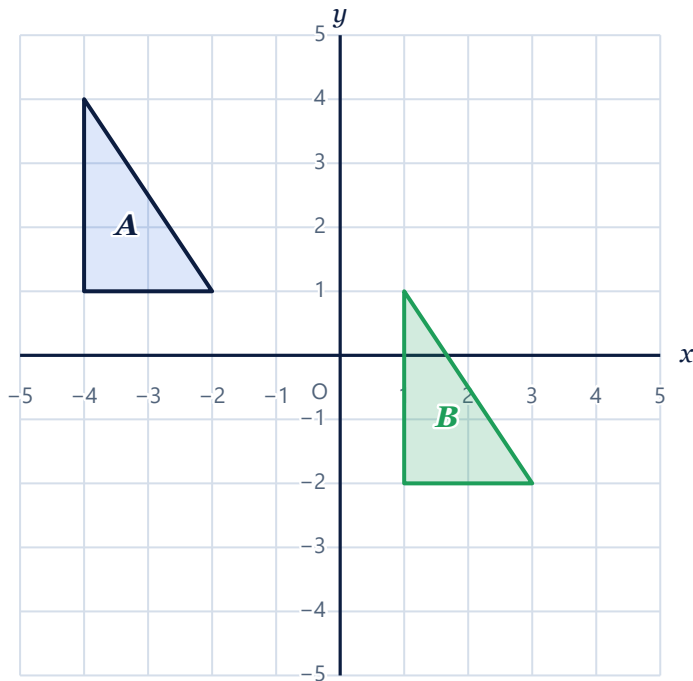




- 1** Triangle A is drawn on the grid.

Translate triangle A by the vector $\begin{pmatrix} 5 \\ -3 \end{pmatrix}$. Label the image B.



(2 marks)

top number 5: 5 right

bottom number -3: 3 down

$(-4, 1), (-2, 1), (-4, 4)$

move each corner 5 right, 3 down

$(1, -2), (3, -2), (1, 1)$

B has corners $(1, -2), (3, -2), (1, 1)$

2

Triangle A has vertices at (1, 1), (3, 1) and (1, 4).

Triangle B has vertices at (5, -1), (7, -1) and (5, 2).

Describe fully the single transformation that maps triangle A onto triangle B.

(2 marks)

Compare matching vertices

(1, 1) maps to (5, -1). The x-change is $5 - 1 = +4$ and the y-change is $-1 - 1 = -2$

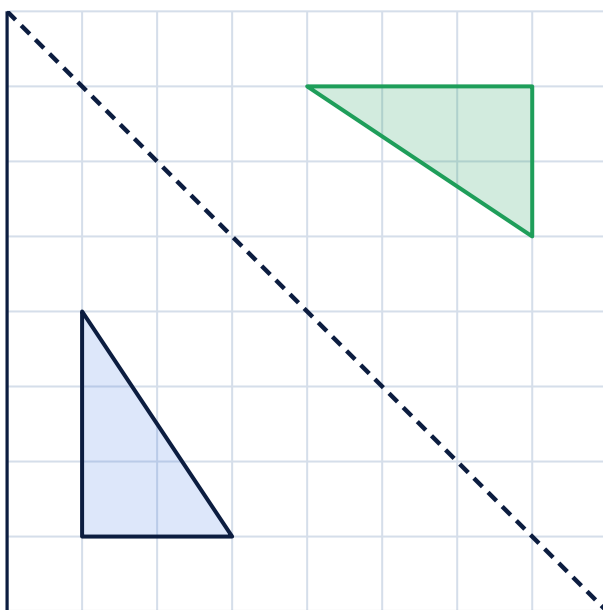
Check with (3, 1) to (7, -1): +4 and -2. Check with (1, 4) to (5, 2): +4 and -2.

Consistent

The single transformation is a translation by the vector (4, -2)

3

Reflect the shape in the mirror line.



