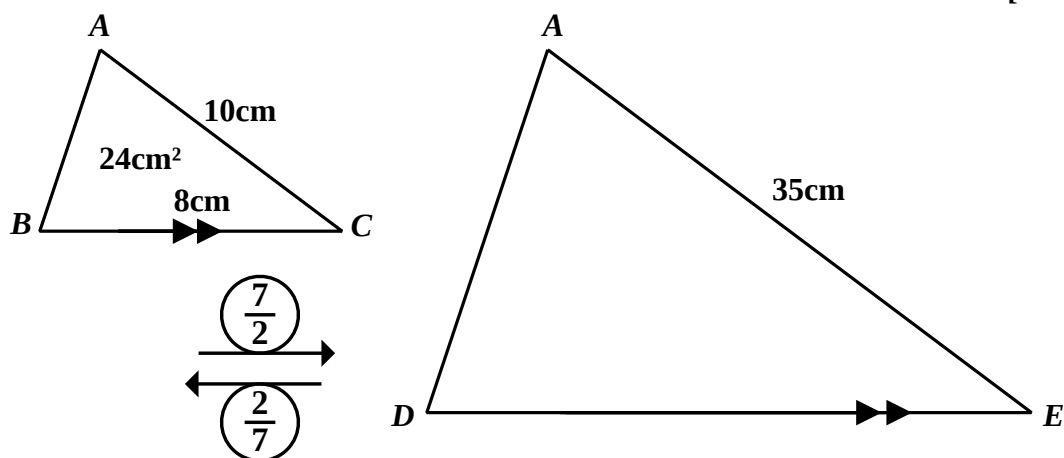
$$\therefore \text{Area trapezium } ABXY = 90 - 40 = 50\text{ cm}^2$$

[6 marks]

Answer 2

(i) Two triangles, drawn separately.

[2 marks]

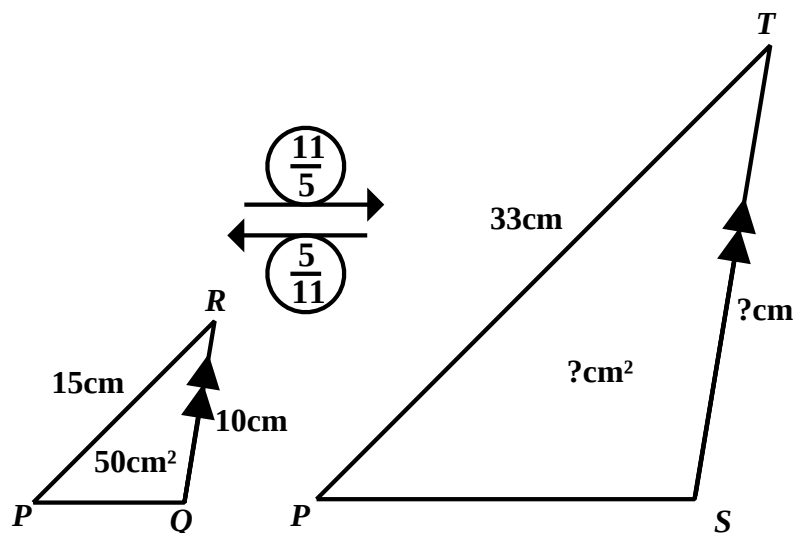


$$(ii) \quad DE = 8 \times \frac{7}{2} = 28\text{ cm} \quad asf = \frac{49}{4} \quad Area \triangle ADE = \frac{49}{4} \times 24 = 294\text{ cm}^2$$

$$\therefore Area \text{ trapezium } BCDE = 294 - 24 = 270\text{ cm}^2$$

[4 marks]

Answer 3



$$ST = 10 \times \frac{11}{5} = 22\text{ cm} \quad asf = \frac{121}{25} \quad Area \triangle TPS = \frac{121}{25} \times 50 = 242\text{ cm}^2$$

$$\therefore Area \text{ trapezium } QRTS = 242 - 50 = 192\text{ cm}^2$$

[6 marks]

Answer 4**(i)**

$$\frac{5}{4}$$

(ii)

$$\frac{8}{7}$$

(iii)

$$\frac{7}{5}$$

[1, 1, 1 marks]**Answer 5**

$$\frac{2}{1} \text{ or just } 2$$

[2 marks]**Answer 6**

A and D

[2 marks]**Answer 7****(a)** 8 cm**(b)** 11.25 cm**(c)** 29 cm² or 29.16 cm²**[2, 2, 3 marks]****Answer 8****(i)** VW = 12 cm (Use $Area \Delta = \frac{1}{2} b h$)**[1 mark]**

UW = 20 cm (Use Pythagoras' Theorem)

[1 mark]XY = 21 cm (Use $Isf = \frac{7}{4}$)**[1 mark]**

VX = 12 cm (From calculation that gave UX = 28 cm)

[1 mark]**(ii)**

$$asf = \frac{49}{16} \quad \text{so } Area \Delta YUX = \frac{49}{16} \times 96$$

$$= 294 \text{ cm}^2$$

$$\therefore Area \text{ trapezium } VWYX = 294 - 96 = 198 \text{ cm}^2$$

[4 marks]

Lesson 9

GCSE Mathematics Ratio and Similarity

9.1 Revision

Marks Available : 47

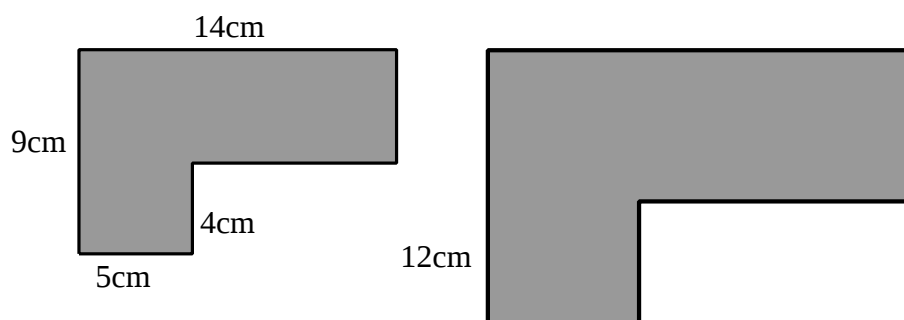
Question 1

A larger cuboid has lengths that are nine times longer than a similar smaller cuboid.
The smaller cuboid measures 6 cm by 7 cm by 8 cm.
What are the measurements of the larger cuboid ?

[2 marks]

Question 2

The two shapes shown below are similar.



(i) Work out the area of the left hand shape.

[2 marks]

(ii) What is the **length** scale factor, greater than 1, of the similarity ?

[1 mark]

(iii) What is the **area** scale factor, greater than 1 of the similarity ?

[1 mark]

(iv) Work out the area of the right hand shape.

[2 marks]

Question 3

True or false ?

(i) All squares are congruent.

[1 mark]

(ii) All isosceles triangles are similar.

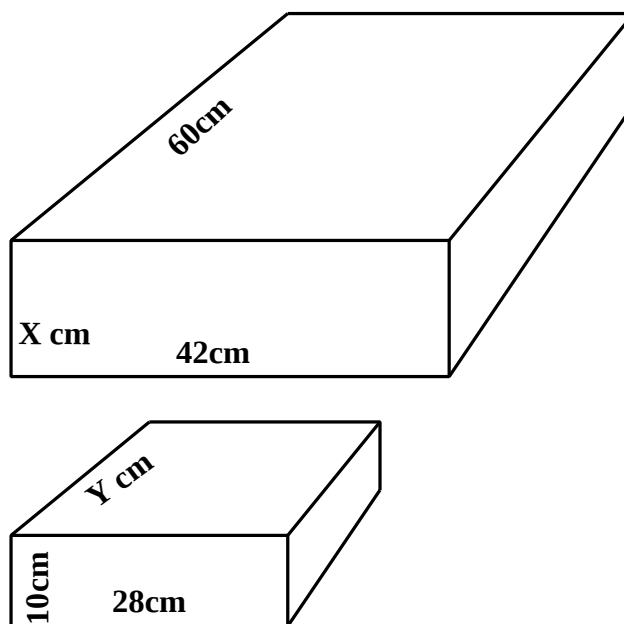
[1 mark]

(iii) All spheres are similar.

