

8.1 Summary

This presentation of *transformation geometry* highlighted:

T1	Translation
T2	Reflection
T3	Rotation
T4	Enlargement

A transformation acts on an original shape, which is transformed to give an *image*. Note that the “shape” can be a “point” or a “line”.

8.1.1 T1 Translation

A *translation* is a “slide” of a fixed shape across the page without rotation.

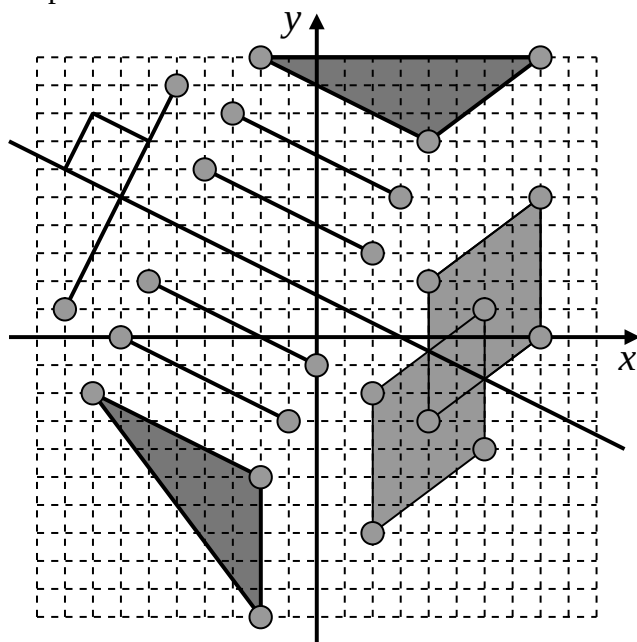
Translations are described by *vectors* such as $\begin{pmatrix} 5 \\ 9 \end{pmatrix}$. (Go 5 across and 9 up)

If one shape is a translation of another then the two shapes are *directly congruent*. Congruent means having the same size and shape.

8.1.2 T2 Reflection

There are three key properties to keep in mind regarding reflections:

- Ref 1** The perpendicular distance of any point from the mirror is equal to the perpendicular distance of the image from the mirror.
- Ref 2** A line drawn from any point to its image passes through the mirror at 90° .
- Ref 3** A line parallel to the mirror has a reflection that is also parallel to the mirror.



The mirror, being a straight line, has an equation of the form $y = m x + c$

8.1.3 T3 Rotation

Three items of information describe a rotation fully:

- Ro1** The size of the **angle** of rotation.
- Ro2** The **point** about which rotation takes place.
- Ro3** The **direction** of the rotation: clockwise or anti-clockwise.

If the direction is omitted then it is assumed to be anti-clockwise.

In mathematics anti-clockwise is considered to be positive.

8.1.4 T4 Enlargement

Two items of information describe an enlargement fully:

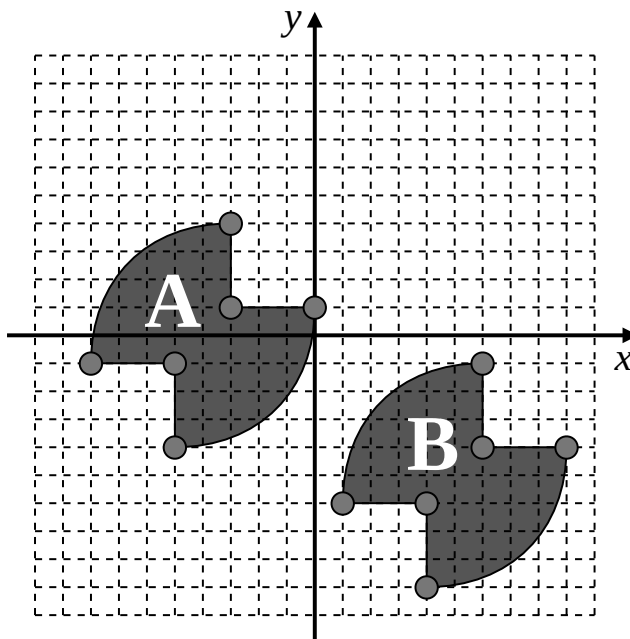
- En1** The **scale factor** of the enlargement.
- En2** The **centre** (a point, a focus) of the enlargement.