(2 marks)

each corner: go at right angles to the mirror
same distance on the other side

diagonal squares on a 45° line

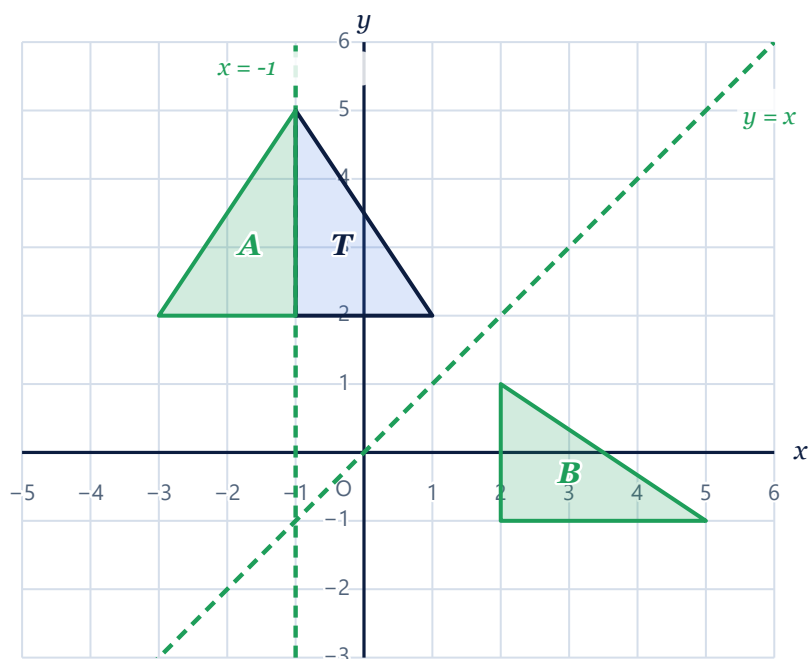
join the new corners

image drawn, same size, flipped over the line

4

Triangle T is drawn on the grid.

- Reflect triangle T in the line $x = -1$. Label the image A.
- Reflect triangle T in the line $y = x$. Label the image B.



(4 marks)

a) draw the line $x = -1$ first

(1, 2): 2 right of the line, so 2 left: (-3, 2)

(-1, 2) and (-1, 5) are on the line: they stay

A at (-1, 2), (-3, 2), (-1, 5)

b) draw $y = x$ through (0, 0), (1, 1), (2, 2)reflect in $y = x$: swap x and y (-1, 2) $\rightarrow$ (2, -1)(1, 2) $\rightarrow$ (2, 1)(-1, 5) $\rightarrow$ (5, -1)

B at (2, -1), (2, 1), (5, -1)

5

Triangle P has vertices at $(2, 1)$, $(5, 1)$ and $(5, 3)$.

Triangle Q has vertices at $(2, -1)$, $(5, -1)$ and $(5, -3)$.

Describe fully the single transformation that maps triangle P onto triangle Q .

(2 marks)

Each vertex of Q has the same x -coordinate as the matching vertex of P , with the y -coordinate's sign changed

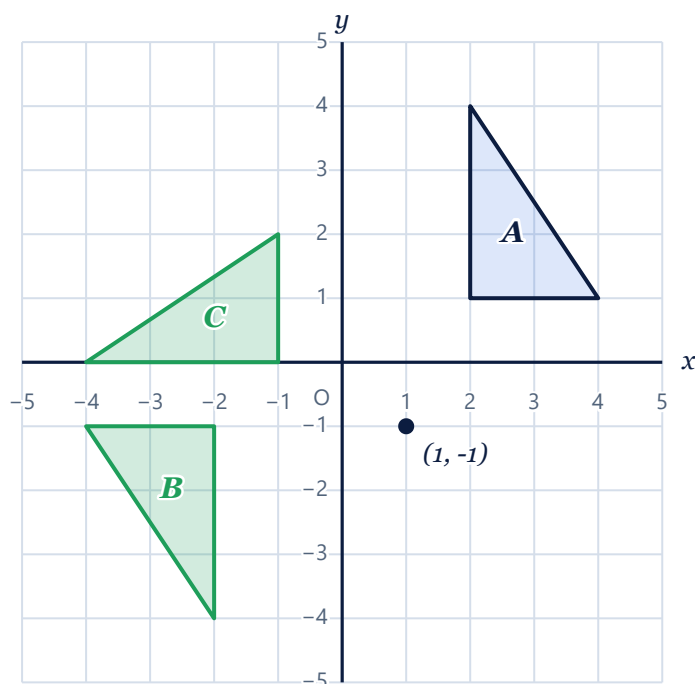
This is a reflection in the x -axis (the line $y = 0$)

Reflection in the x -axis.

