GCSE

Basic Transformations
Translate, enlarge, rotate, reflect, tessellate

6 sections 24 Questions. Total marks 42

ANSWERS

Marks shown in brackets for each question (2)

Question	Type of question	Marks
1	Translation	5
2	Enlargement	7
3	Reflection	8
4	Rotation	10
5	Describing transformations	9
6	Tessellation	3

Authors Note

Every possible effort has been made to ensure that everything in this paper is accurate and the author cannot accept responsibility for any errors.

1. Translation

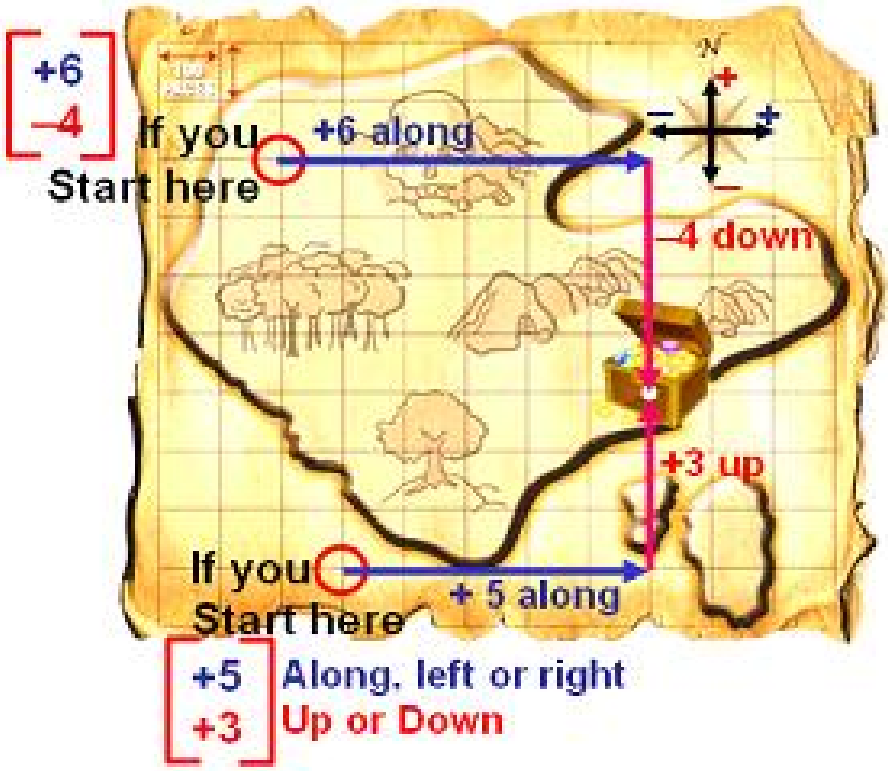
Translate is like finding your way around a treasure map.
Where ever you start, you have **move in two directions** to get to the treasure

We write these two directions like this $\begin{bmatrix} +6 \\ -4 \end{bmatrix}$

This means move 6 paces along to the right and 4 paces down.

The top number is for horizontal movement which is called the x axis

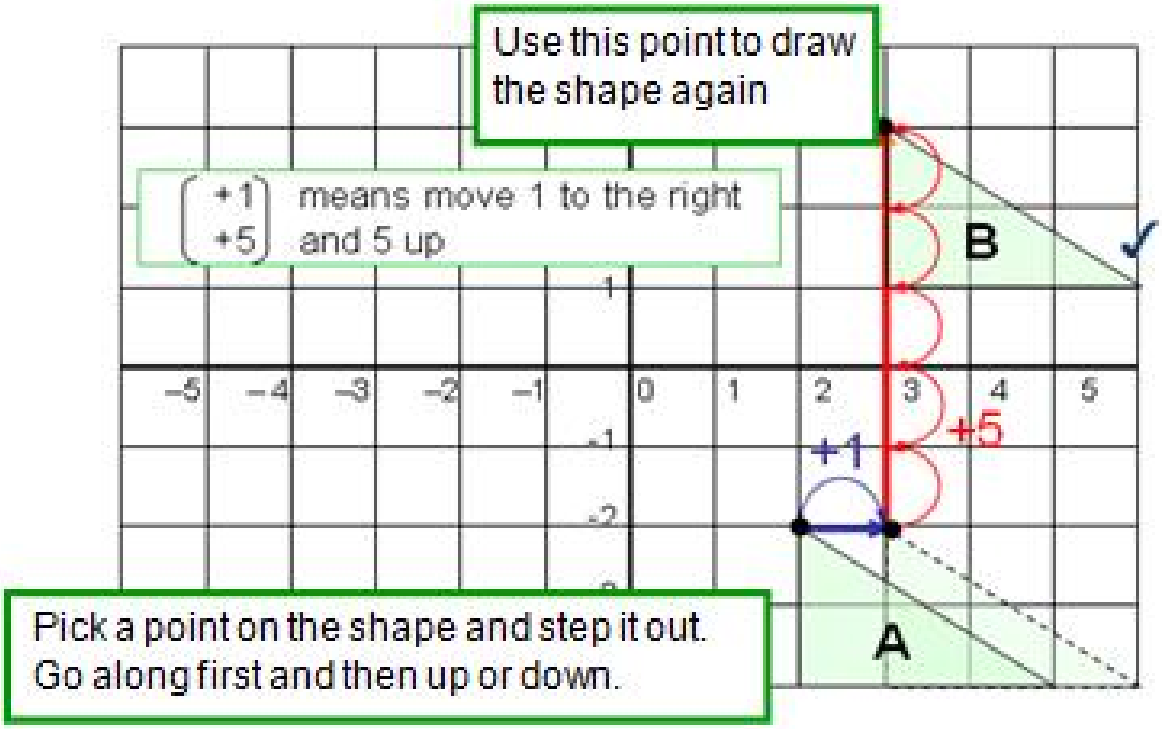
and the bottom number is for vertical movement which is called the y axis



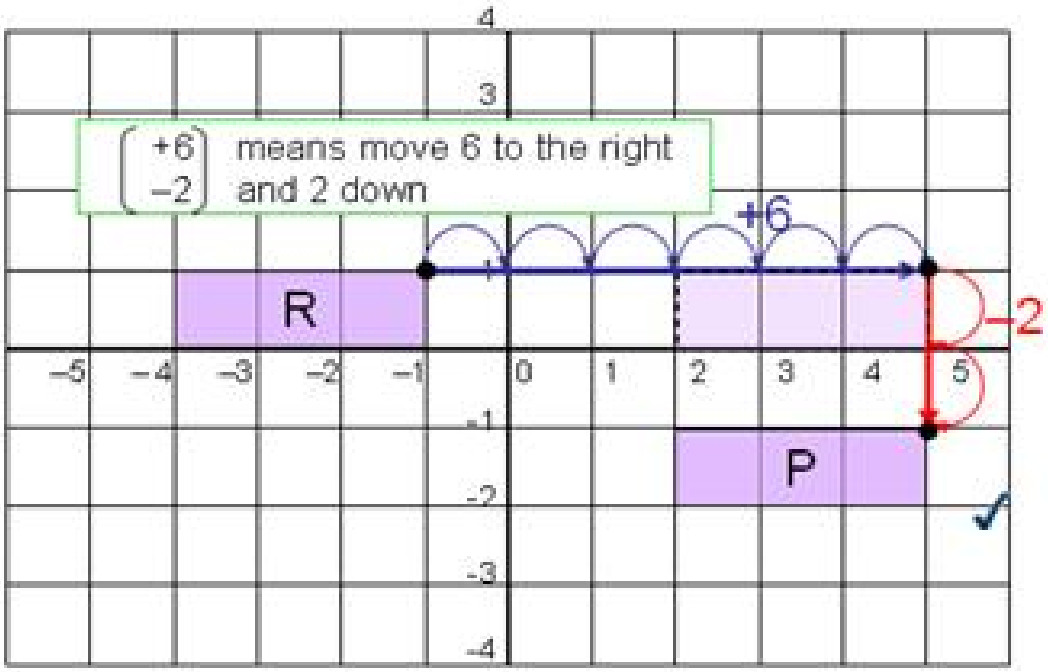
When you see a shape on a grid and you are asked to translate it by $\begin{bmatrix} +5 \\ -4 \end{bmatrix}$

