**SYMMETRY**

There are two kinds of symmetry:

a)     reflective symmetry

b)     rotational symmetry
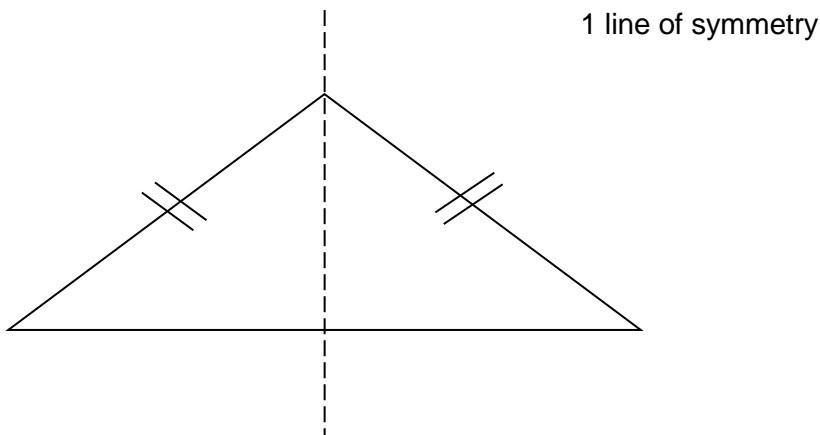
a)     **Reflective Symmetry**

A shape which can be divided by a straight line, so that each part is the mirror image of the other has reflective symmetry.

It is easy to tell if a shape has this type of symmetry if you think of folding the shape as you would a piece of paper.
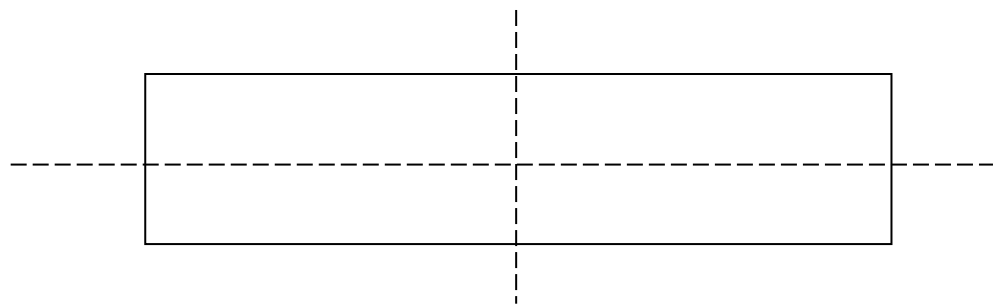
You are often asked how many lines of symmetry a given shape has.
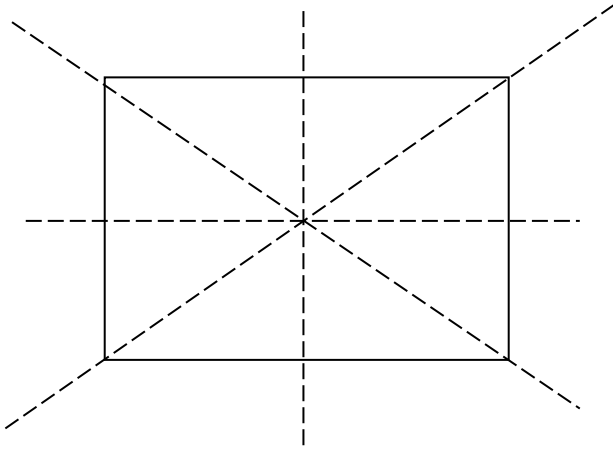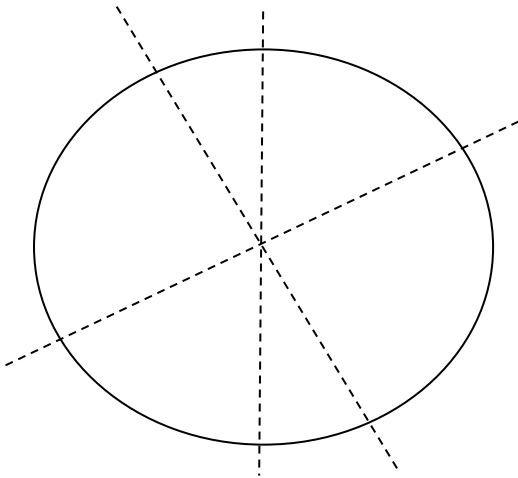
**Examples:**