[1 mark]

Question 4

The two cuboids shown below are similar.



(i) What is the **length** scale factor, greater than 1, of the similarity ?

[1 mark]

(ii) What is the length of the side marked X ?

[1 mark]

(iii) What is the **length** scale factor, less than 1, of the similarity ?

[1 mark]

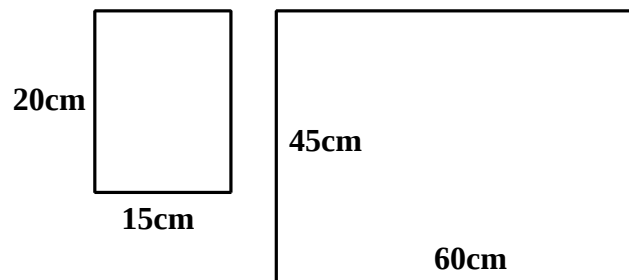
(iv) What is the length of the side marked Y ?

[1 mark]

Question 5

The following two rectangles are similar.

What is the **length scale factor** between them ?

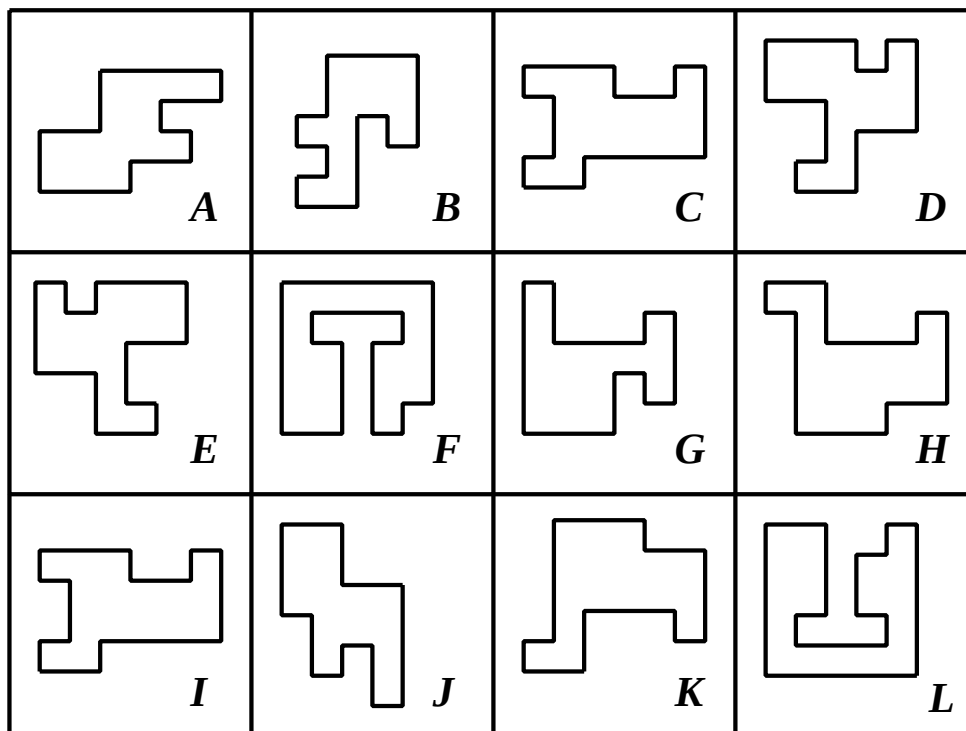


[2 marks]

Question 6

For the following shapes, shade in those that are **directly congruent** in one colour and, in a different colour, those that are **indirectly congruent**.

Provide a key to explain what the colours used represent.



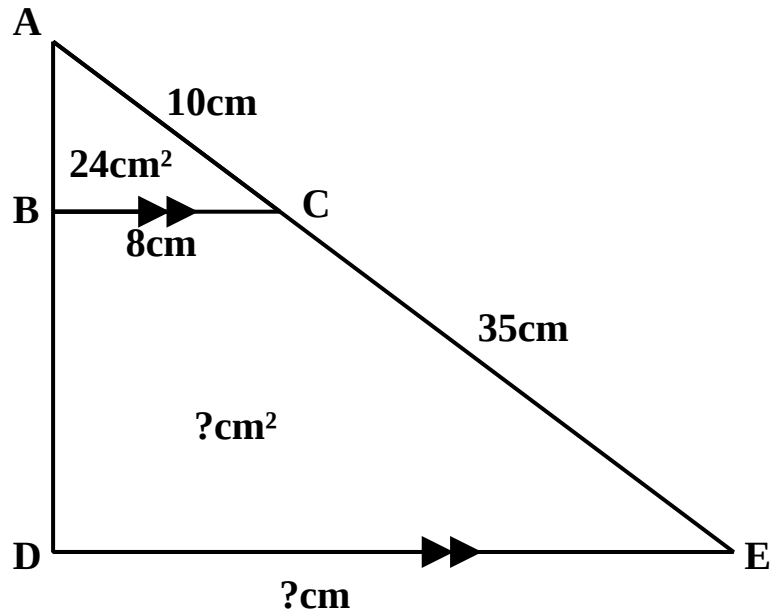
[6 marks]

Question 7

In the diagram below, $AC = 10$ cm, $BC = 8$ cm and $CE = 35$ cm.

The area of $\triangle ABC$ is 24 cm^2 .

BC is parallel to DE .



Do **NOT** assume that $\triangle ABC$ is right angled at B

Find the length of DE and the area of the trapezium $BCED$

[6 marks]

Decide, giving a reason, if $\triangle ABC$ is right angled at B or not.

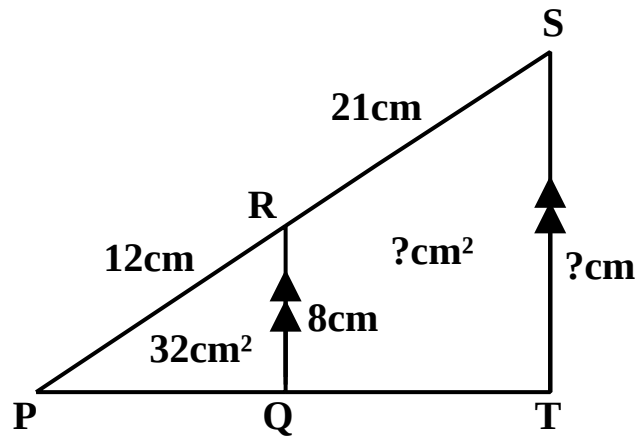
[2 marks]

Question 8

In the diagram below, $PR = 12$ cm, $RT = 21$ cm and $QR = 8$ cm.

The area of $\triangle PQR$ is 32 cm^2 .

QR is parallel to TS .



Do **NOT** assume that $\triangle PQR$ is right angled at Q

Find the length TS and the area of the trapezium $QRST$

[6 marks]

Decide, giving a reason, if $\triangle PQR$ is right angled at Q or not.

[2 marks]

Question 9

In this question give your answers in the form $\frac{p}{q}$ in as simple a form as possible where p and q are integers and $q \neq 0$

What is the **length** scale factor that maps;

(i) A length of 12 cm onto a length of 21 cm ?