It means Move the whole shape by 5 steps along to the right and 4 steps down

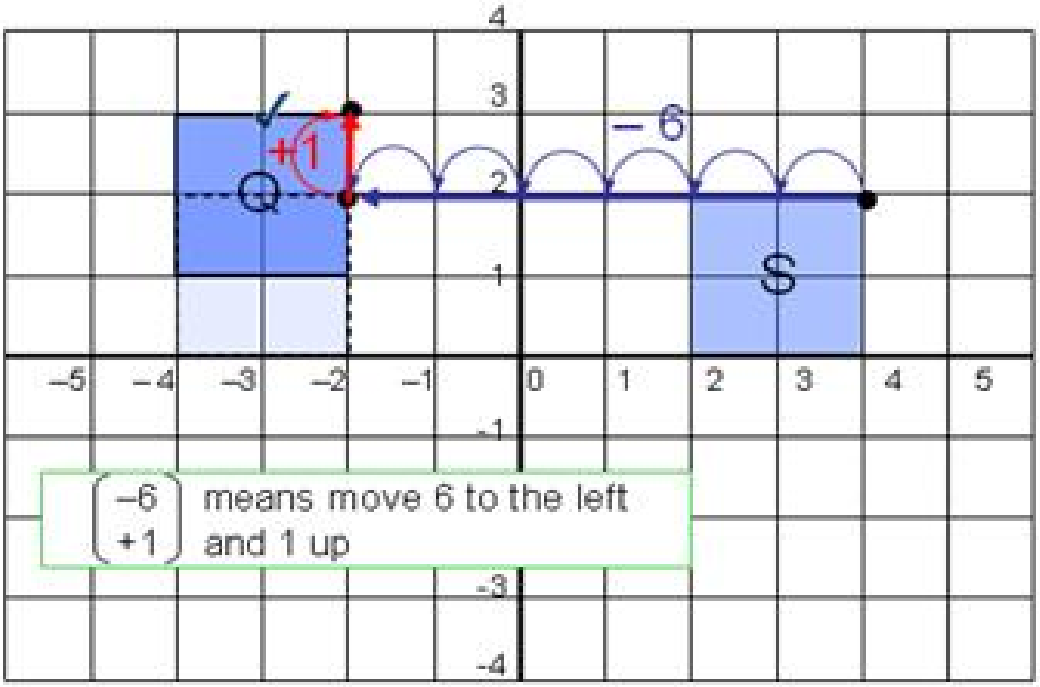
1. a) Translate triangle A by the vector $\begin{pmatrix} +1 \\ +5 \end{pmatrix}$ Label the new triangle B.



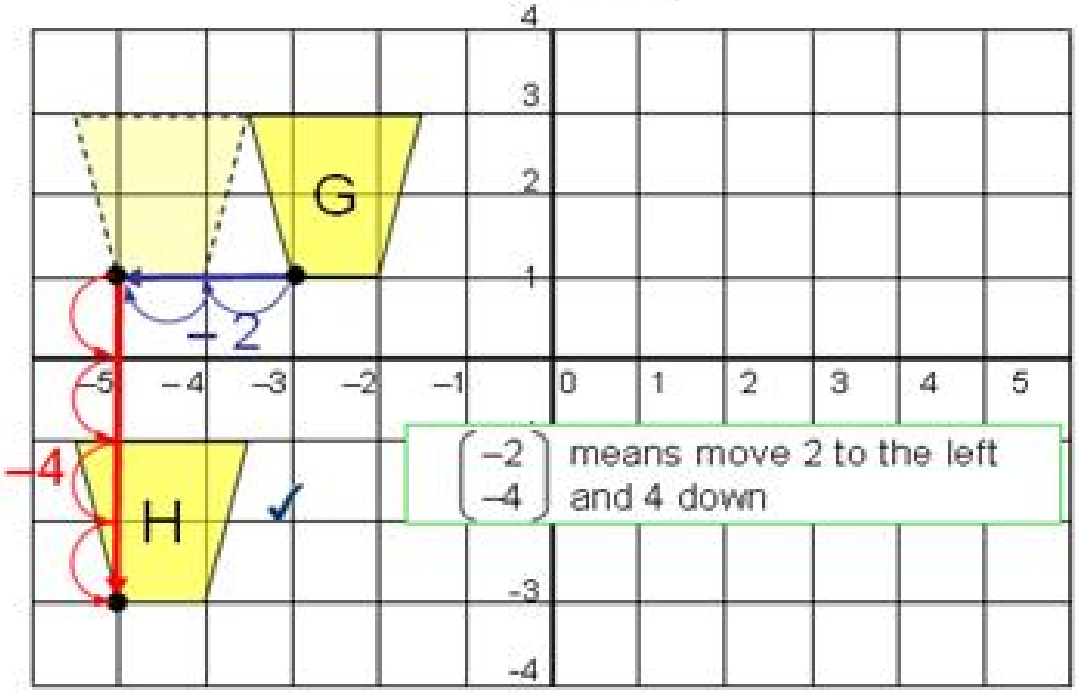
b) Translate rectangle R by the vector $\begin{pmatrix} +6 \\ -2 \end{pmatrix}$ Label the new rectangle P.



c) Translate square S by the vector $\begin{pmatrix} -6 \\ +1 \end{pmatrix}$ Label the new square Q.



d) Translate shape G by the vector $\begin{pmatrix} -2 \\ -4 \end{pmatrix}$ Label the new shape H.



(1)

e) Name the shape G

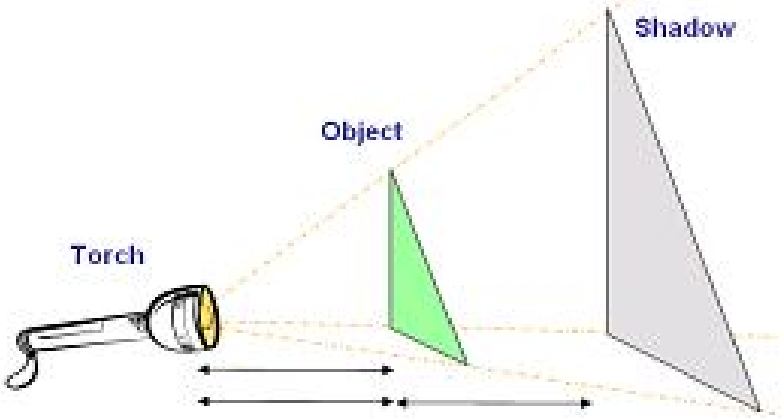
Trapezium ✓

2. Enlargement

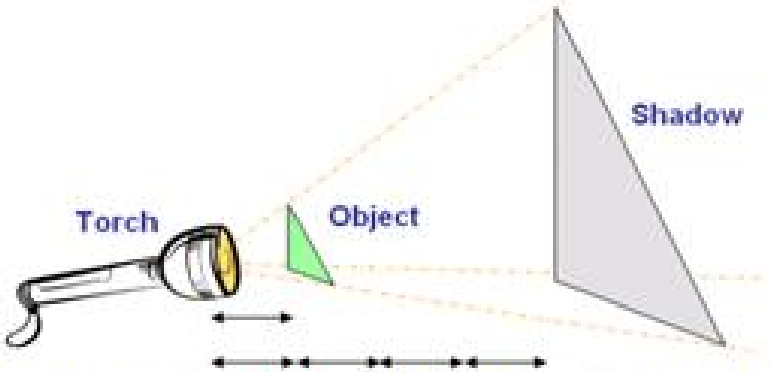
Enlargement is like shining a torch at a shape to make a shadow

The shadow is an enlarged copy of the shape

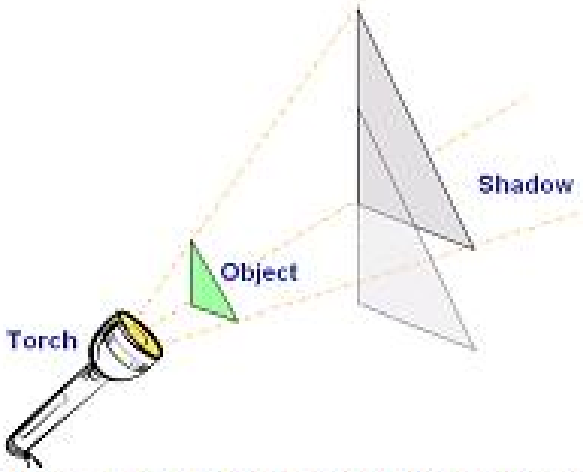
The size of the enlargement depends on how far away the shadow is from the torch compared to how far the shape is from the torch.