**Isosceles Triangle**

1 line of symmetry

**Rectangle**

2 lines of symmetry
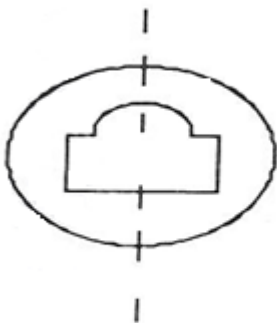
**Square**



4 lines of symmetry

**Circle**



Infinite number of lines of symmetry
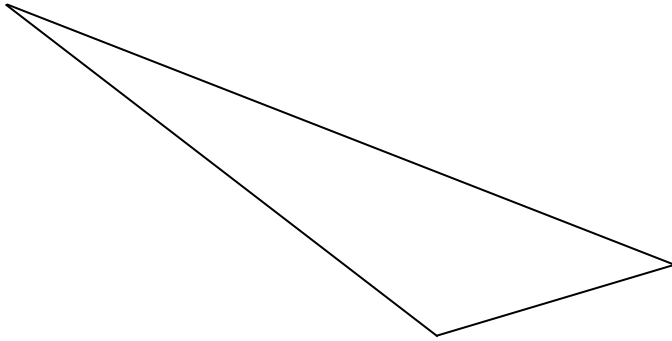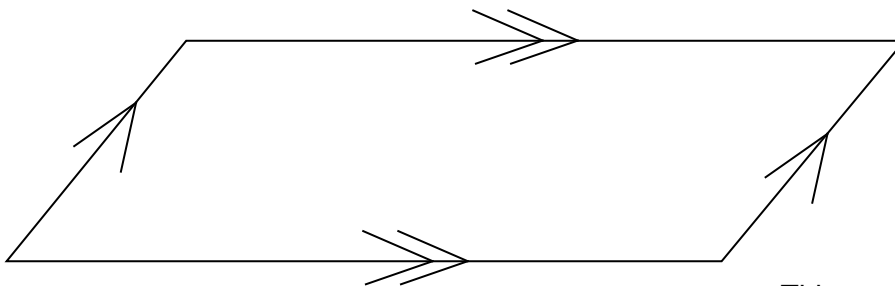
**BUT**



1 line of symmetry

Also, there are many shapes which have <u>no</u> reflective symmetry.

**Scalene Triangle**        i.e. triangle with all sides different.

**Parallelogram**

This one is rather surprising

**Exercise 1**

1.    Look at the following letters and if there are any lines of symmetry draw them in.
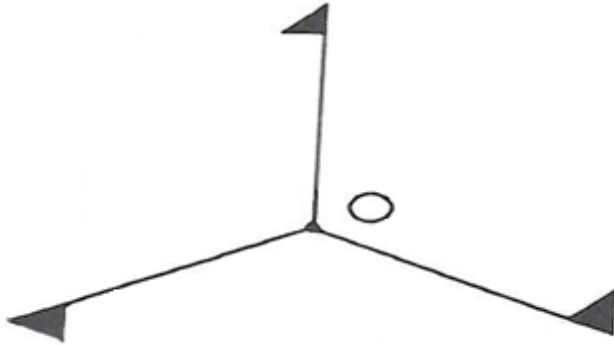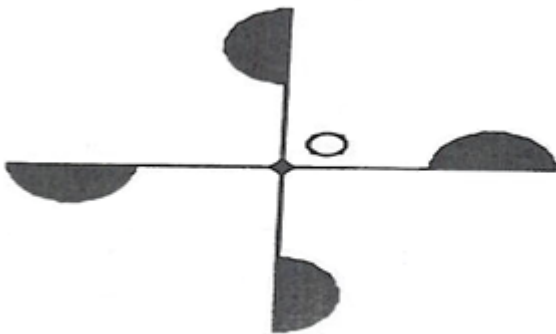
A

C

F

X

Z

W

S

T

H

E

b)   **Rotational Symmetry**

A figure which looks the same after it has been turned through an angle about some point is said to have rotational symmetry.
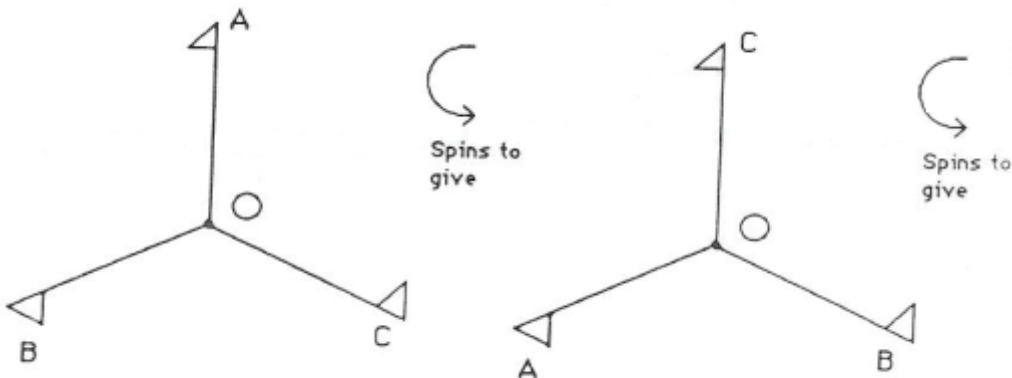
**Example 1**



**Example 2**



The figure will have a definite centre.  Call it O. Think of sticking a pin at O, and then turning the shape round a small amount at a time, so that it looks exactly the same as it did before the rotation.