6

Triangle A is drawn on the grid.

- Rotate triangle A 180° about the origin. Label the image B.
- Rotate triangle A 90° anticlockwise about the point $(1, -1)$. Label the image C.



(4 marks)

a) 180° about $(0, 0)$: change both signs

$$(2, 1) \rightarrow (-2, -1)$$

$$(4, 1) \rightarrow (-4, -1)$$

$$(2, 4) \rightarrow (-2, -4)$$

B at $(-2, -1), (-4, -1), (-2, -4)$

b) tracing paper, pin at $(1, -1)$, quarter turn anticlockwise
check $(2, 1)$

from $(1, -1)$: 1 right, 2 up

after the turn: 2 left, 1 up

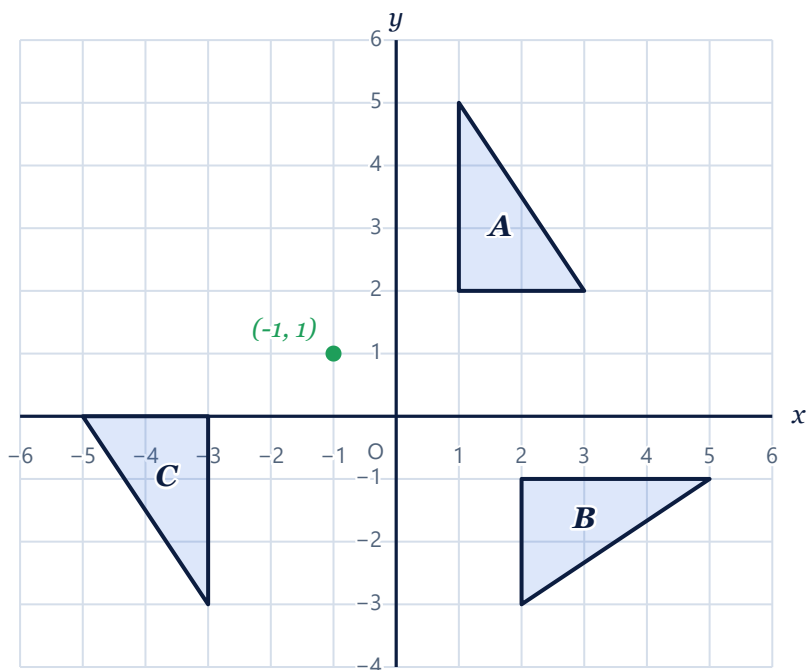
$$(1 - 2, -1 + 1) = (-1, 0)$$

C at $(-1, 0), (-1, 2), (-4, 0)$

7

Triangles A, B and C are drawn on the grid.

- Describe fully the single transformation that maps triangle A onto triangle B.
- Describe fully the single transformation that maps triangle A onto triangle C.



(4 marks)

a) quarter turn, clockwise

try centre $(0, 0)$ with tracing paper

$$(1, 2) \rightarrow (2, -1)$$

Rotation 90° clockwise about $(0, 0)$

b) upside down: 180°

centre = midpoint of a corner and its image

$$(1, 2) \rightarrow (-3, 0)$$

$$x = (1 + -3) \div 2 = -1$$

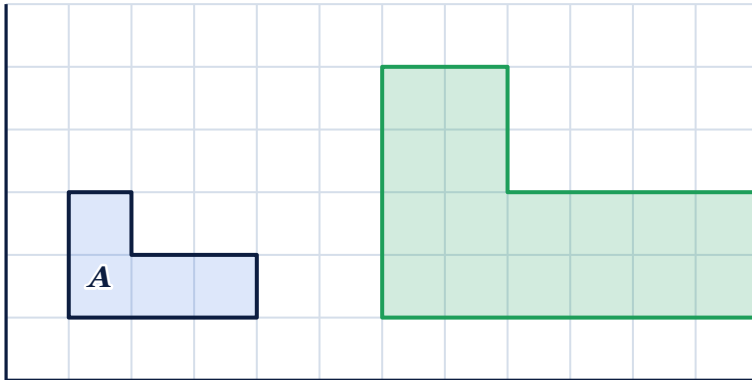
$$y = (2 + 0) \div 2 = 1$$

Rotation 180° about $(-1, 1)$

8

Shape A is drawn on the grid.

