Worksheet - Transformations

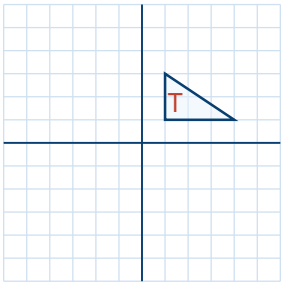
Year: Year 11 · 21

Show your working.

Question 1

Question 1 – Reflections *(Section A · Skills practice)*

Triangle T has vertices $A(1,1)$, $B(4,1)$ and $C(1,3)$.



a. Reflect T in the y-axis. Write the new coordinates. [2 marks]
b. Reflect T in the line $y = x$. [2 marks]
c. Reflect T in the line $x = 5$. [2 marks]
d. Which reflections leave the point $A(1,1)$ unchanged? [1 mark]

Question 2

Question 2 – Translations *(Section A · Skills practice)*

Triangle T has vertices $A(1,1)$, $B(4,1)$ and $C(1,3)$.

a. Translate T by the vector $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$. [2 marks]
b. Write the vector that translates the image back to T. [1 mark]
c. Triangle T is translated so that A goes to $(6,-2)$. Write the vector and the images of B and C. [3 marks]

Question 3

Question 3 – Rotations about the origin *(Section A · Skills practice)*

Triangle T has vertices $A(1,1)$, $B(4,1)$ and $C(1,3)$.

a. Rotate T by 90° clockwise about the origin. [3 marks]
b. Rotate T by 90° anticlockwise about the origin. [3 marks]
c. Rotate T by 180° about the origin. [2 marks]

Question 4

Question 4 – Rotating about another centre *(Section A · Skills practice)*

Point P is $(4, 1)$ and centre C is $(2, 2)$.

a. Write P relative to C (the vector). [1 mark]

b. Rotate this vector 90° anticlockwise. [1 mark]
c. Find the image of P after a 90° anticlockwise rotation about C. [2 marks]
d. Check that the image is the same distance from C as P. [2 marks]

Question 5

Question 5 – Enlargements *(Section A · Skills practice)*

Triangle T has vertices $A(1, 1)$, $B(4, 1)$ and $C(1, 3)$.

a. Enlarge T by scale factor 2, centre the origin. [3 marks]
b. Enlarge T by scale factor 3, centre $(1, 1)$. [3 marks]
c. Find the area of T and the area of the image in part (b). [3 marks]

Question 6

Question 6 – Describing a transformation *(Section A · Skills practice)*

Triangle T has vertices $A(1, 1)$, $B(4, 1)$ and $C(1, 3)$. Describe the single transformation that maps T onto each image.

a. Image 1: $(-1, 1)$, $(-4, 1)$, $(-1, 3)$. [2 marks]
b. Image 2: $(3, 4)$, $(6, 4)$, $(3, 6)$. [2 marks]
c. Image 3: $(-1, -1)$, $(-4, -1)$, $(-1, -3)$. [3 marks]

Question 7

Question 7 – A robot arm *(Section B · Real-life practice)*

A robot arm pivots about the origin. Its tip is at $(6, 0)$ and the units are centimetres.

a. Where is the tip after a rotation of 90° anticlockwise? [2 marks]
b. Where is the tip after a rotation of 180°? [1 mark]
c. The arm rotates 270° anticlockwise from the start. Where does it end up? [2 marks]
d. Show that the tip stays on a circle and find the length of the path for one full turn. [3 marks]

Question 8

Question 8 – Enlarging a plan *(Section B · Real-life practice)*

An architect draws a rectangle with corners $(2, 2)$, $(6, 2)$, $(6, 5)$ and $(2, 5)$ (units in cm). It is enlarged by scale factor 1.5, centre the origin.

a. Find the new coordinates. [3 marks]
b. Find the area of the rectangle before and after. [3 marks]
c. Find the ratio of the two areas. [2 marks]

Question 9

Question 9 – A logo with a negative scale factor (Higher) *(Section B · Real-life practice)*

A logo has a vertex at $P(3, 2)$. It is enlarged with scale factor -2 and centre $(1, 1)$.

a. Find the vector from the centre to P. [1 mark]
b. Find the image of P. [3 marks]
c. Describe what a negative scale factor does to the position and size of the shape. [2 marks]
d. The original logo has area 5 cm². Find the image area. [2 marks]

Question 10

Question 10 – A fairground wheel *(Section B · Real-life practice)*

A wheel turns about its centre $C(3, 3)$. A seat is at $S(6, 3)$.

a. Find the position of the seat after a 90° clockwise rotation about C. [3 marks]
b. Find its position after a 180° rotation. [2 marks]
c. The wheel makes one complete turn in 40 seconds. Through what angle does it turn in 15 seconds? [2 marks]
d. Find the speed of the seat in cm/s if the units are centimetres and the radius is 3 cm. [3 marks]

Question 11

Question 11 – Finding the centre of an enlargement (Higher) *(Section B · Real-life practice)*

A point $P(2, 2)$ is mapped to $P'(5, 5)$ by an enlargement with scale factor 2.