The scale factor has the following properties;

- SF1** IF **scale factor** > 1 THEN a bigger, similar shape results.
- SF2** IF $0 < \text{scale factor} < 1$ THEN a smaller, similar shape results.
- SF3** IF $-1 < \text{scale factor} < 0$ THEN a smaller, similar, inverted shape results.
- SF4** IF **scale factor** < -1 THEN a bigger, similar, inverted shape results.
- SF5** IF **scale factor** $= 1$ THEN the original and image are 'one on top of the other'.
- SF6** IF **scale factor** $= 0$ THEN there is no image.
- SF7** IF **scale factor** $= -1$ THEN the image is a rotation of 180° about the focus.

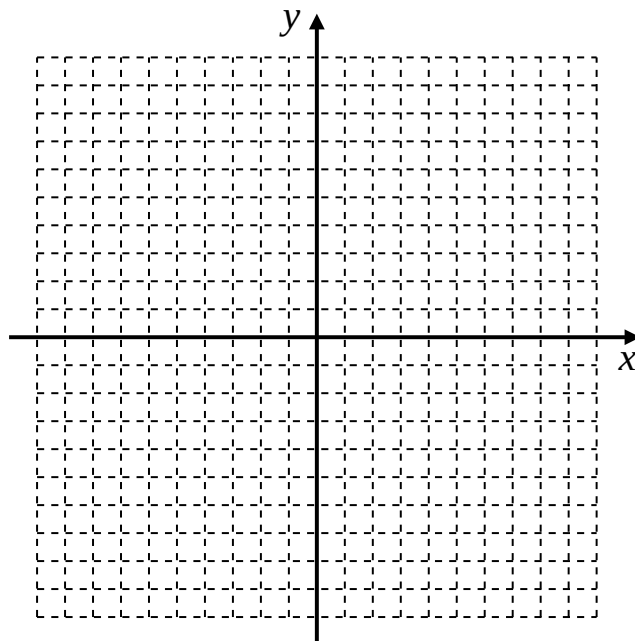
8.2 Exercise

Question 1



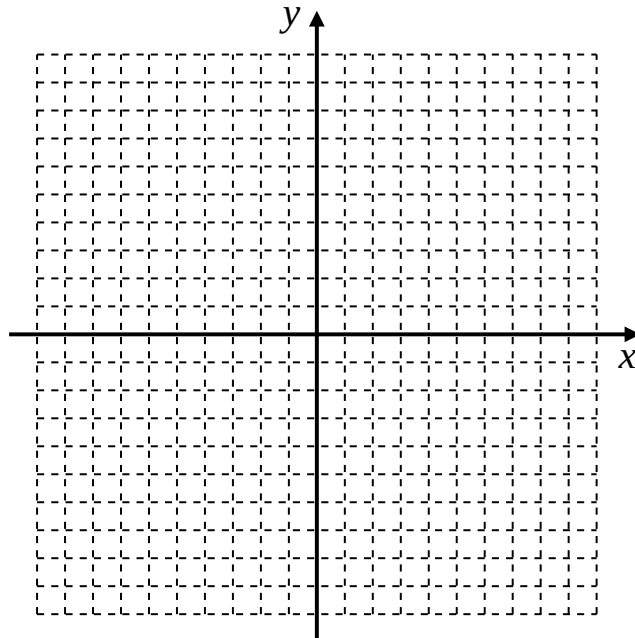
- (a) Translate A by $\begin{pmatrix} 6 \\ 5 \end{pmatrix}$ and label the image C.
- (b) Write down the vector that translates A onto B.