- On the grid, enlarge shape A by scale factor 2
- Shape A is enlarged again so that its longest side is 9 squares long. Write down the scale factor of this enlargement.



(3 marks)

a) every length $\times 2$

bottom: $3 \rightarrow 6$ squares

left side: $2 \rightarrow 4$ squares

each 1-square step $\rightarrow 2$ squares

enlarged shape drawn, sides twice as long

b) longest side of A is 3 squares

scale factor = $9 \div 3$

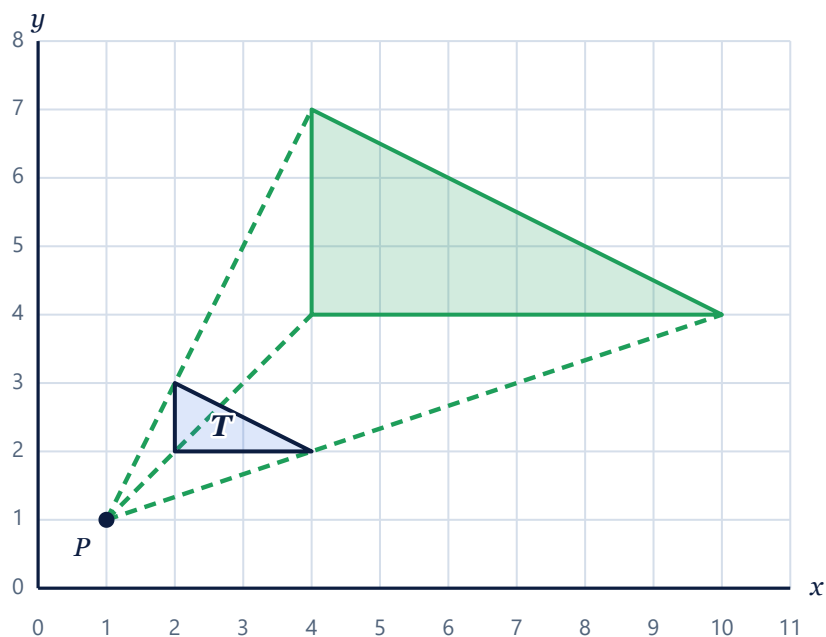
scale factor = 3

3

9

Triangle T and the point P (1, 1) are drawn on the grid.

Enlarge triangle T by scale factor 3, centre P.



(3 marks)

from P (1, 1) to each corner, then $\times 3$

(2, 2): 1 right, 1 up $\rightarrow$ 3 right, 3 up $\rightarrow$ (4, 4)

(4, 2): 3 right, 1 up $\rightarrow$ 9 right, 3 up $\rightarrow$ (10, 4)

(2, 3): 1 right, 2 up $\rightarrow$ 3 right, 6 up $\rightarrow$ (4, 7)