Shadow is two times as big as the object since the distance to the shadow is twice as far

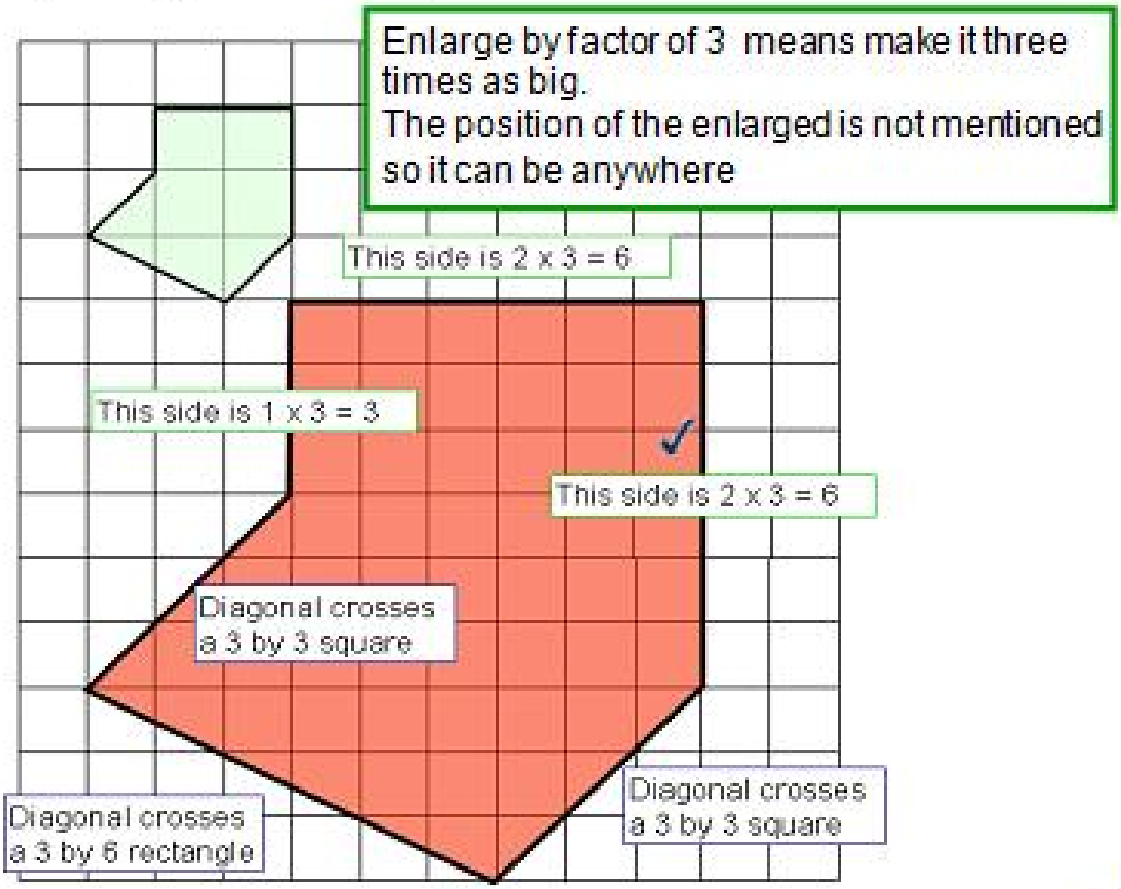


Shadow is 4 times as big as the object since the distance to the shadow is 4 times as far



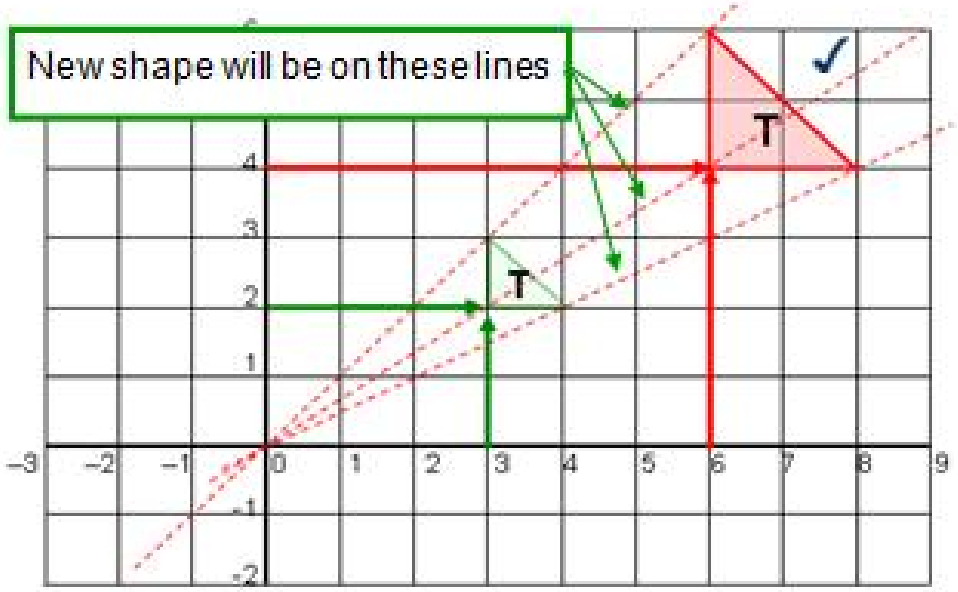
The position of the shadow compared to the object depends on where the torch is placed

a) Enlarge the shape shown below by a factor of three.



(1)

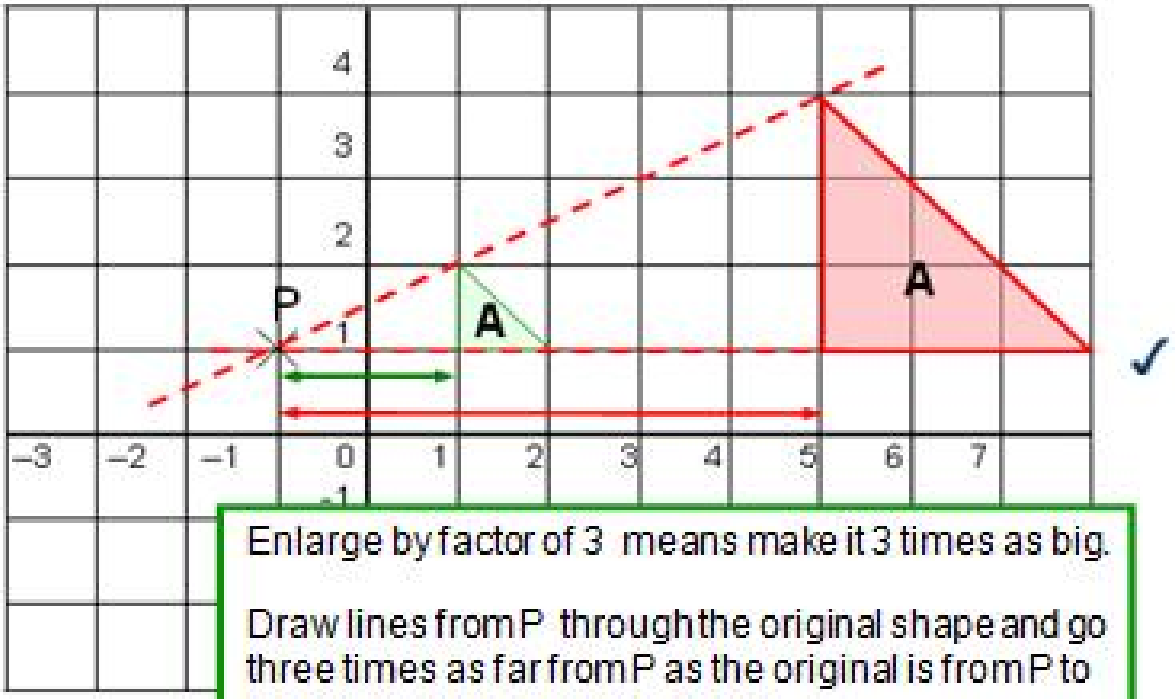
b) Enlarge the triangle T by a factor of ½ from the origin.



(2)

Enlarge by ½ means make it half as big.
Draw lines from the origin to the shape and go half way between them to find the position for the triangle.