Question 2



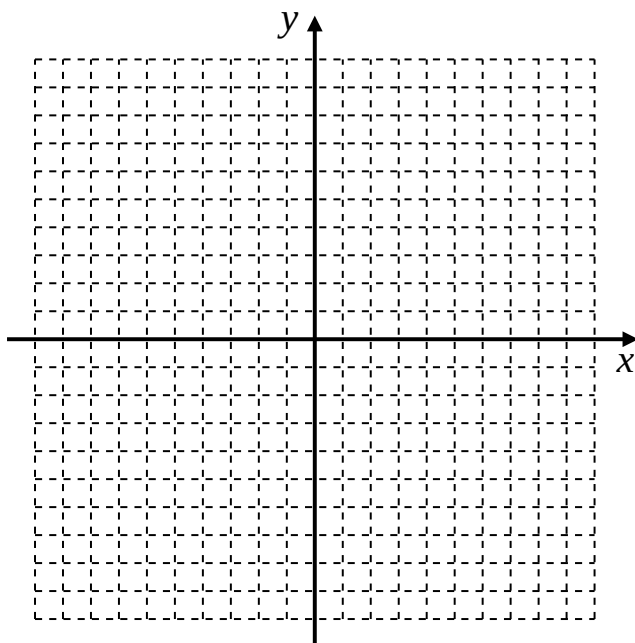
- (a) Reflect the shape in the mirror.
- (b) What is the equation of the mirror line ?

Question 3



- (a) Plot the FLAG with vertices;
 $A(-2, -5)$, $B(-1, -5)$, $C(-1, 3)$,
 $D(4, 3)$, $E(4, 5)$, $F(-2, 8)$
- (b) Rotate the FLAG by 90° about the point $(1, -1)$

Question 4

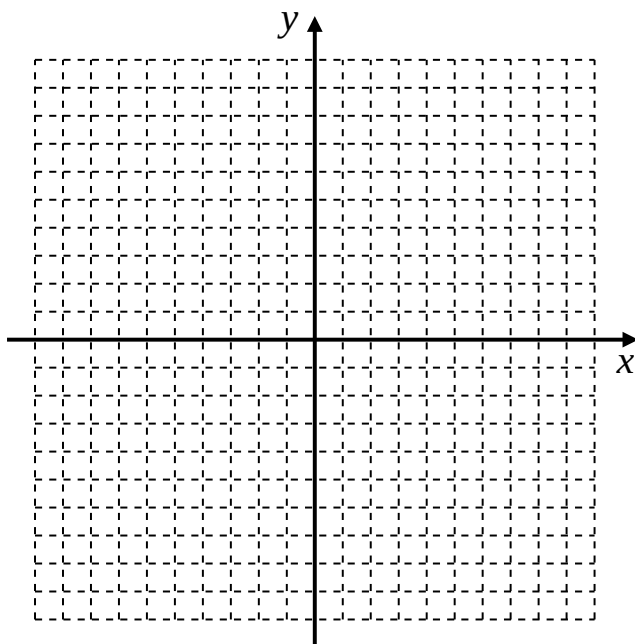


(a) Plot the SPIRAL with vertices;

$G(-8, 4), \quad H(-8, 8), \quad I(-3, 8),$
 $J(-3, 4), \quad K(-6, 4), \quad L(-6, 6),$
 $M(-5, 6), \quad N(-5, 5), \quad O(-4, 5),$
 $P(-4, 7), \quad Q(-7, 7), \quad R(-7, 4).$

