Worksheet - Similarity and enlargement

Year: Year 9 · 20

Show your working.

Question 1

Question 1 – Using a scale factor *(Section A · Skills practice)*

An enlargement multiplies every length by the scale factor k. If k is less than 1 the shape gets smaller.

a. A rectangle 4 cm by 3 cm is enlarged by scale factor 2.5. Find the new sides.
b. A line of 5 cm is enlarged by scale factor 3. Find the new length.
c. A length of 6 cm becomes 15 cm. Find the scale factor.
d. A length of 20 cm becomes 5 cm. Find the scale factor.

Question 2

Question 2 – Missing sides in similar shapes *(Section A · Skills practice)*

Shapes are similar if one is an enlargement of the other. Find the missing lengths using the scale factor.

a. Triangle with sides 3, 4, 5 and a similar triangle with sides 9, 12, x.
b. Triangle with sides 6, 10, 14 and a similar triangle with sides 9, 15, y.
c. Rectangle 8 cm by 5 cm and a similar rectangle 12 cm by z.
d. Triangle with sides 7, 7, 4 and a similar triangle with sides 10.5, 10.5, w.

Question 3

Question 3 – Congruent or similar? *(Section A · Skills practice)*

Congruent shapes are identical; similar shapes have the same shape but may differ in size. For each pair, write congruent, similar (not congruent) or neither.

a. Triangles with sides $3, 4, 5$ and $6, 8, 10$.
b. Triangles with sides $5, 5, 6$ and $5, 5, 6$.
c. Triangles with sides $2, 3, 4$ and $4, 6, 9$.
d. Squares with sides 4 cm and 7 cm.

Question 4

Question 4 – Enlargement from the origin *(Section A · Skills practice)*

Triangle ABC has vertices $A(1, 1)$, $B(3, 1)$ and $C(1, 2)$. Enlarge it with the centre of enlargement at the origin $(0, 0)$. Multiply each coordinate by the scale factor.

a. Find the image with scale factor 2.
b. Find the image with scale factor 3.
c. Find the image of $P(4, 6)$ and $Q(8, 2)$ with scale factor $\frac{1}{2}$.
d. Triangle ABC has base 2 and height 1. Find the area of the original and of the image after the enlargement with scale factor 2.

Question 5

Question 5 – Centre not at the origin *(Section A · Skills practice)*

To enlarge about another centre, find the vector from the centre to the point, multiply it by the scale factor, and add it to the centre.

a. Enlarge $P(3, 2)$ by scale factor 2 about the centre $(1, 1)$.
b. Enlarge $Q(2, 4)$ by scale factor 2 about the centre $(1, 1)$.
c. Enlarge $R(2, 2)$ by scale factor 3 about the centre $(0, 1)$.
d. Enlarge $S(9, 5)$ by scale factor $\frac{1}{2}$ about the centre $(1, 1)$.

Question 6

Question 6 – Congruence conditions *(Section A · Skills practice)*

Two triangles are congruent if they satisfy SSS, SAS, ASA or RHS. For each pair, name the condition that proves they are congruent, or say that there is not enough information.

a. Sides 5 cm, 6 cm, 7 cm in both triangles.
b. Sides 4 cm and 6 cm with an angle of 50° between them, in both.
c. Angles of 40° and 60° in both, with a side of 8 cm between them.
d. Angles of 30°, 60°, 90° in both, with no sides given.

Question 7

Question 7 – The model car *(Section B · Real-life practice)*

A model car is built to scale 1 : 24. The real car is 4.8 m long and 1.8 m wide.

a. Find the length of the model in centimetres.
b. The model is 7 cm tall. Find the height of the real car in centimetres, then in metres.
c. The real car has a boot of 0.45 m wide. How wide is the boot of the model, in centimetres?
d. A second, larger model has scale 1 : 12. Find its length.

Question 8

Question 8 – Shadows and the tree *(Section B · Real-life practice)*

A stick 1.5 m tall casts a shadow of 2 m. At the same time a tree casts a shadow of 12 m. The sun's rays make similar triangles.



a. Find the scale factor between the two shadows.
b. Find the height of the tree.
c. Later the stick's shadow is 3 m. How long is the tree's shadow then?
d. A flagpole, at the first time, casts a shadow of 8 m. How tall is it?

Question 9

Question 9 – Enlarging a photograph *(Section B · Real-life practice)*

Priya has a photograph that is 15 cm wide and 10 cm tall. She wants an enlargement for a frame.

a. The enlargement is 24 cm wide. Find the scale factor and the height.
b. A poster-size print is 60 cm wide. Find its height.
c. A frame is 30 cm by 25 cm. Does the photograph enlarge to fit exactly? Explain.
d. Find the scale factor of the largest print that fits inside a 30 cm by 25 cm frame, and its size.

Question 10

Question 10 – The map *(Section B · Real-life practice)*

On a map with scale 1 : 25 000, 4 cm on the map represents 1 km in real life.

a. Show that 1 cm on the map is 250 m.
b. A railway line measures 7.5 cm on the map. Find its real length in kilometres.
c. A footpath is 3.5 km long. How long is it on the map in centimetres?
d. A field is 6 cm by 4 cm on the map. Find its real dimensions and area in square kilometres.

Question 11

Question 11 – The tower and the pole *(Section B · Real-life practice)*

Hassan wants the height of a tower. He holds a pole 1.2 m tall upright at 4 m from his eye. The top of the pole lines up with the top of the tower. He is 36 m from the base of

the tower. (Ignore his own height.)

a. Find the scale factor between the small triangle and the large triangle.
b. Find the height of the tower.
c. He moves to 24 m from the tower. How far must he hold the pole from his eye (the same pole) to line up again?
d. Why must the triangles be similar?