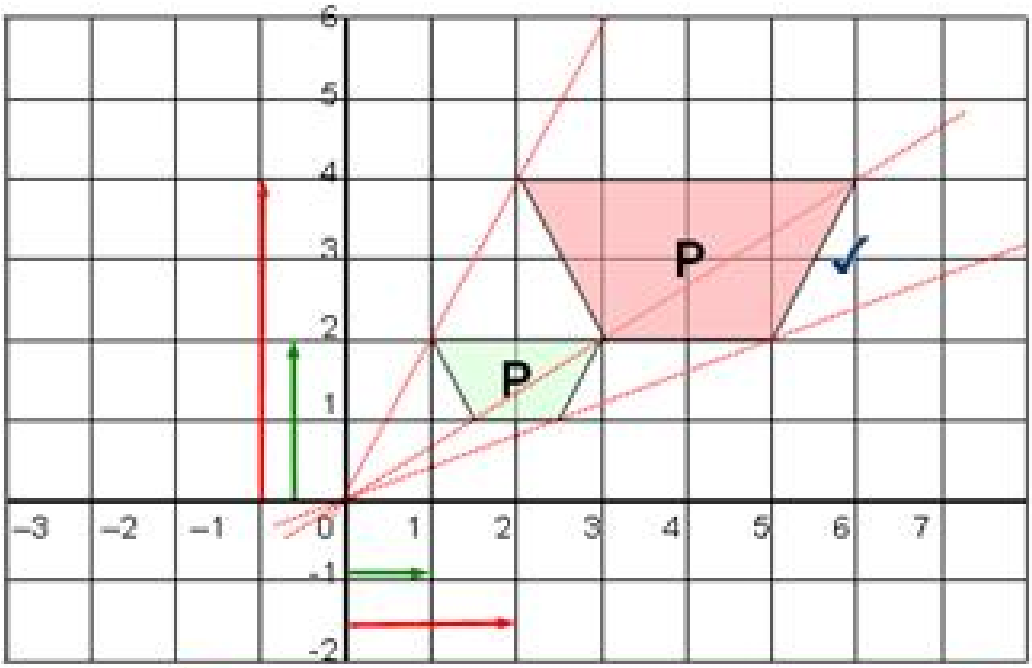
c) Enlarge the triangle A by a factor of 3 from centre P.



Enlarge by factor of 3 means make it 3 times as big.

Draw lines from P through the original shape and go three times as far from P as the original is from P to locate where to draw the shape

d) Enlarge shape **P** by scale factor 2, centre *O*, to give shape **Q**.



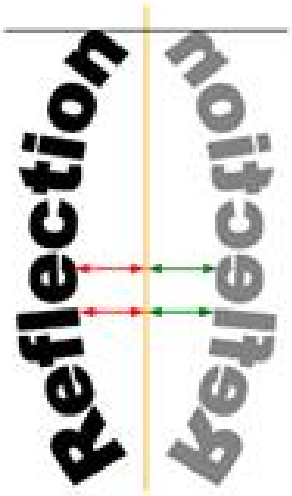
Draw lines from the origin to the shape and go twice as far from the origin to find the position for the triangle.

3. Reflection

A reflection is what you see in a mirror – an exact image but switch around somehow.

Look at the word reflection that we have reflected in the horizontal mirror.

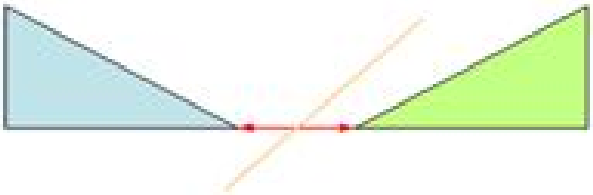
What do you notice about the reflected word above?



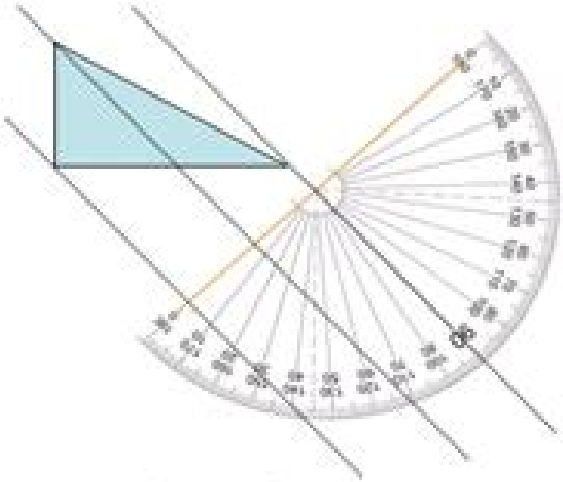
Now we have reflected the word reflection in a vertical mirror. The distance from every point on one side of the mirror is the same as the distance on the other side Look at the green and red arrows.

What happens if the mirror is at an angle to the shape? Do we just measure the distance? See over for the answer.

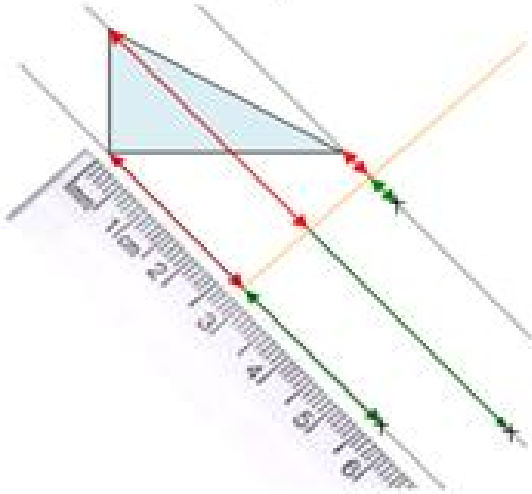
Reflecting in a mirror that is at an angle to the shape



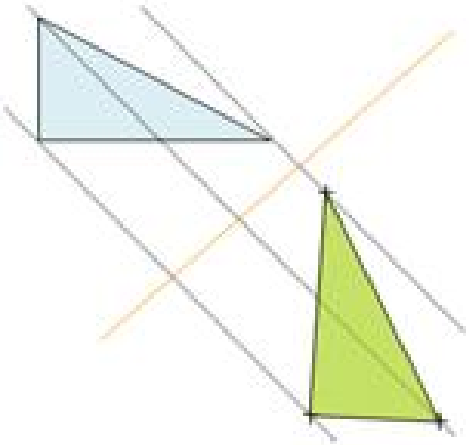
Measuring the same distance either side of an angled mirror produces the wrong reflection



We need to draw ray lines at right angles to the mirror. Use a protractor



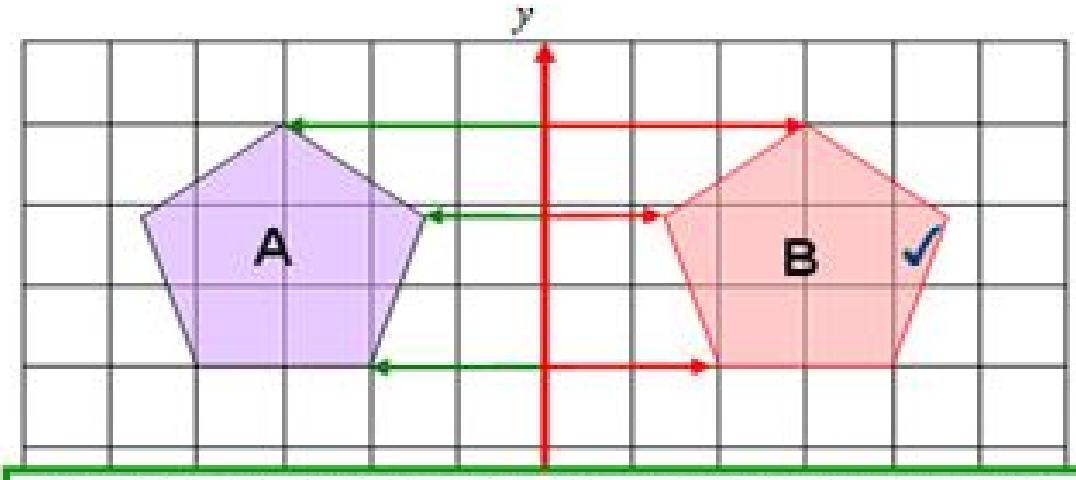
Now measure the same distance either side of the mirror line along the ray lines and mark the points



Join the points to get the reflected triangle.