(b) Enlarge the SPIRAL by scale factor -2 , centre $(-3, 2)$

Question 5

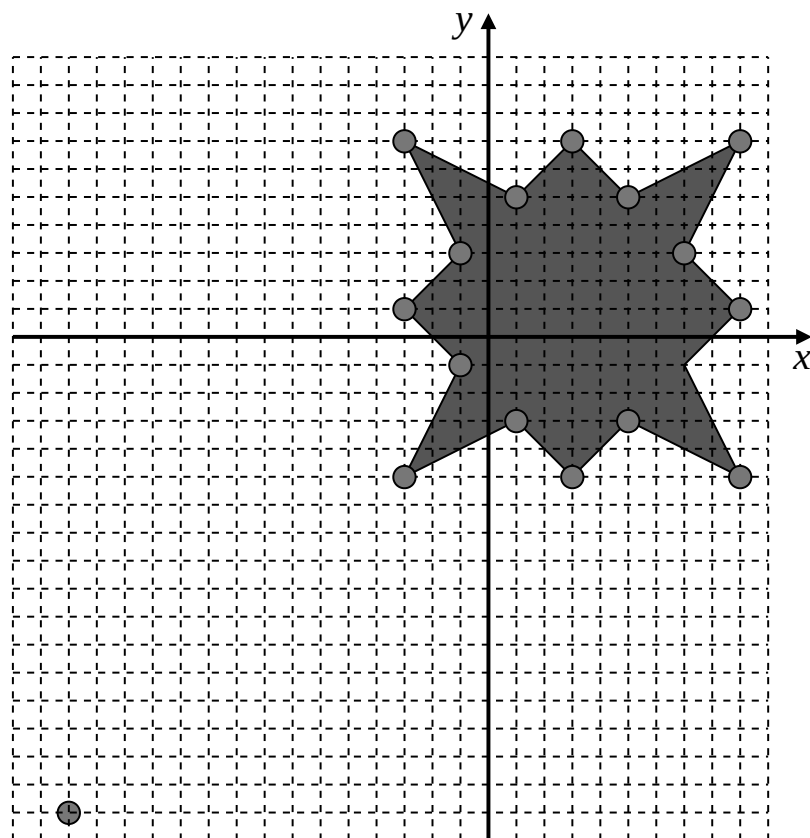


(a) Plot the DART with vertices;

$D(-6, 0), \quad A(-3, -1), \quad R(-2, -4), \quad T(6, 8).$

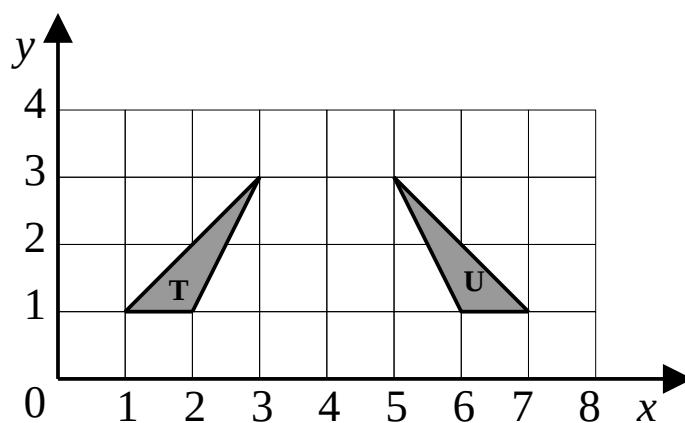
(b) Reflect the DART in the line $x = 2$.

Question 6



Enlarge the given shape by scale factor 0.5, centre $(-15, -17)$.