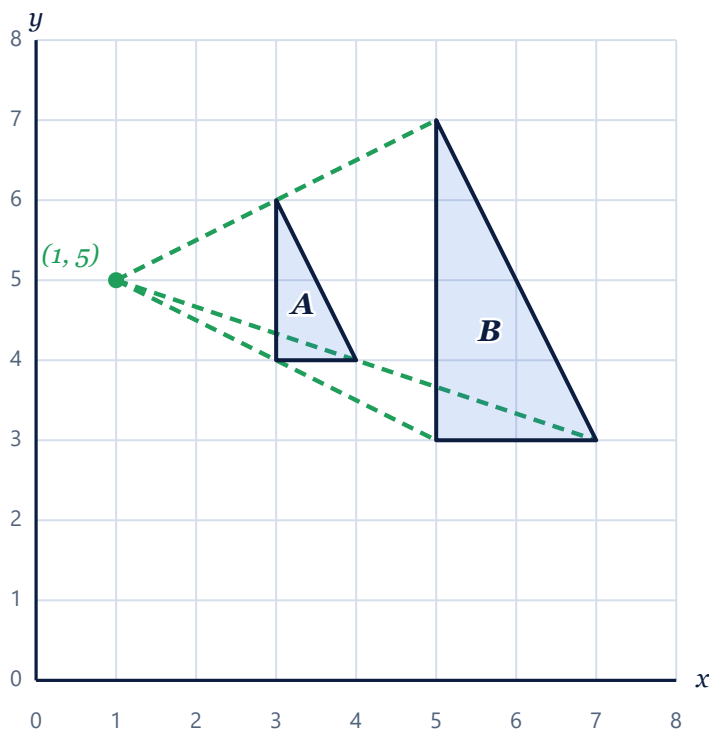
check: rays from P go through each pair

image at (4, 4), (10, 4), (4, 7)

10

Triangle B is an enlargement of triangle A.

- Write down the scale factor of the enlargement.
- Find the coordinates of the centre of the enlargement.



(3 marks)

a) compare matching sides

A: 1 square, B: 2 squares

$$\text{scale factor} = 2 \div 1 = 2$$

2

b) join each corner of B to the matching corner of A
extend the lines until they meet

they meet at (1, 5)

check (3, 4): 2 right, 1 down from (1, 5)

x 2: 4 right, 2 down $\rightarrow$ (5, 3), a corner of B

(1, 5)

11 Rectangle A has vertices at $(1, 1)$, $(3, 1)$, $(3, 2)$ and $(1, 2)$.

Rectangle B has vertices at $(2, 2)$, $(6, 2)$, $(6, 4)$ and $(2, 4)$.

Describe fully the single transformation that maps rectangle A onto rectangle B .

(2 marks)

The sides of B are twice as long as the sides of A , so the scale factor is 2

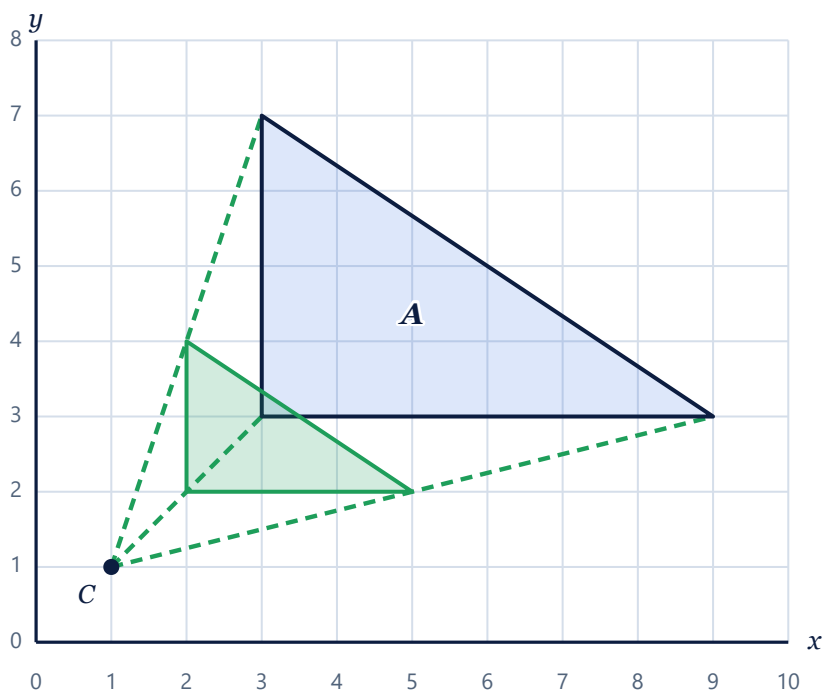
Every vertex of B is exactly double the matching vertex of A : $(1, 1)$ maps to $(2, 2)$, $(3, 1)$ maps to $(6, 2)$, and so on

So the transformation is an enlargement, scale factor 2, centre the origin $(0, 0)$

EXTENSION QUESTIONS

12 Triangle A and the point $C(1, 1)$ are drawn on the grid.

Enlarge triangle A by scale factor $\frac{1}{2}$, centre C .