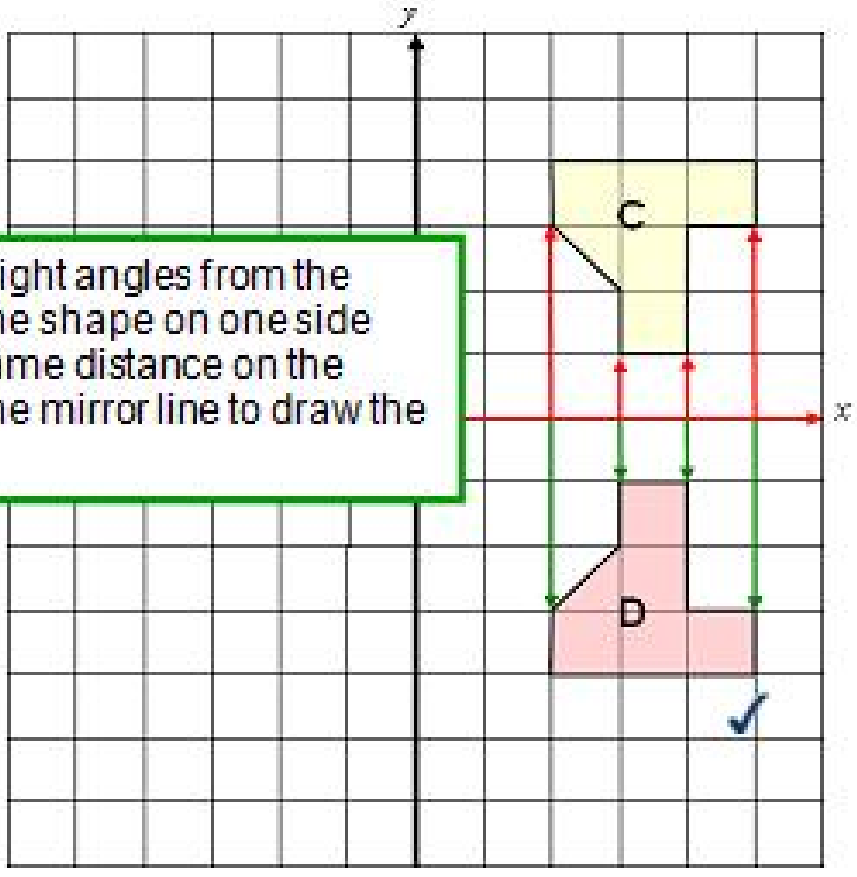
Notice how different it is to our original attempt.

4. a) Reflect the shape A in the y-axis. Label it B



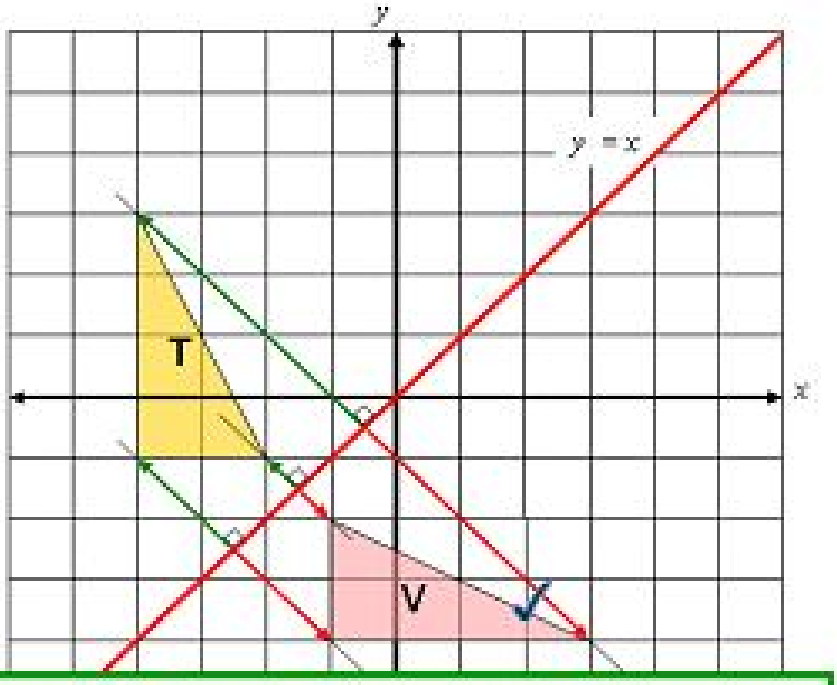
Draw lines at right angles from the mirror line to the shape on one side and use the same distance on the other side of the mirror line to draw the reflection.

b) Reflect the shape C in the x-axis. Label it D



Draw lines at right angles from the mirror line to the shape on one side and use the same distance on the other side of the mirror line to draw the reflection.

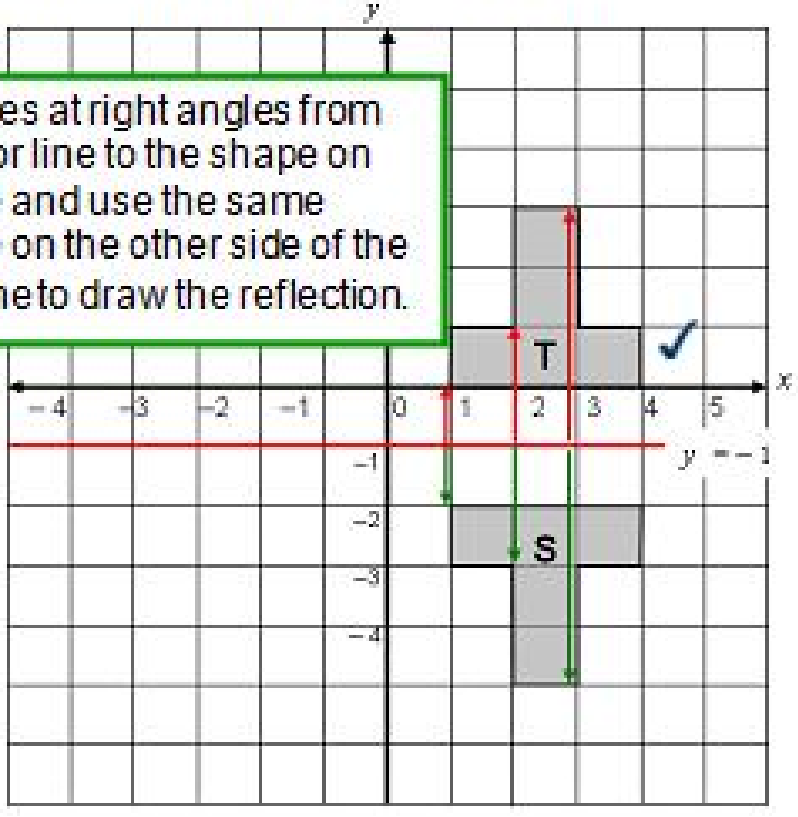
c) Reflect the triangle T in the line y = x
Label it V



Draw ray lines at right angles from the mirror line to the shape on one side and use the same distance on the other side of the mirror line to draw the reflection.

d) Reflect shape S in the line y = – 1. Label it T.

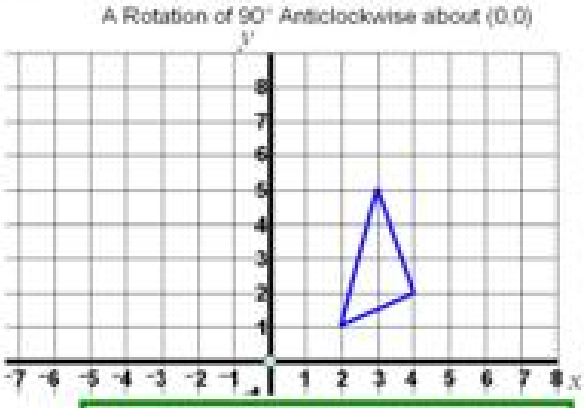
Draw lines at right angles from the mirror line to the shape on one side and use the same distance on the other side of the mirror line to draw the reflection.



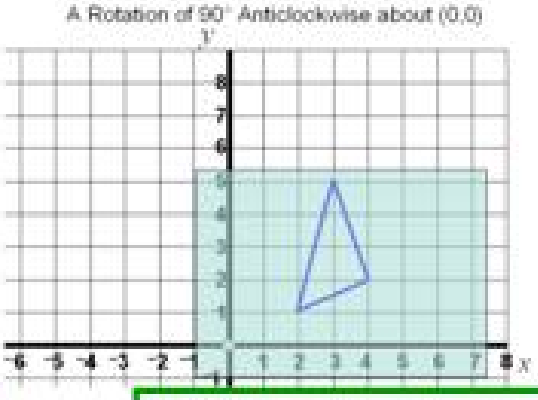
4. Rotation

For Rotation you need :

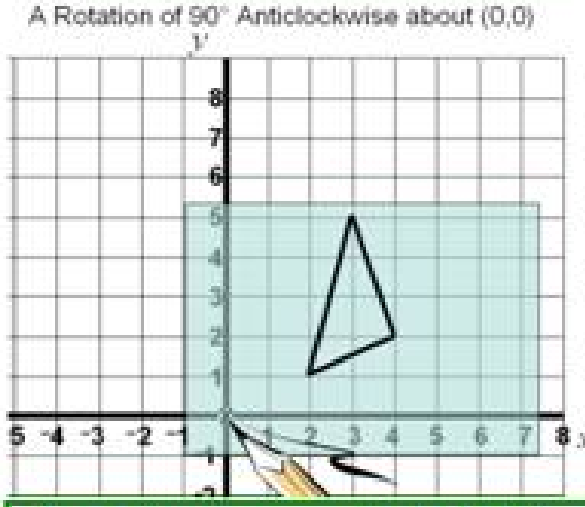
- An angle or degree of turn. 90° or a Quarter Turn; 180° or a Half Turn
- A direction – Clockwise or Anticlockwise
- A Centre of Rotation or a point around which Object rotates



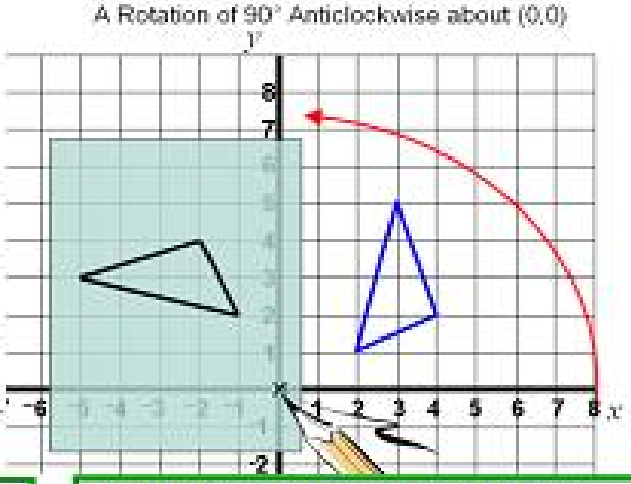
Mark the centre of rotation



Place tracing paper over the shape.