[1 mark]

(ii) A length of 24 cm onto a length of 32 cm ?

[1 mark]

(iii) A length of 36 cm onto a length of 63 cm ?

[1 mark]

Question 10

A mini-doughnut has a diameter of 3 cm.

A jumbo-doughnut, similar to the mini-doughnut, has a diameter of 12 cm.

(i) What is the **length** scale factor, greater than 1, of the similarity ?

[1 mark]

(ii) When considering food, it's volume that's important.
How many mini-doughnuts would Mr Stuff have to eat to have consumed the same amount of doughnut material as Mr Munch, who has just eaten **FIVE** jumbo-doughnuts ?

[4 marks]

9.2 Answers

GCSE Mathematics
Ratio and Similarity

Answer 1

$54 \times 63 \times 72$

[2 marks]

Answer 2

(i) 90 cm^2

(ii) $lsf = \frac{4}{3}$

(iii) $asf = \frac{16}{9}$

(iv) 160 cm^2

[2, 1, 1, 2 marks]

Answer 3

(i) F

(ii) F

(iii) T

[1, 1, 1 marks]

Answer 4

(i) $lsf = \frac{3}{2}$

(ii) 15 cm

(iii) $lsf = \frac{2}{3}$

(iv) 40 cm

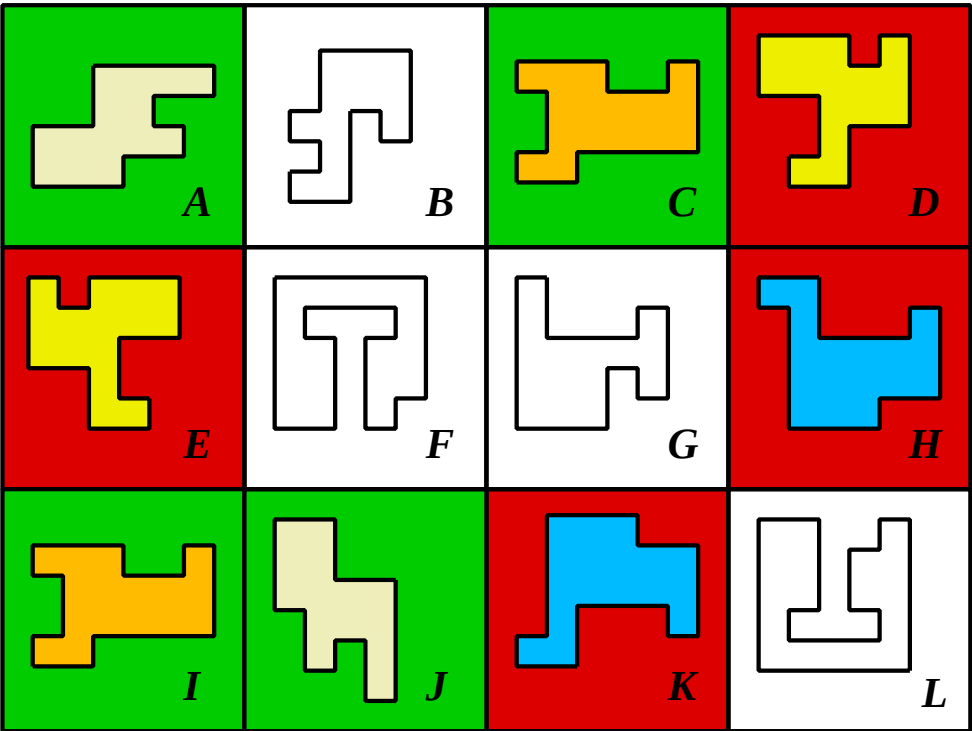
[1, 1, 1, 1 marks]

Answer 5

3

[2 marks]

Answer 6



[6 marks]

Answer 7

36 cm

$$486 - 24 = 462 \text{ cm}^2$$

[3, 3 marks]Yes, $\triangle ABC$ is right angled

Reasoning might consider if Pythagoras' Theorem holds

or if the formula $\text{Area } \triangle = \frac{1}{2} b h$ holds**[2 marks]****Answer 8**

22 cm

$$242 - 32 = 210 \text{ cm}^2$$

[3, 3 marks]No, $\triangle PQR$ is not right angled

Reasoning might consider if Pythagoras' Theorem holds - it doesn't

or if the formula $\text{Area } \triangle = \frac{1}{2} b h$ holds - it doesn't**[2 marks]****Answer 9****(i)**

$$\frac{7}{4}$$

(ii)

$$\frac{4}{3}$$

(iii)

$$\frac{7}{4}$$

[3 marks]**Answer 10****(i)**

4

(ii)

$$4^3 \times 5 = 320$$

[1, 4 marks]

Lesson 10

GCSE Mathematics Ratio and Similarity

10.1 Test

Marks Available : 60

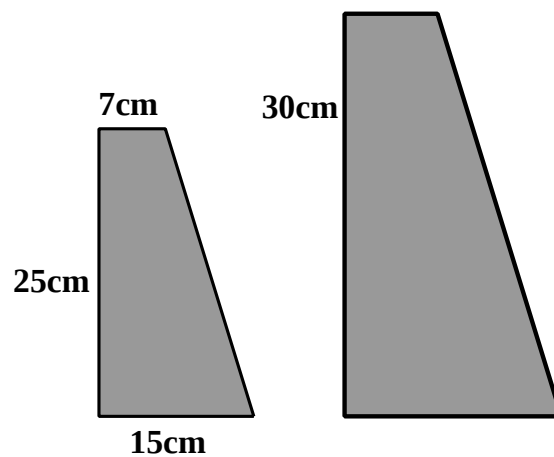
Question 1

A larger cuboid has lengths that are six times longer than a similar smaller cuboid.
The smaller cuboid measures 9 cm by 11 cm by 16 cm.
What are the measurements of the larger cuboid ?

[2 marks]

Question 2

The two shapes shown below are similar.



(i) Work out the area of the left hand shape.

[1 mark]

(ii) What is the **LENGTH** scale factor, greater than 1, of the similarity ?

[1 mark]

(iii) What is the **AREA** scale factor, greater than 1 of the similarity ?

[1 mark]

(iv) Work out the area of the right hand shape.

[1 mark]

Question 3

True or false ?

(i) All cubes are congruent.

[1 mark]

(ii) All equilateral triangles are similar.

[1 mark]

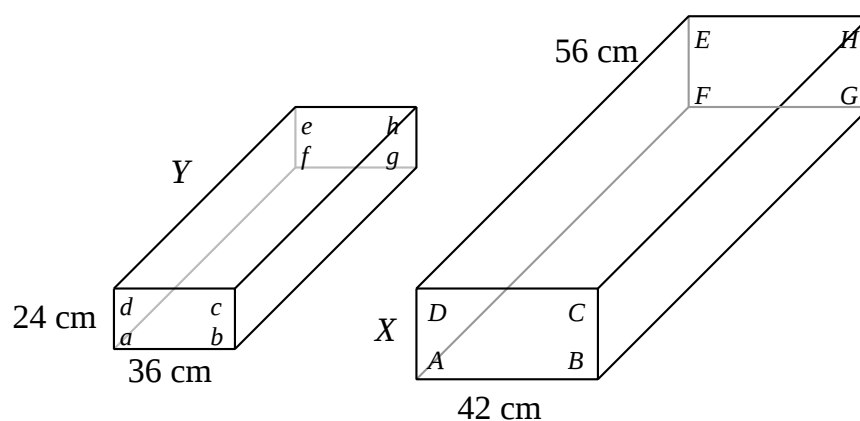
(iii) All pyramids are similar.

[1 mark]

Question 4

The two cuboids shown below are similar.