a. Let the centre be (a, b). Show that $a + 2(2 - a) = 5$. [2 marks]
b. Find the centre. [2 marks]
c. Check using a second point $Q(3, 2)$ and find its image Q'. [3 marks]

Question 12

Question 12 – Two reflections (Higher) *(Section B · Real-life practice)*

Triangle T has vertices $(1, 1)$, $(4, 1)$ and $(1, 3)$. It is reflected in the y-axis and then the image is reflected in the x-axis.

a. Find the coordinates after both reflections. [3 marks]
b. Describe the single transformation that has the same effect. [2 marks]
c. Does the order of the two reflections matter? Test it. [2 marks]

Question 13

Question 13 – Tessellation with a translation *(Section B · Real-life practice)*

A tile is a square with corners $(0, 0)$, $(2, 0)$, $(2, 2)$ and $(0, 2)$. A floor pattern is made by translating the tile repeatedly.

a. Write the vectors for the tile to the right and the tile above. [2 marks]
b. Write the coordinates of the corners of the tile 3 places to the right and 2 places above. [3 marks]
c. A room is 6 m by 4 m and the tiles are 0.5 m squares. How many tiles are needed? [3 marks]

Question 14

Question 14 – A pantograph *(Section B · Real-life practice)*

A pantograph is used to enlarge a drawing by scale factor 2.5. A line on the original is 8 cm long and a shape has area 12 cm².

a. Find the length of the line on the copy. [1 mark]
b. Find the area of the shape on the copy. [2 marks]
c. The copy is a shape of area 75 cm². Find the area of the original. [2 marks]

Question 15

Question 15 – Two reflections make a rotation (Higher) *(Section C · Problem solving)*

Point P is $(2, 5)$.

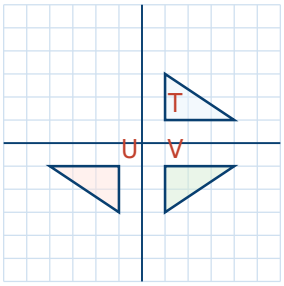
a. Reflect P in the line $y = x$ and then reflect the result in the y-axis. [3 marks]
b. Describe the single rotation that maps P to the final point. [2 marks]
c. Test your rule on $(3, 1)$. [2 marks]

Question 16

Question 16 – Describe fully *(Section C · Problem solving)*

Triangle T has vertices $(1, 1)$, $(4, 1)$, $(1, 3)$. Triangle U has vertices $(-1, -1)$, $(-4, -1)$,

$(-1, -3)$. Triangle V has vertices $(1, -1)$, $(4, -1)$, $(1, -3)$.



a. Describe fully the single transformation that maps T to V. [2 marks]
b. Describe two different transformations that map T to U. [4 marks]
c. Describe the single transformation that maps V to U. [2 marks]

Question 17

Question 17 – A negative enlargement (Higher) *(Section C · Problem solving)*

Triangle PQR has $P(3, 2)$, $Q(5, 2)$ and $R(3, 4)$. It is enlarged with scale factor -2 about the centre $(1, 1)$.

a. Find the coordinates of P', Q' and R'. [6 marks]
b. Find the area of PQR and of $P'Q'R'$. [3 marks]
c. Explain why the image is on the opposite side of the centre. [1 mark]

Question 18

Question 18 – Scale factors for area and volume *(Section C · Problem solving)*

A shape is enlarged by scale factor 3.

a. Its area was 20 cm². Find the new area. [2 marks]
b. A solid of volume 12 cm³ is enlarged by scale factor 3. Find the new volume. [2 marks]
c. A different shape is reduced by scale factor 0.5. A length of 10 cm becomes what, and an area of 40 cm² becomes what? [4 marks]

Question 19

Question 19 – Finding the centre by drawing lines *(Section C · Problem solving)*

Triangle ABC has $A(2, 2)$, $B(3, 2)$, $C(2, 4)$ and its image has $A'(3, 4)$, $B'(5, 4)$, $C'(3, 8)$.

a. Find the scale factor of the enlargement. [2 marks]
b. Find the equations of the lines AA' and BB'. [4 marks]
c. Find where the lines meet and state the centre. [3 marks]

Question 20

Question 20 – Combined transformations (Higher) *(Section C · Problem solving)*

Triangle T has vertices $(1, 1)$, $(4, 1)$, $(1, 3)$. It is reflected in the x-axis, then translated by $\begin{pmatrix} -2 \\ 5 \end{pmatrix}$.

a. Find the final coordinates. [4 marks]
b. Is the final triangle congruent to T? Explain. [2 marks]
c. Is it possible to describe the combined effect as a single reflection? Test it on point A. [3 marks]

Question 21

Question 21 – Challenge: two mirrors *(Section D · Challenge)*

Point P is $(1, 1)$.

a. Reflect P in the line $x = 3$ and then reflect the image in the line $x = 7$. [3 marks]
b. Describe the single transformation that has the same effect and relate it to the distance between the mirrors. [3 marks]
c. Reflect $(2, 0)$ in the line $y = 0$ and then in the line $y = x$. Describe the single transformation, relating the angle to the angle between the mirrors. [4 marks]