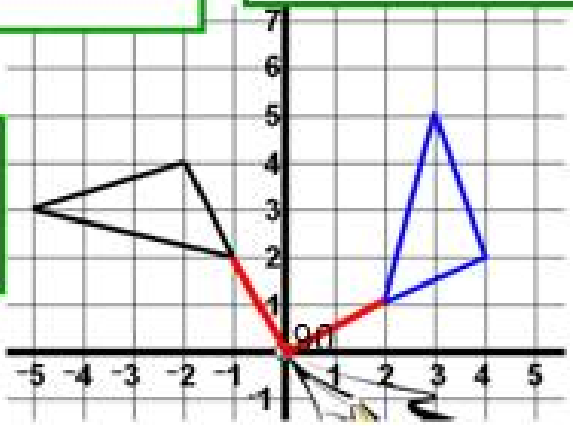


Trace the shape and put point of pencil or compass through the point of rotation.

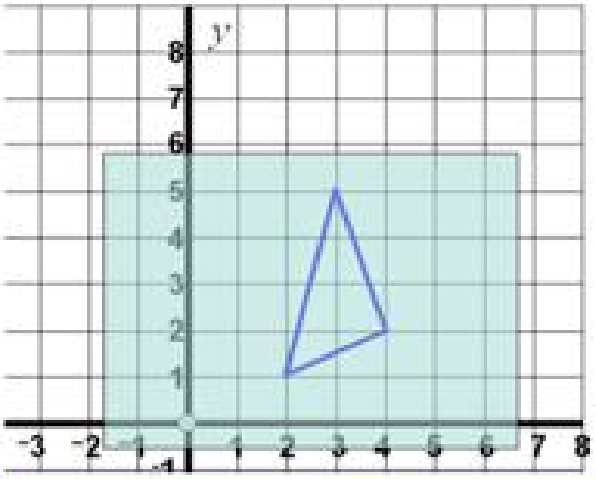


Rotate the tracing paper by 90° anticlockwise and go over shape on tracing

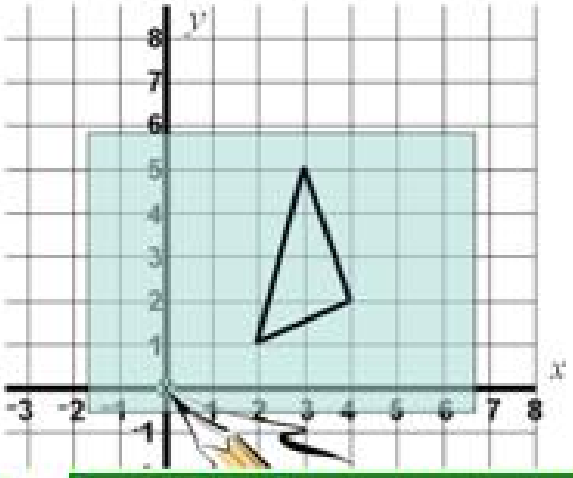
The rotated shape is at 90 degrees to the original



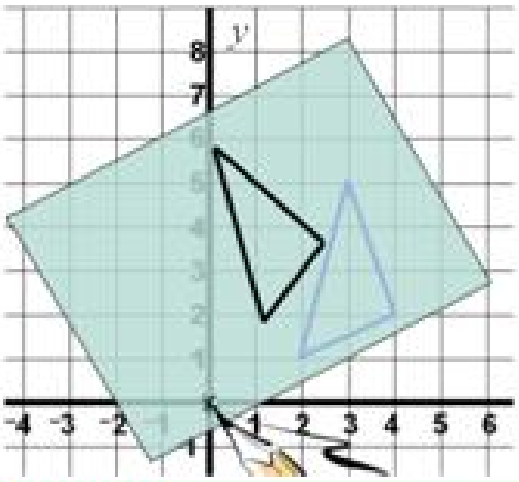
Rotation of 180 degree about origin (0, 0)



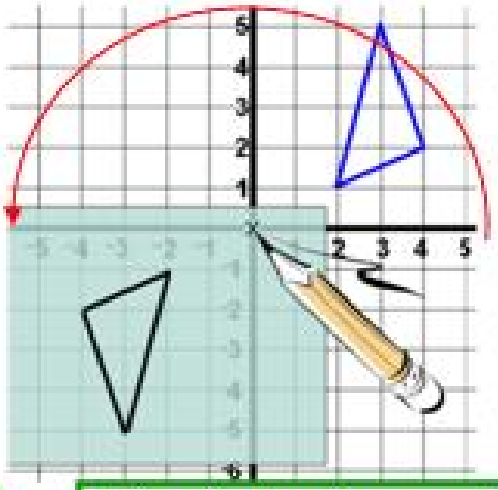
Mark the centre of rotation and place tracing paper over the shape.



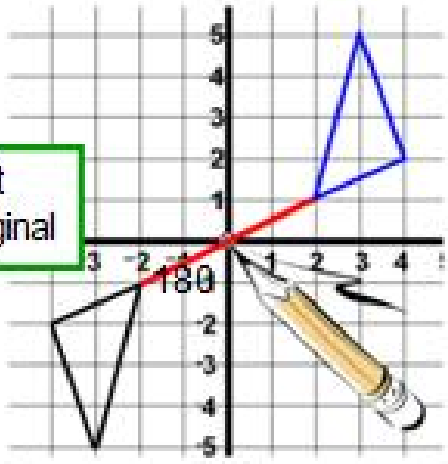
Trace shape and put point of pencil or compass through the point of rotation.



Rotate the tracing paper anticlockwise

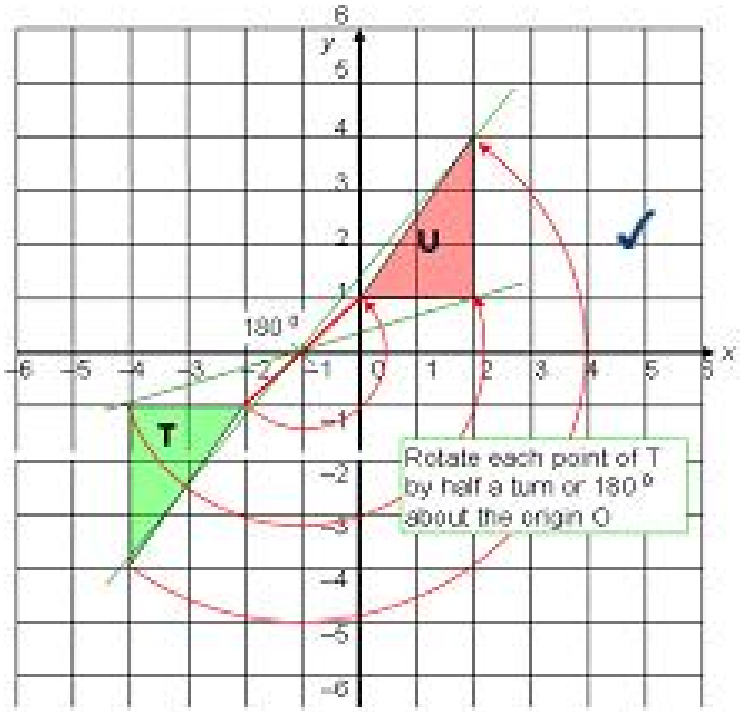


When the tracing paper has rotate by 180 degrees stop and go over shape on tracing paper