The edges of $abcdefgh$ match up with $ABCDEFGH$ in the obvious way.



(i) What is the *length* scale factor, greater than 1, of the similarity ?

[1 mark]

(ii) Show how your part (i) answer may be used to find the length of the side marked X ?

[1 mark]

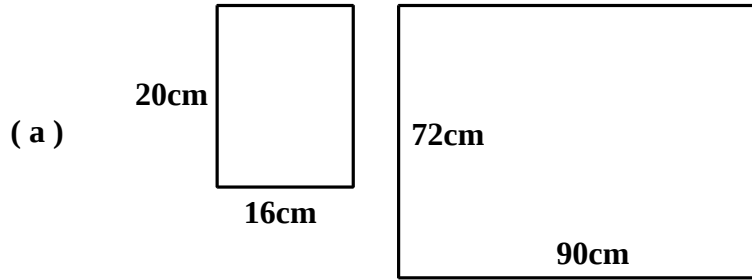
(iii) What is the *length* scale factor, less than 1, of the similarity ?

[1 mark]

(iv) Show how your part (iii) answer may be used to find the length of the side marked Y ?

[1 mark]

Question 5



The two rectangles are similar.

What is the **length** scale factor, greater than 1, between them ?

[2 marks]

(b) Cuboid A measures 12 m by 8 m by 32 m.

Cuboid B measures 48 cm by 12 m by 18 m.

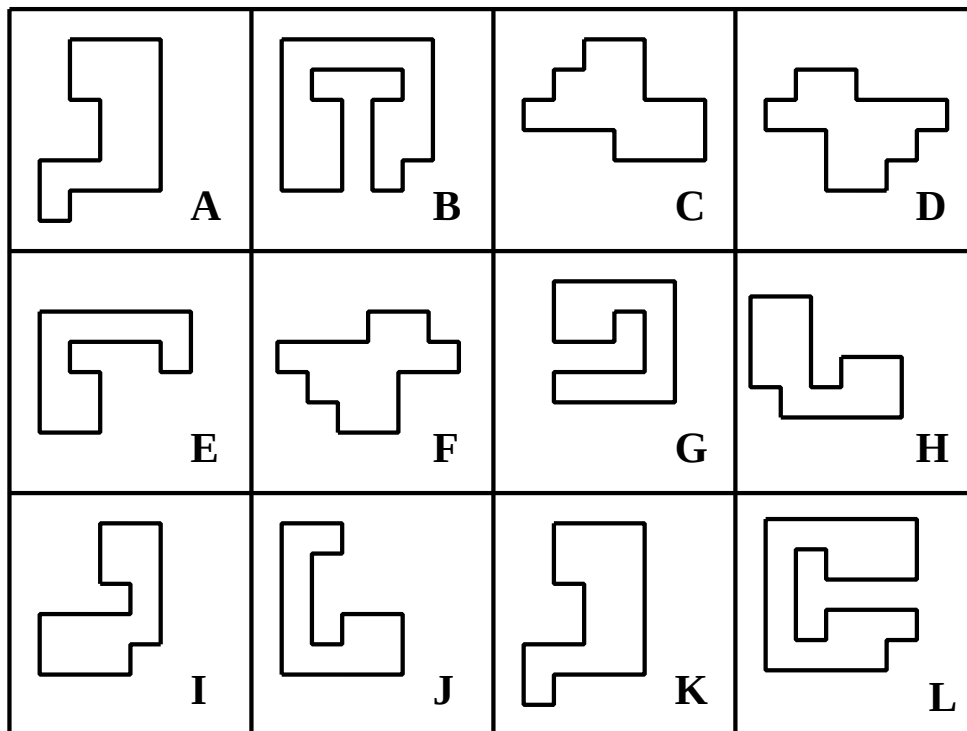
What is the length scale factor, less than 1, between them ?

[2 marks]

Question 6

For the following shapes, shade in those that are **directly congruent** in one colour and, in a different colour, those that are **indirectly congruent**.

Provide a key to explain what the colours used represent.



[6 marks]

Question 7

GCSE Examination Question from January 2012. Paper 3H, Q12 (Edexcel)

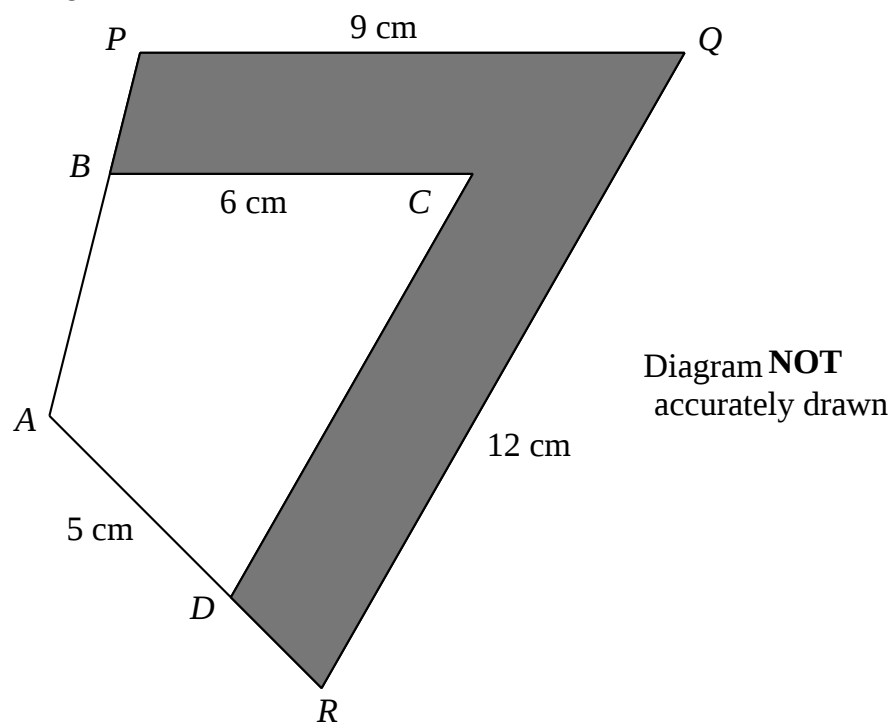
$ABCD$ and $APQR$ are two similar quadrilaterals.

$$PQ = 9 \text{ cm}$$

$$BC = 6 \text{ cm}$$

$$AD = 5 \text{ cm}$$

$$QR = 12 \text{ cm}$$



(a) Find the length of DC .

[2 marks]

(b) Find the length of AR .

[2 marks]

The area of the quadrilateral $ABCD$ is 32 cm^2

(c) Calculate the area of the shaded region.

[4 marks]

Question 8

GCSE Examination Question from June 2011. Paper 3H, Q12 (Edexcel)

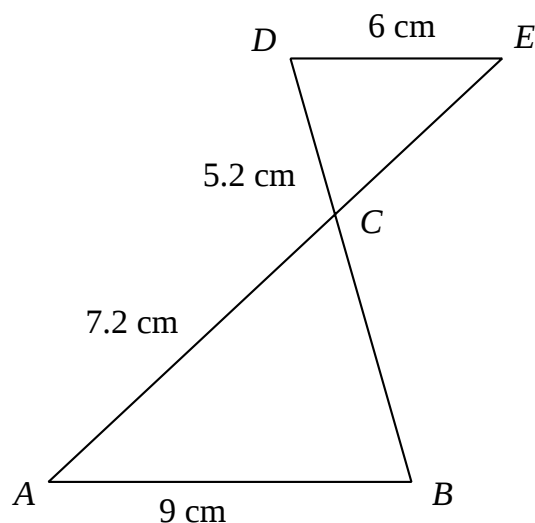


Diagram **NOT**
accurately drawn

AB is parallel to DE .