Question 12

Question 12 – A banner for the school fair *(Section B · Real-life practice)*

The school logo is 8 cm wide and 5 cm tall. It will be enlarged to a banner 2 m wide.

a. Find the scale factor.
b. Find the height of the banner in metres.
c. The text in the logo is 1.2 cm tall. Find its height on the banner.
d. Paint for the banner costs £6 per square metre. Find the area of the banner and the cost.

Question 13

Question 13 – Paper sizes *(Section B · Real-life practice)*

An A4 sheet is 297 mm by 210 mm. An A3 sheet is 420 mm by 297 mm.

a. Work out the length-to-width ratio for each sheet, to 2 decimal places.
b. Are the A4 and A3 sheets similar? Explain.
c. Find the scale factor from A4 to A3.
d. A drawing is copied from A4 to A3 using an enlargement. A line of 10 cm on A4 becomes how long on A3?

Question 14

Question 14 – The playground plan *(Section B · Real-life practice)*

A plan of the school playground is drawn to scale 1 : 200. On the plan the playground is a rectangle 12 cm by 8 cm.

a. Find the real length and width in metres.
b. Find the real perimeter.
c. Fencing costs £11 per metre. Find the cost of fencing the whole playground.
d. The plan shows the gate as 1.5 cm wide. How wide is the gate in real life?

Question 15

Question 15 – Similar triangles table *(Section C · Problem solving)*

Triangle ABC has sides 6 cm, 8 cm and 10 cm. Triangles DEF and PQR are similar to

ABC.

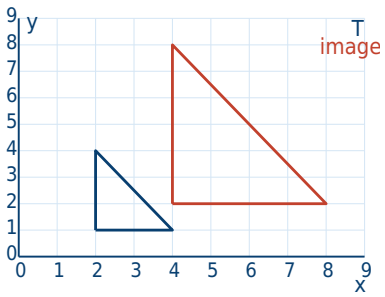
Triangle	Side 1	Side 2	Side 3	Scale factor from ABC
ABC	6	8	10	1
DEF	9	?	?	?
PQR	3	?	?	?

a. Complete the table.
b. Find the perimeter of each triangle.
c. Triangle XYZ has sides 12, 16 and 21. Is it similar to ABC?
d. Which of the three triangles is the right-angled one? Show using Pythagoras.

Question 16

Question 16 – Enlarging on a grid *(Section C · Problem solving)*

Triangle T has vertices $A(2,1)$, $B(4,1)$ and $C(2,4)$. It is shown on the grid and then enlarged by scale factor 2 with centre $(0,0)$.



a. Write down the coordinates of the image of each vertex.
b. The same triangle is now enlarged by scale factor 2 with centre $(1,1)$. Find the image of each vertex.
c. Find the area of triangle T and of its image in part (a).
d. What is the connection between the scale factor and the areas?
e. Describe fully the single transformation that maps triangle T onto the image in part (a).

Question 17

Question 17 – Shadows at different times *(Section C · Problem solving)*

Ella is 1.6 m tall and casts a shadow of 2.4 m. At the same time a flagpole casts a shadow of 15 m, and a building casts a shadow of 45 m.

a. Find the height of the flagpole.
b. Find the height of the building.
c. Later, Ella's shadow is only 1.2 m. How long is the flagpole's shadow then?
d. At that time, the building's shadow is how long?
e. Explain why the shadows get shorter around midday.

Question 18

Question 18 – Lengths, areas and volumes *(Section C · Problem solving)*

Two solid cubes are similar. Cube A has sides of 2 cm. Cube B has sides of 6 cm.

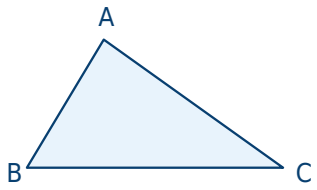
	Cube A	Cube B
Side	2 cm	6 cm
Surface area	24 cm²	?
Volume	8 cm³	?

a. Find the scale factor from A to B.
b. Find the surface area and volume of cube B.
c. By what number is the surface area multiplied? And the volume?
d. A toy model of a statue is 20 cm tall and the real statue is 3 m tall. Find the scale factor, and the ratio of the surface areas.
e. The model needs 40 ml of paint. How much does the real statue need if it is painted the same thickness?

Question 19

Question 19 – Parallel lines and similar triangles *(Section C · Problem solving)*

In triangle ABC, D is on AB and E is on AC with DE parallel to BC. $AD = 4$ cm, $DB = 2$ cm, $DE = 5$ cm and $AE = 6$ cm.



a. Explain why triangles ADE and ABC are similar.
b. Find the scale factor from ADE to ABC.
c. Find BC.
d. Find AC and then EC.
e. Find the perimeter of triangle ABC if $AB = 6$ cm, using your answers.

Question 20

Question 20 – Challenge: paper sizes *(Section D · Challenge)*

In the A series, each sheet is made by folding the one before in half. A4 is 297 mm by 210 mm. Every size is similar to the next.

a. A4 is folded in half to make A5, with the long side 210 mm. Find the short side of A5 to the nearest mm.
b. Find the ratio long side ÷ short side for A4 and for A5.
c. Show by algebra that, if a sheet of length L and width W is folded in half to make

a similar sheet, then $\frac{L}{W} = \sqrt{2}$.

d. Find the scale factor from A5 to A4 and the ratio of their areas.

e. A0 has an area of 1 m². Show that A4 has an area close to $\frac{1}{16}$ m².