The **order of symmetry** describes the number of different turns which will give the same appearance.
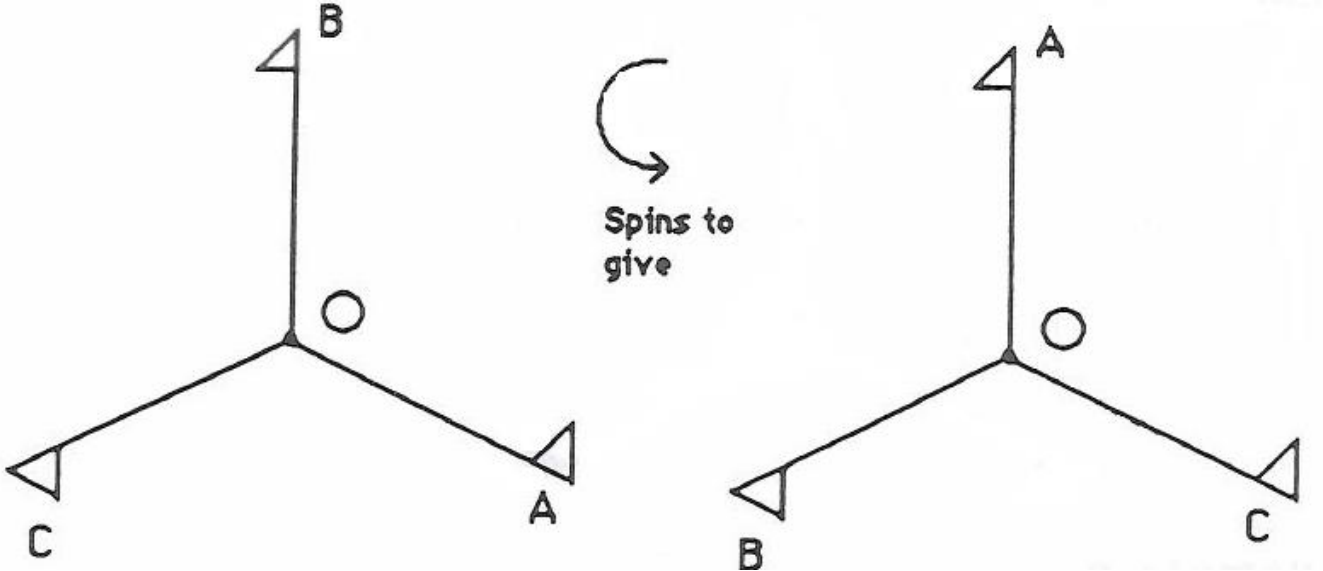
For example, 1 above (adding letters so that we can follow the moves) we have:

There are **3** distinct positions.

Each time we spun through an angle of $120^0$.

**Figure** has **symmetry** of **order 3**.



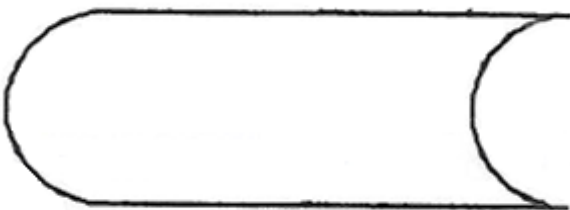**For example, 2** we can find 4 positions **each** time turning through [ ].

So, the shape has **rotational symmetry** of **order 4**.

So, a rule could be

"Decide the angle of the turn. Divide $360^0$ by the size of the angle. This gives the order of symmetry."

If you have to turn a shape round $360^0$ before it looks the same then it has **no** rotational symmetry.
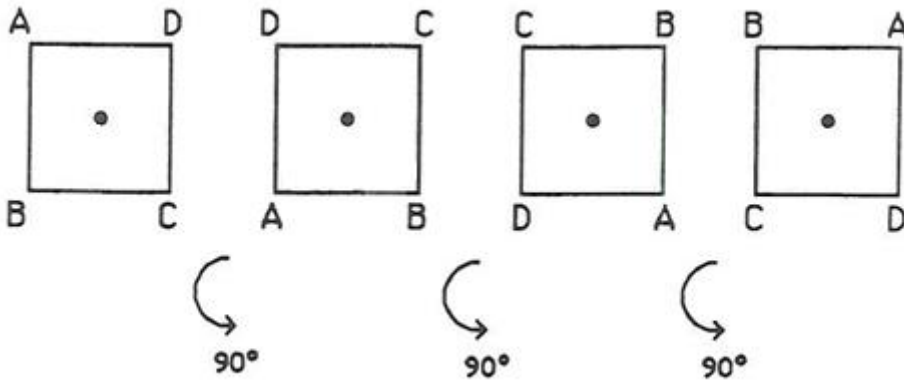
**Example**



(Note: we **do not say** order 1!)