ACE and BCD are straight lines.

$AB = 9\text{ cm}$.

$AC = 7.2\text{ cm}$.

$CD = 5.2\text{ cm}$.

$DE = 6\text{ cm}$.

(a) Calculate the length of BC .

[2 marks]

(b) Calculate the length of CE .

[2 marks]

Question 9

A mini-doughnut has a diameter of 3.2 cm.

A jumbo-doughnut, similar to the mini-doughnut, has a diameter of 7.2 cm.

How many mini-doughnuts would Mr Bloat have to eat to have consumed the same amount of doughnut material as Mr Pucké, who's just eaten 5 jumbo-doughnuts ?

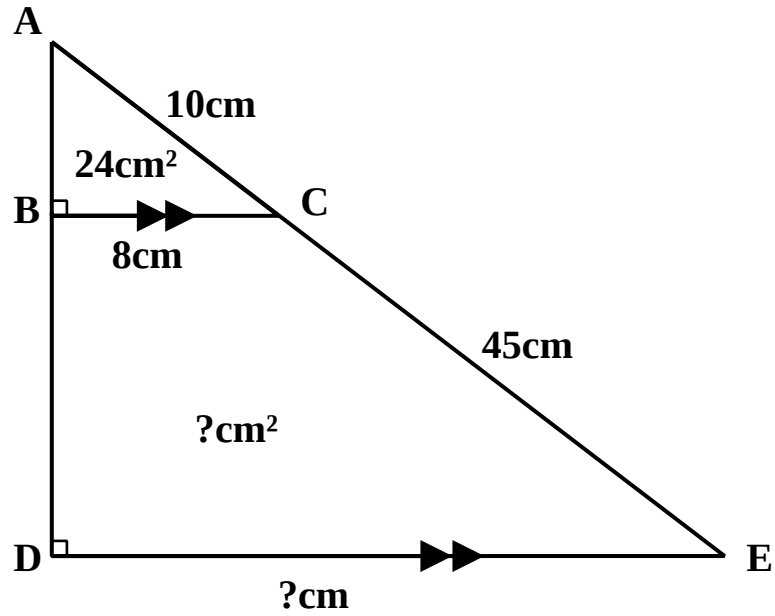
[4 marks]

Question 10

In the diagram below, $AC = 10\text{ cm}$, $BC = 8\text{ cm}$ and $CE = 45\text{ cm}$

The area of $\triangle ABC$, which is right angled, is 24 cm^2

BC is parallel to DE



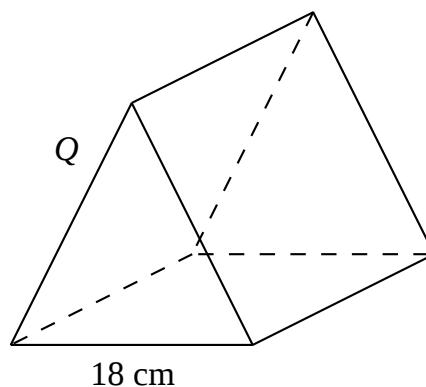
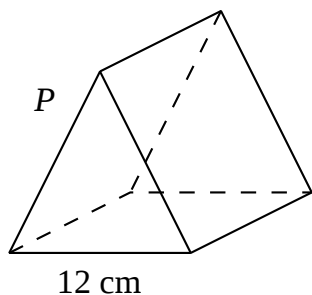
Find the length of DE and the area of the trapezium $BCED$.

[6 marks]

Question 11

GCSE Examination Question from June 2010. Paper 3H, Q17.

Diagram **NOT**
accurately drawn



Two prisms, P and Q are similar.

The cross-section of prism P is a triangle with a base of length 12 cm.

The cross-section of prism Q is a triangle with a base of length 18 cm.

The total surface area of prism P is 544 cm^2 .

Calculate the total surface area of prism Q .

[4 marks]

Question 12

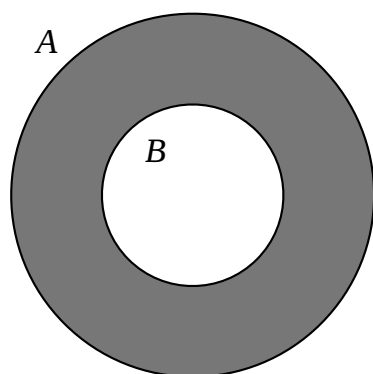


Diagram **NOT**
accurately drawn

The diagram shows a circle A with a circle B removed.

The area of the large circle, A , is 75 cm^2 .

The radius of circle A , is two and a half times the radius of circle B .

Work out the area shown shaded.

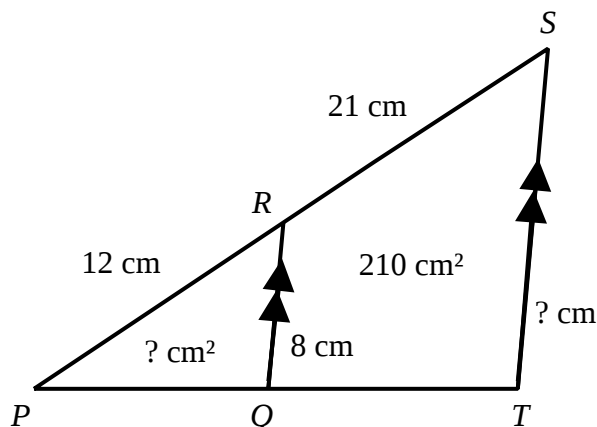
[4 marks]

Question 13

In the diagram $PR = 12$ cm, $RS = 21$ cm and $QR = 8$ cm.

The area of the trapezium $RSTQ$ is 210 cm².

QR is parallel to TS .



- (i) Find the length of TS .

[2 marks]

- (ii) Find the area of $\triangle PQR$.

[3 marks]

- (iii) Find the area of $\triangle PST$.

[2 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

10.2 Answers

GCSE Mathematics Ratio and Similarity

Answer 1

$$54 \times 66 \times 96$$

[2 marks]

Answer 2

$$\begin{aligned} \text{(i)} \quad \frac{1}{2} \times (7 + 15) \times 25 &= \frac{1}{2} \times 22 \times 25 \\ &= 275 \text{ cm}^2 \end{aligned}$$

[1 mark]

$$\text{(ii)} \quad \frac{30}{25} = \frac{6}{5} \qquad \text{(iii)} \quad \frac{36}{25} \qquad \text{(iv)} \quad 275 \times \frac{36}{25} = 396 \text{ cm}^2$$

[1, 1, 1 marks]

Answer 3

$$\text{(i)} \quad \text{F} \qquad \text{(ii)} \quad \text{T} \qquad \text{(iii)} \quad \text{F}$$

[1, 1, 1 marks]

Answer 4

$$\begin{aligned} \text{(i)} \quad \frac{42}{36} &= \frac{7}{6} & \text{(ii)} \quad 24 \times \frac{7}{6} &= 28 \text{ cm} \\ \text{(iii)} \quad \frac{6}{7} & & \text{(iv)} \quad 56 \times \frac{6}{7} &= 48 \text{ cm} \end{aligned}$$

[1, 1, 1, 1 marks]

Answer 5

$$\text{(a)} \quad \frac{90}{20} = \frac{9}{2} \qquad \text{(b)} \quad \frac{2}{3}$$

[2, 2 marks]

Answer 6

Directly Congruent : A - K E - J H - I
Indirectly Congruent : B - L D - F

[6 marks]

Answer 7

$$\text{(a)} \quad 8 \text{ cm} \qquad \text{(b)} \quad 7.5 \text{ cm} \qquad \text{(c)} \quad 40 \text{ cm}^2$$

[2, 2, 4 marks]