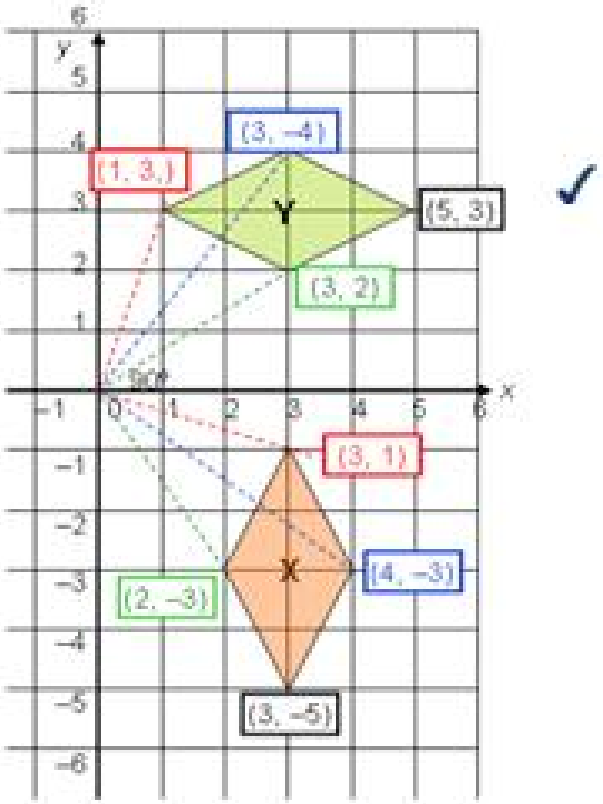


The rotated shape is at 180 degrees to the original

4. a) Rotate triangle T by 180° about the point (– 1, 0). Label it U

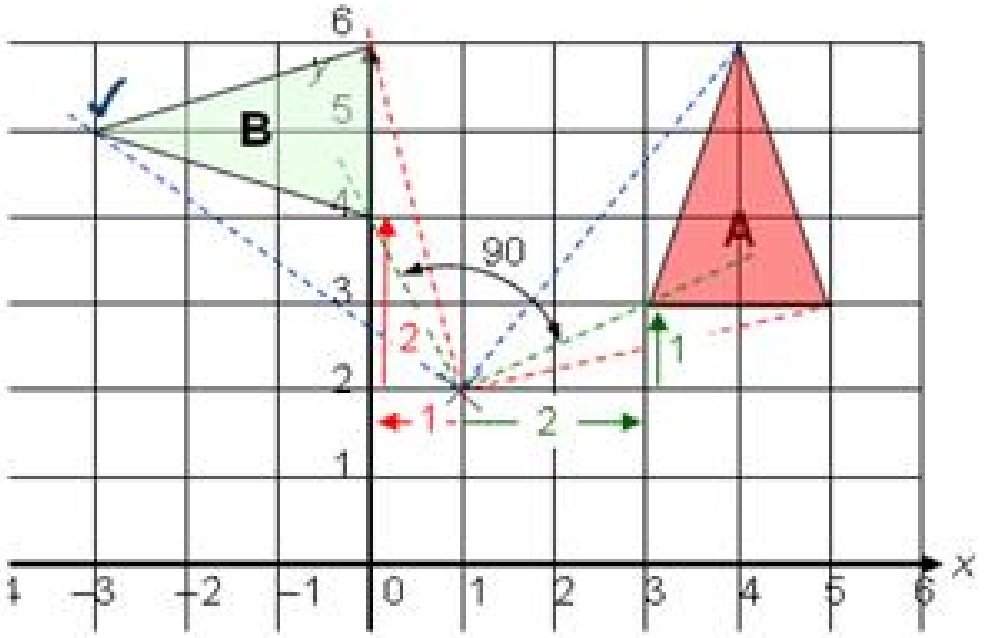


b) Rotate shape **X** by 90° clockwise about the origin (0, 0). Label it shape Y



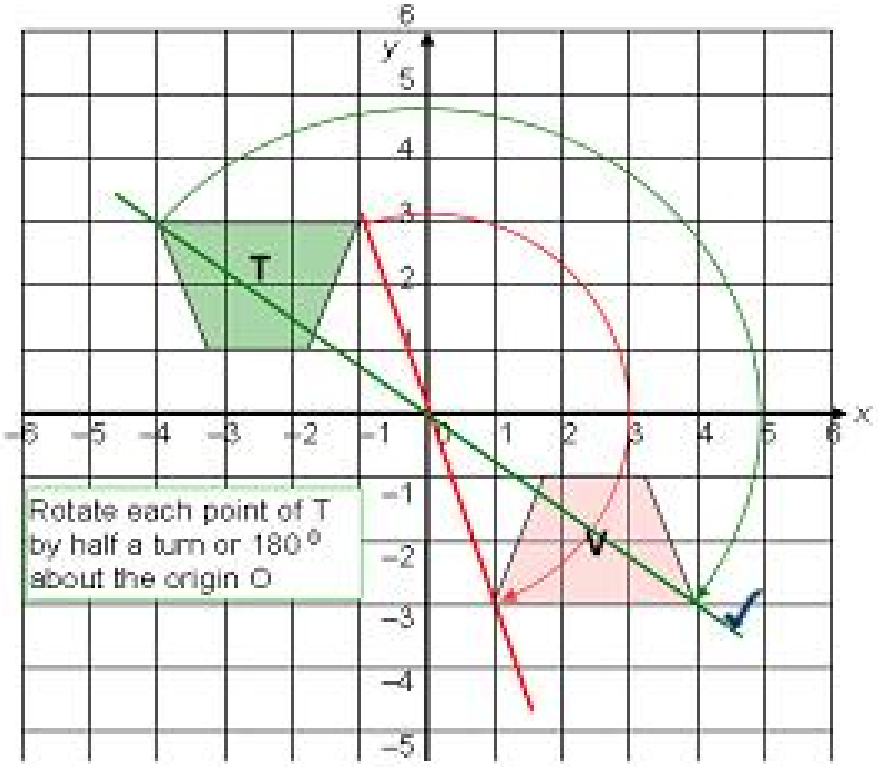
Notice how the co-ordinates for each point change
(2, – 3) → (3, 2) etc

c) Rotate triangle **A** by 90° anticlockwise about the point (1, 2). Label it B



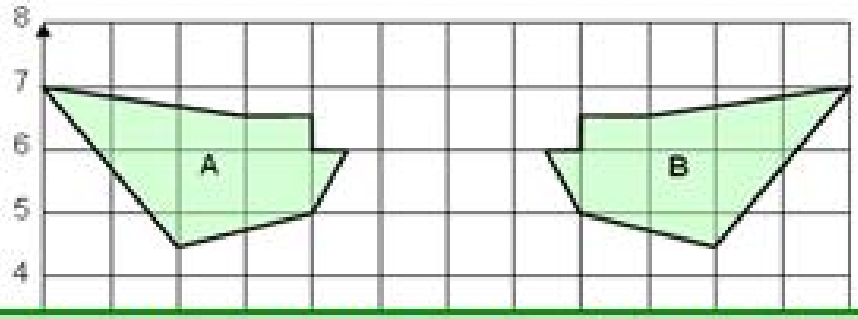
The bottom left point of triangle A is 2 horizontally and 1 vertically from the turning point. On the rotated triangle B this is 1 horizontally and 2 vertically from the turning point. The other points on B follow the same pattern.

d) Rotate shape T by 180° clockwise about the origin (0, 0). Label it V



5. Describing Transformations

a) Fully describe the single transformation which takes shape A to shape B

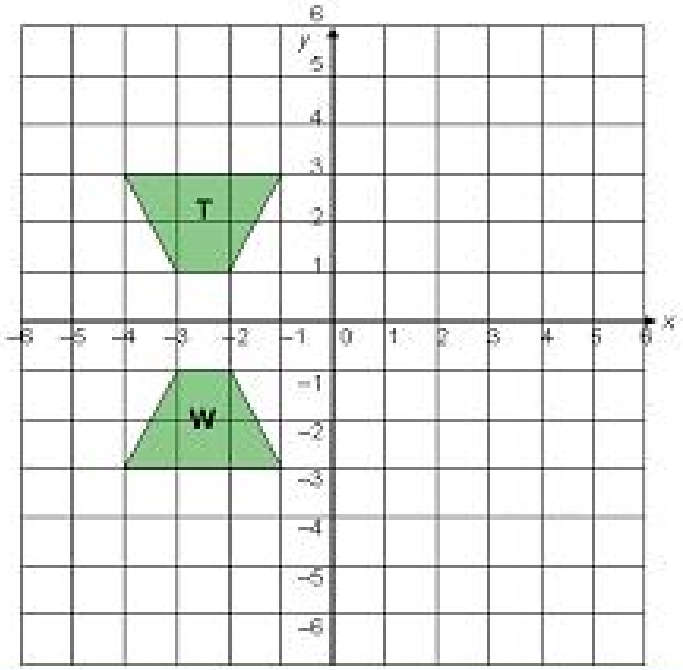


Fully describe means explain how shape A got to be shape B.
It can be either translate, enlarge, reflect or rotate.