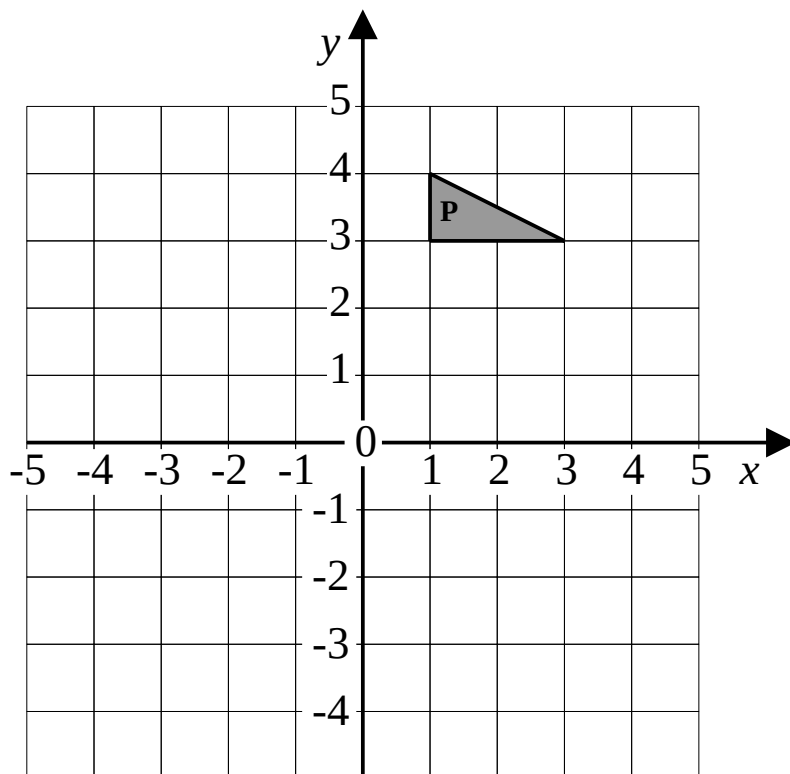
Question 7



Describe fully the single transformation which maps triangle **T** onto triangle **U**.

[2 marks]

Question 8



Reflect triangle **P** in the y-axis to give triangle **Q**.

Then rotate triangle **Q** about **O** through 90° clockwise to give triangle **R**.

Describe fully the **single** transformation which maps triangle **P** onto triangle **R**.

[4 marks]

Question 9

In your mind picture the alphabet written as BLOCK CAPITALS.

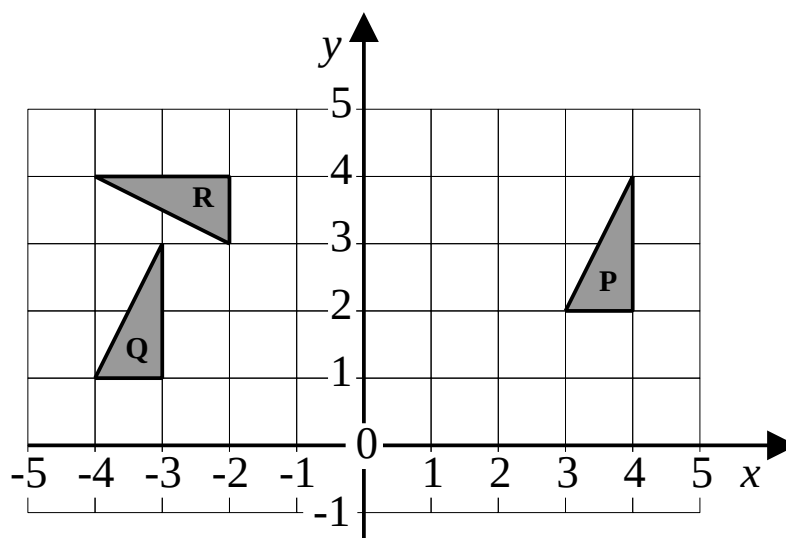
i.e. A B C D E

- (i) Ignoring any small, fancy font embellishments, list the 3 letters which have rotational symmetry and no mirror symmetry.

- (ii) Ignoring any small, fancy font embellishments, list the 7 or 8 letters which have neither rotational symmetry* nor mirror symmetry.
(Which letter is the 'debatable' one ?)

* By no rotational symmetry is meant only the trivial case of Rotational Symmetry of Order 1

Question 10



- (a) Describe fully the single transformation which maps triangle **P** onto triangle **Q**

[2 marks]

- (b) Describe fully the single transformation which maps triangle **P** onto triangle **R**

[3 marks]