Answer 8

$$\text{(a)} \quad 7.8 \text{ cm} \qquad \text{(b)} \quad 4.8 \text{ cm}$$

[2, 2 marks]

Answer 9

$$\begin{aligned} lsf &= \frac{7.2}{3.2} = \frac{72}{32} = \frac{9}{4} \quad \therefore vsf = \frac{729}{64} \\ \text{Number of doughnuts} &= 5 \times \frac{729}{64} = 57 \end{aligned}$$

[4 marks]

Answer 10

$$\begin{aligned} lsf &= \frac{55}{10} = \frac{11}{2} \quad \therefore DE = 8 \times \frac{11}{2} = 44 \text{ cm} \\ asf &= \frac{121}{4} \quad \therefore \text{Area } ADE = 24 \times \frac{121}{4} = 726 \text{ cm}^2 \\ \text{Area trapezium } BCED &= 726 - 24 \\ &= 702 \text{ cm}^2 \end{aligned}$$

[6 marks]

Answer 11

$$\begin{aligned} lsf &= \frac{18}{12} = \frac{3}{2} \\ \therefore asf &= \frac{9}{4} \\ \text{Area prism } Q &= 544 \times \frac{9}{4} \\ &= 1224 \text{ cm}^2 \end{aligned}$$

[4 marks]

Answer 12

$$\begin{aligned} \text{Area shaded} &= 75 - \left(\frac{2}{5} \right)^2 \times 75 \\ &= 63 \text{ cm}^2 \end{aligned}$$

[4 marks]

Answer 13

$$(i) \quad lsf = \frac{33}{12} = \frac{11}{4} \quad \therefore TS = 8 \times \frac{11}{4} = 22 \text{ cm}$$

[2 marks]

(ii) Let area $\triangle PQR$ be x in which case,

$$\begin{aligned} (x + 210) \times \left(\frac{4}{11} \right)^2 &= x \\ 16x + 3360 &= 121x \\ 105x &= 3360 \\ x &= 32 \text{ cm}^2 \end{aligned}$$

[3 marks]

(iii) 242 cm^2

[2 marks]

11.1 Later Date Revision

When two geometric objects are described as being *similar* it means that they have the same *shape* but not necessarily the same *size*; one is an enlargement of the other. All the lengths of one are more than (or less than) the corresponding lengths of the other by the same multiplicative length scale factor, *lsf*. Also, any area of one is more than (or less than) the corresponding area of the other by the same multiplicative area scale factor, *asf*. The same is true of any corresponding volumes. In summary, between two shapes described as being similar, there can be up to three different scale factors in play;

- Length scale factor, *lsf*
- Area scale factor, *asf*
- Volume scale factor, *vsf*

Of great use is the mathematical relationship between these three scale factors. Given any one, the other two can be found as follows;

- Finding *lsf* from either the *asf* or the *vsf*

$$\text{length scale factor} = \sqrt{\text{area scale factor}}$$

$$\text{length scale factor} = \sqrt[3]{\text{volume scale factor}}$$

- Finding *asf* from either *lsf* or *vsf*

$$\text{area scale factor} = (\text{length scale factor})^2$$

$$\text{area scale factor} = (\sqrt[3]{\text{volume scale factor}})^2$$

- Finding *vsf* from either *lsf* or *asf*

$$\text{volume scale factor} = (\text{length scale factor})^3$$

$$\text{volume scale factor} = (\sqrt{\text{area scale factor}})^3$$

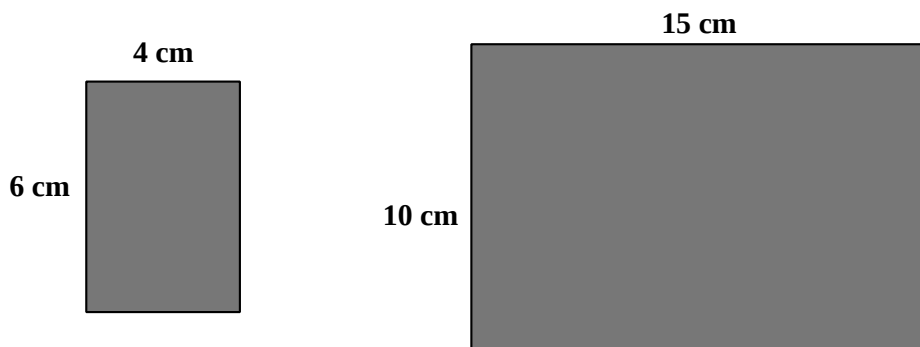
Spotting similar shapes in geometric problems often provides a particularly easy method of solution side stepping more complicated answers that use trigonometry and angle properties such as alternate or corresponding angles. Even just identifying that two triangles are similar is often the key step, after which using nothing more than the length scale factor between them is enough to crack a seemingly difficult question.

Easier questions present the similar shapes in the same orientation but, as the following example demonstrates, this is not always the case.

11.2 Orientation Examples

(i) The two rectangles shown below are similar even although

$$\frac{10}{6} \neq \frac{15}{4}$$



Complete the following to explain the apparent anomaly.

_____ = _____ Which both cancel down to _____

∴ The two rectangles are indeed similar.

[2 marks]

(ii) Is a Δ with sides 5, 3 and 4 cm similar to one with sides 12, 9 and 15 cm ?
Give a reason for your answer.

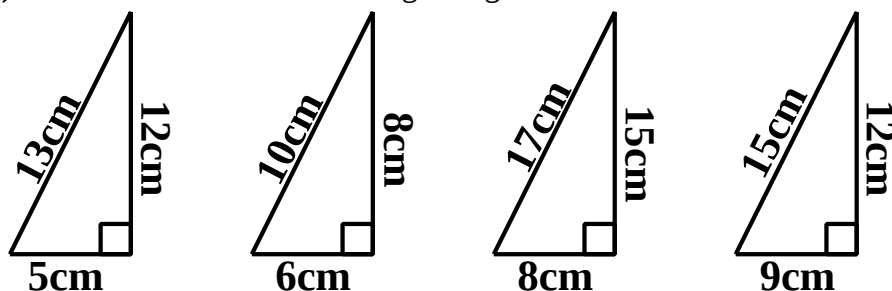
Yes, because $\frac{15}{5} = \frac{12}{4} = \frac{9}{3}$

which all cancel down to _____

∴ The two triangles are similar.

[2 marks]

(iii) Which two of the following triangles are similar ?



Explain your answer.

_____ = _____ = _____ which all cancel down to _____

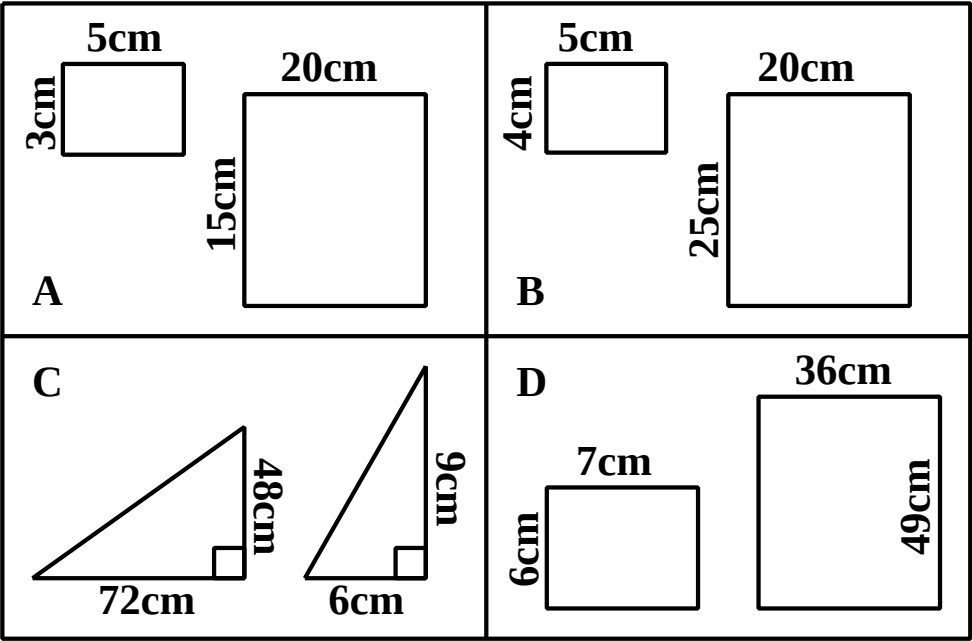
∴

[2 marks]

11.3 Exercise

Marks Available : 50

Question 1



For each pair of shapes, complete the following to determine in each case if the pair is similar or not.