For the two marks don't forget to say where the mirror was

This looks like a REFLECTION in the vertical mirror line at the x = 6 ✓

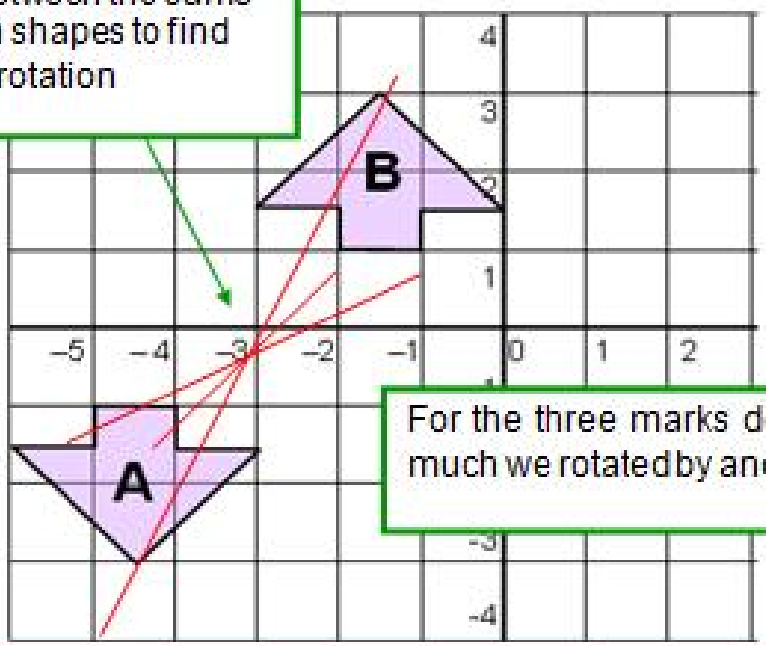
b) Fully describe the single transformation which takes shape T to shape W



This looks like a REFLECTION in the x axis or y = 0 ✓

c) Fully describe the single transformation which takes shape A to shape B

Draw lines between the same points in both shapes to find the centre of rotation



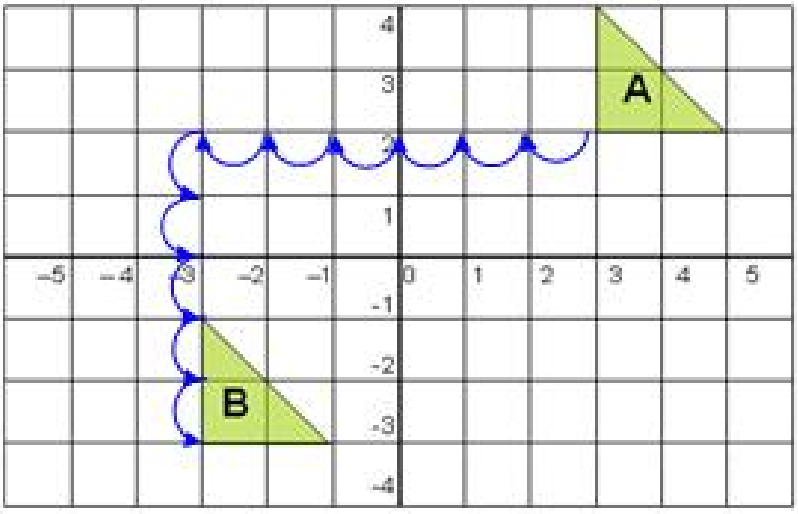
For the three marks don't forget to say how much we rotated by and the centre of rotation

This looks like a ROTATION by 180 degrees about the point (– 3 , 0) ✓

.....

(3)

d) Fully describe the single transformation which takes triangle A to triangle B



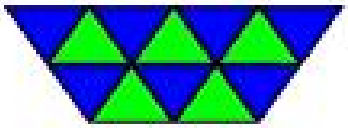
This looks like a TRANSLATE by 4 to the left and 5 down or $\begin{bmatrix} -6 \\ -5 \end{bmatrix}$ ✓

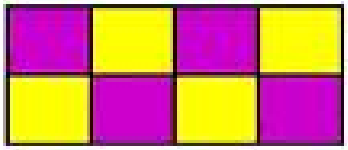
.....

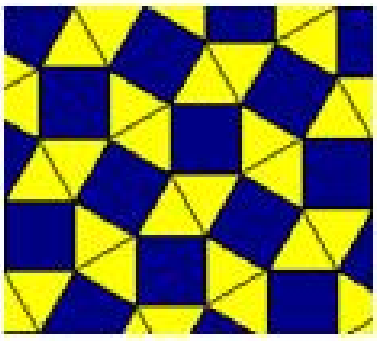
(2)

6. Tessellate

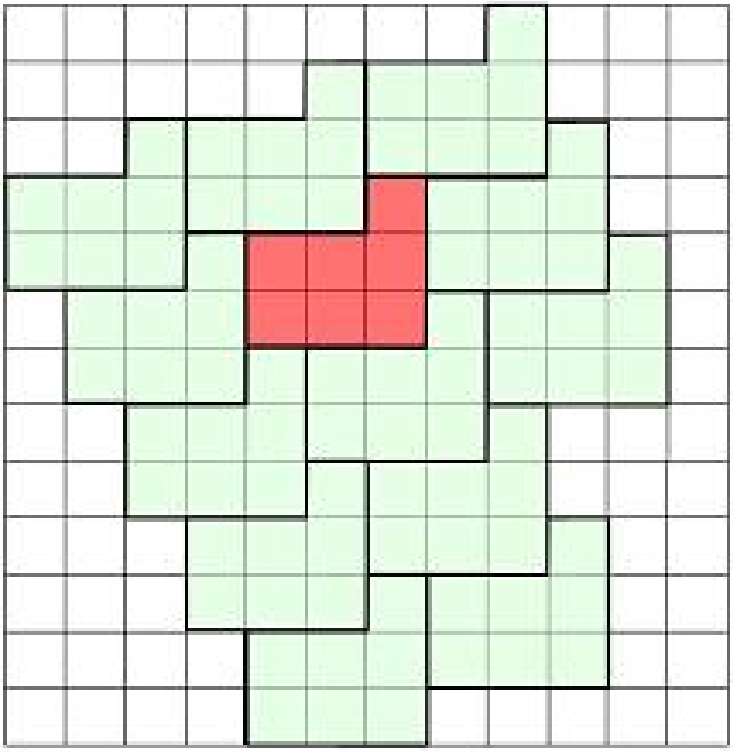
A tessellation is a pattern made from shapes that connect together with no overlaps and no gaps. Some examples are shown.



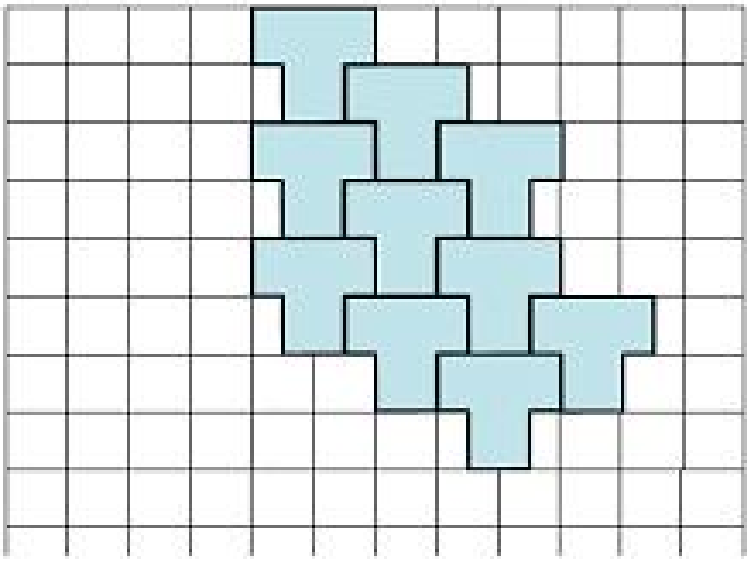




5. **a)** On the grid below, show how the shaded shape will tessellate.
You should draw at least six shapes.



b) On the grid draw at least 6 shapes to show how the shape tessellates.



c) On the grid below draw how this shape tessellates. Make at lease 6 shapes.