(3 marks)

from $C(1, 1)$ to each corner, then halve

$(3, 3)$: 2 right, 2 up $\rightarrow$ 1 right, 1 up $\rightarrow (2, 2)$

$(9, 3)$: 8 right, 2 up $\rightarrow$ 4 right, 1 up $\rightarrow (5, 2)$

$(3, 7)$: 2 right, 6 up $\rightarrow$ 1 right, 3 up $\rightarrow (2, 4)$

sides are half as long: $6 \rightarrow 3$, $4 \rightarrow 2$

image at $(2, 2)$, $(5, 2)$, $(2, 4)$

13 Triangle T has vertices at $(1, 1)$, $(3, 1)$ and $(1, 2)$.

Triangle T is reflected in the y -axis to give triangle T_1 .

Triangle T_1 is then reflected in the x -axis to give triangle T_2 .

Describe fully the single transformation that maps triangle T onto triangle T_2 .

(3 marks)

Reflecting in the y -axis maps (x, y) to $(-x, y)$, so T_1 has vertices $(-1, 1)$, $(-3, 1)$, $(-1, 2)$

Reflecting T_1 in the x -axis maps (x, y) to $(x, -y)$, so T_2 has vertices $(-1, -1)$, $(-3, -1)$, $(-1, -2)$

Overall (x, y) has mapped to $(-x, -y)$, which is a rotation of 180° about the origin

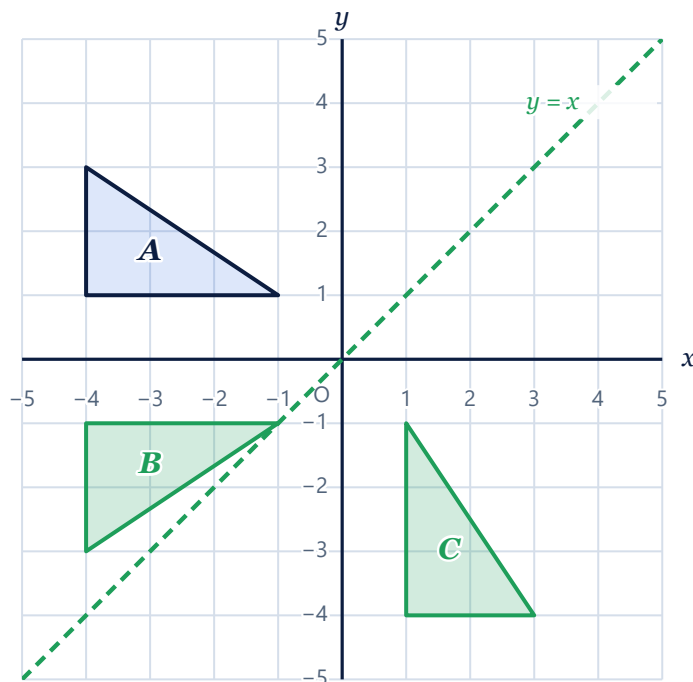
So the single transformation is a rotation of 180° , centre $(0, 0)$

EXTENSION QUESTIONS

14

Triangle A is drawn on the grid.

- Reflect triangle A in the x -axis. Label the image B.
- Rotate triangle B 90° anticlockwise about the origin. Label the image C.
- Describe fully the single transformation that maps triangle A onto triangle C.



(5 marks)

a) reflect in the x -axis: y changes sign

$$(-4, 1), (-1, 1), (-4, 3) \rightarrow (-4, -1), (-1, -1), (-4, -3)$$

$$\text{B at } (-4, -1), (-1, -1), (-4, -3)$$

b) 90° anticlockwise about $(0, 0)$: $(x, y) \rightarrow (-y, x)$

$$(-4, -1), (-1, -1), (-4, -3) \rightarrow (1, -4), (1, -1), (3, -4)$$

$$\text{C at } (1, -4), (1, -1), (3, -4)$$

c) compare A and C

$$(-4, 1) \rightarrow (1, -4): x \text{ and } y \text{ swap}$$

$$(-1, 1) \rightarrow (1, -1): \text{swap}$$

swapping x and y is a reflection in $y = x$

$$\text{Reflection in the line } y = x$$