A

Not similar because $\frac{\quad}{\quad} \neq \frac{\quad}{\quad}$

and also $\frac{\quad}{\quad} \neq \frac{\quad}{\quad}$

[2 marks]

B

Similar because $\frac{\quad}{\quad} = \frac{\quad}{\quad}$ which both cancel to $\frac{\quad}{\quad}$

[2 marks]

C

Similar because $\frac{\quad}{\quad} = \frac{\quad}{\quad}$ which both cancel to $\frac{\quad}{\quad}$

[2 marks]

D

because $\frac{\quad}{\quad} \neq \frac{\quad}{\quad}$

[2 marks]

Question 2

The **area** scale factor between two similar solids is $\frac{49}{25}$

- (i) What is the **length** scale factor between the two solids ?

[1 mark]

- (ii) What is the **volume** scale factor between the solids ?

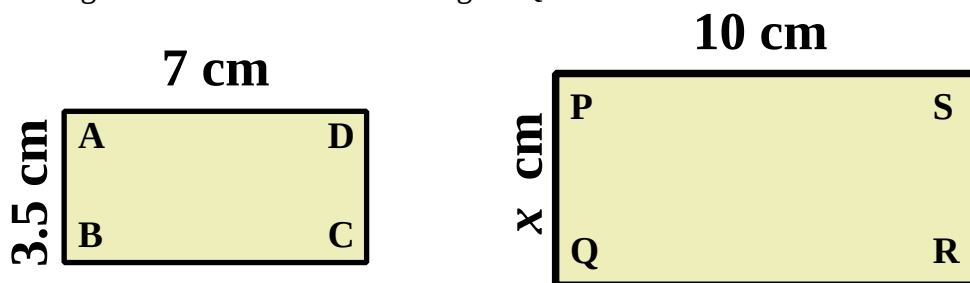
[1 mark]

- (iii) If the smaller has a volume of 250cm^3 what is the volume of the larger ?

[1 mark]

Question 3

Rectangle $ABCD$ is similar to rectangle $PQRS$.



Find the length of side x assuming that the 7 cm and 10 cm sides pair off.

[2 marks]

Question 4

One cube has a volume which is 64 times greater than the volume of another cube.

- (i) Explain why all cubes are similar.

[1 mark]

- (ii) What is the **length scale factor**, greater than 1, between the cubes ?

[1 mark]

- (iii) What is the **area scale factor**, greater than 1, between the cubes ?

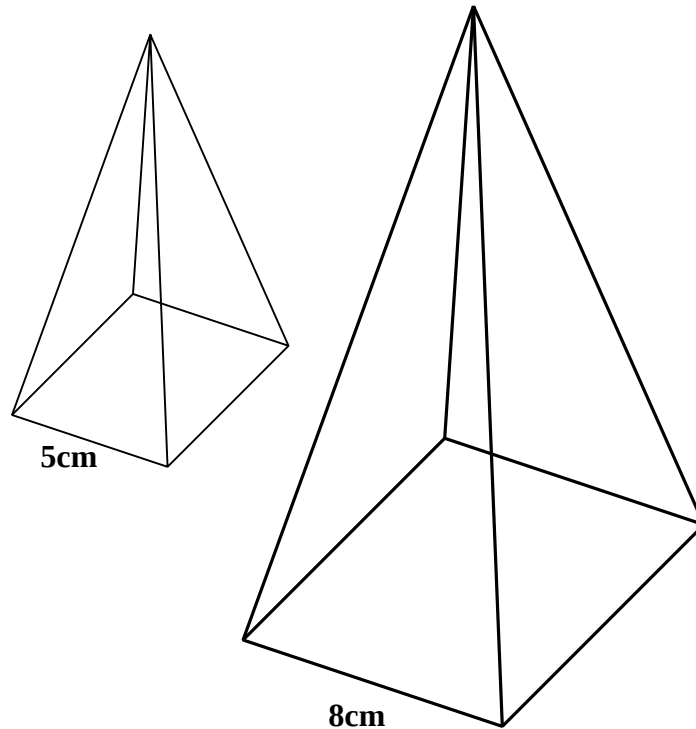
[1 mark]

- (iii) If the smaller cube has a total surface area of 20cm^2 what is the total surface area of the larger cube ?

[1 mark]

Question 5

A couple of similar square based pyramids are shown below.



(i) What is the **length scale factor**, greater than 1, of the similarity ?

[1 mark]

(ii) What is the **length scale factor**, less than 1, of the similarity ?

[1 mark]

(iii) What is the **area scale factor**, greater than 1, of the similarity ?

[1 mark]

(iv) What is the **area scale factor**, less than 1, of the similarity ?

[1 mark]

(v) What is the **volume scale factor**, greater than 1, of the similarity ?

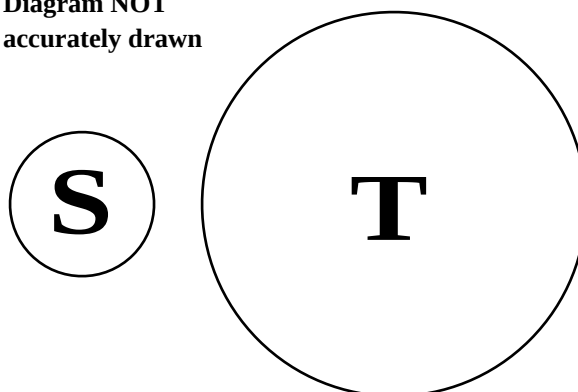
[1 mark]

(vi) What is the **volume scale factor**, less than 1, of the similarity ?

[1 mark]

Question 6

Diagram NOT
accurately drawn



The area of circle **S** is 4 cm^2 .

The radius of circle **T** is three times the radius of circle **S**.

Work out the area of circle **T**.

[2 marks]

Question 7

True or false ?

(a) All equilateral triangles are similar.

[1 mark]

(b) All cubes are similar.

[1 mark]

(c) All triangles with sides 3cm, 4cm and 5cm are similar.

[1 mark]

(d) All rectangles are similar.

[1 mark]

(e) An A5 piece of paper paper is similar to an A4 piece of paper.

[1 mark]

(f) A football is similar to a rugby ball.

[1 mark]

(g) All square based pyramids are similar.

[1 mark]

(h) All dodecahedrons are similar.

[1 mark]

(i) All circles are similar.

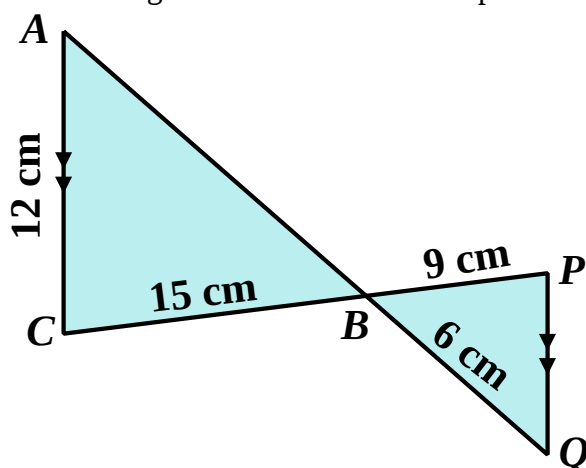
[1 mark]

(j) All parabolas are similar.

[1 mark]

Question 8

The two triangles in the diagram are similar with AC parallel to PQ .



Think about alternate angles. (Z - angles)

(i) Is $\angle PQB$ the same size as $\angle BCA$ or $\angle BAC$?

[1 mark]

(ii) Is the length scale factor between the similar triangles $\frac{15}{9}$ or $\frac{15}{6}$?

[1 mark]

(iii) Find the length of AB and also the length of PQ

[2 marks]

Question 9

GCSE Examination Question from June 2021, Paper 2H, Q20 (Edexcel)

Mathematically similar wooden blocks are made in a workshop.

There are small blocks and there are large blocks.

The volume of each small block is 300 cm^3

Given that

the surface area of each small block : the surface area of each large block

$$= 25 : 36$$

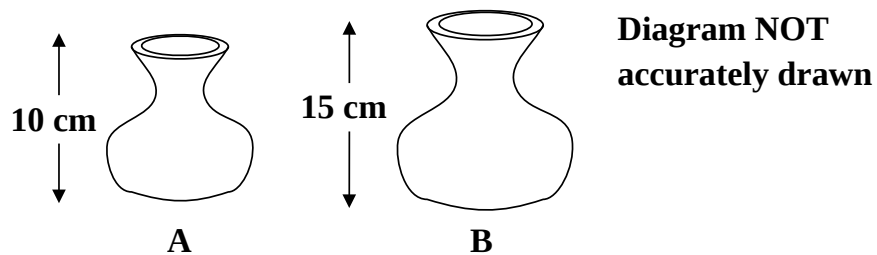
work out the volume of each large block.

[3 marks]

Question 10

GCSE Examination Question from January 2022, Paper 1H, Q17 (Edexcel)

A and **B** are two similar vases.



Vase **A** has height 10 cm

Vase **B** has height 15 cm

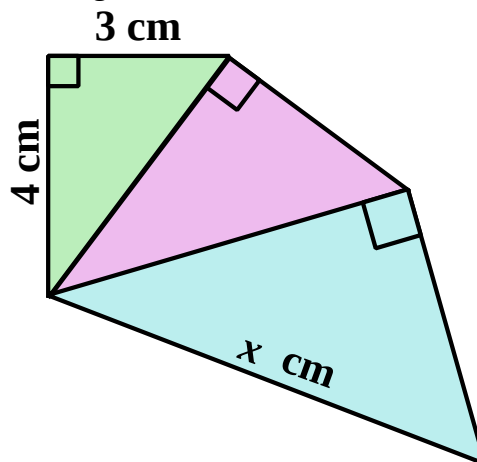
The difference between the volume of vase A and the volume of vase B is 1197 cm^3

Calculate the volume of vase **A**

[4 marks]

Question 11

The three triangles in the figure below are all similar.



Find the length marked x .

[4 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

11.4 Answers

GCSE Mathematics Ratio and Similarity

11.4.1 Solutions to 11.2 Orientation Examples

- (i) $\frac{10}{4} = \frac{15}{6}$ which both cancel down to $\frac{5}{2}$
- (ii) Yes, because $\frac{15}{5} = \frac{12}{4} = \frac{9}{3}$ which all cancel down to $\frac{3}{1}$
- (iii) Second and last as $\frac{15}{10} = \frac{12}{8} = \frac{9}{6}$ which all cancel down to $\frac{3}{2}$
- [2, 2, 2 marks]

11.4.2 Solutions to 11.3 Exercise

Answer 1

- A Not similar because $\frac{20}{5} \neq \frac{15}{3}$
- B Similar because $\frac{25}{5} = \frac{20}{4}$ which both cancel to $\frac{5}{1}$
- C Similar because $\frac{72}{9} = \frac{48}{6}$ which both cancel to $\frac{8}{1}$
- D Not similar because $\frac{49}{7} \neq \frac{36}{6}$
- [2, 2, 2, 2 marks]

Answer 2

- (i) $lsf = \frac{7}{5}$ (ii) $vsf = \frac{343}{125}$ (iii) 686 cm^3
- [1, 1, 1 marks]

Answer 3

The $lsf = \frac{10}{7}$ $\therefore x = \frac{10}{7} \times 3.5 = 5 \text{ cm}$

[2 marks]

Answer 4

- (i) All cubes have the same **shape** (but can be of different sizes). [1 mark]
- (ii) 4 [1 mark]
- (iii) 16 [1 mark]
- (iv) 320 cm^2 [1 mark]

Answer 5

(i)	$\frac{8}{5}$	(ii)	$\frac{5}{8}$	1.6	0.625
(iii)	$\frac{64}{25}$	(iv)	$\frac{25}{64}$	2.56	0.390625
(v)	$\frac{512}{125}$	(iv)	$\frac{125}{512}$	4.096	0.244140625

[1 mark each, 6 marks total]**Answer 6**

$$3^2 \times 4 = 36 \text{ cm}^2$$

[2 marks]**Answer 7**

(a)	T	(f)	F
(b)	T	(g)	F
(c)	T	(h)	T
(d)	F	(i)	T
(e)	T	(j)	F

[1 mark each, 10 marks total]**Answer 8**(i) $\angle BAC$ **[1 mark]**

(ii) $\frac{15}{9} = \frac{5}{3}$

[1 mark](iii) $AB = 10 \text{ cm}$ and $PQ = 7.2 \text{ cm}$ **[2 marks]****Answer 9**

$$asf = \frac{36}{25} \Leftrightarrow lsf = \frac{6}{5} \Leftrightarrow vsf = \frac{216}{125}$$

$$\text{Volume of each large block} = 300 \times \frac{216}{125}$$

$$= 518.4 \text{ cm}^3$$

[3 marks]

Answer 10

$$lsf = \frac{15}{10} = \frac{3}{2} \Leftrightarrow vsf = \frac{27}{8}$$

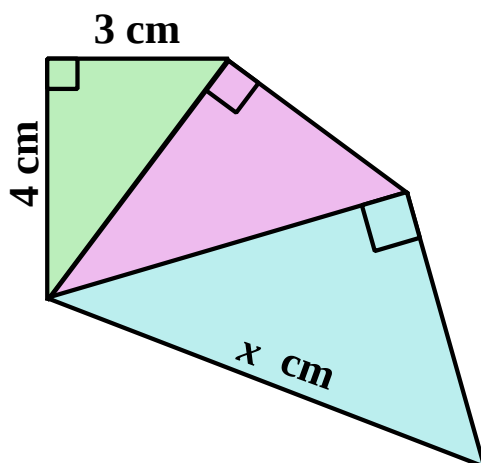
Let the volume of vase **A**, which we are trying to find, be x in which case the volume of vase **B** minus the volume of vase **A** is the 1197 cm^3 given in the question.

$$x \times \frac{27}{8} - x = 1197$$

$$x \times \frac{19}{8} = 1197$$

$$x = 504 \text{ cm}^3$$

[4 marks]

Answer 11

By the theorem of Pythagoras, the hypotenuse of the green triangle is 5 cm.

Between the green and the pink triangle this gives $lsf = \frac{5}{4}$

Consequently, the blue triangle has a hypotenuse given by,

$$4 \times \left(\frac{5}{4} \right)^3 = \frac{125}{16} \text{ cm (As a decimal: 7.8125 cm)}$$

[4 marks]