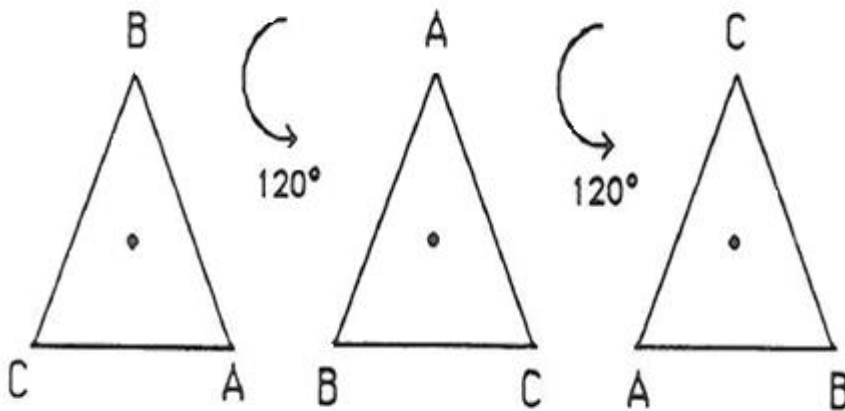Many familiar shapes will have both reflective **and** rotational symmetry.

**Example**

**Square**



Rotational symmetry of order 4.

**Equilateral Triangle**



Rotational symmetry of order 3.

**Exercise 2**

1.  Now look at the following letters, and if they have rotational symmetry, mark the centre of rotational with the letter 0, and give the order of rotational symmetry.

2.  Sketch each of the following shapes and if they have rotational symmetry mark the centre of rotation with the letter o and give the order of rotational symmetry.

    i)    Rectangle              v)    Parallelogram

    ii)   Rombus                 vi)   Kite

    iii)  Square                 vii)  Isosceles Triangle

    iv)   Regular Hexagon        vi)   Circle

**TRANSFORMATION GEOMETRY**

When a shape has been drawn on squared paper, you may be asked to move it around the page in a variety of ways.

These are called:

1.    Reflection
2.    Rotation
3.    Translation
4.    Enlargement

In this pack, we will introduce reflection and rotation.  Translation and Enlargement will come in a later pack.

**Reflection**

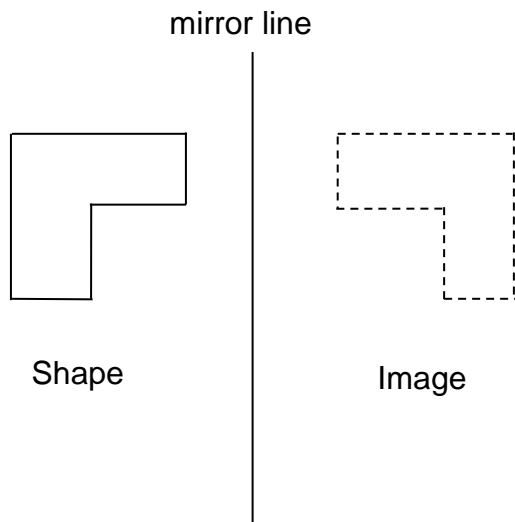This means sketch the "reflection" of a shape as if through a mirror.  The resulting shape may be called the image.

Remember that a reflection is as far behind the mirror as the object is in front.

**Example**

The diagrams show a shape and a mirror line.

Draw the reflection of each shape using the grid lines to help.

1.

mirror line

Shape          Image

2.

Shape

mirror line

Image

3.    mirror line

Image

Shape

4.

mirror line

Shape        Image

5.

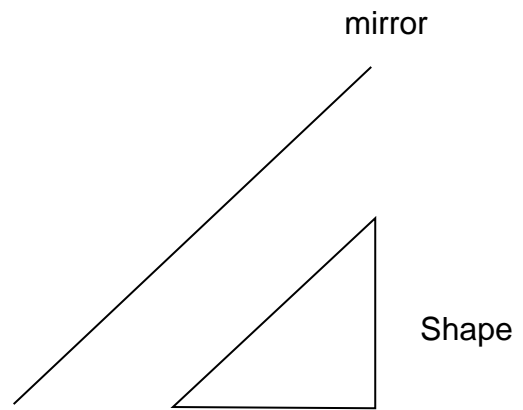mirror line

Shape

Image
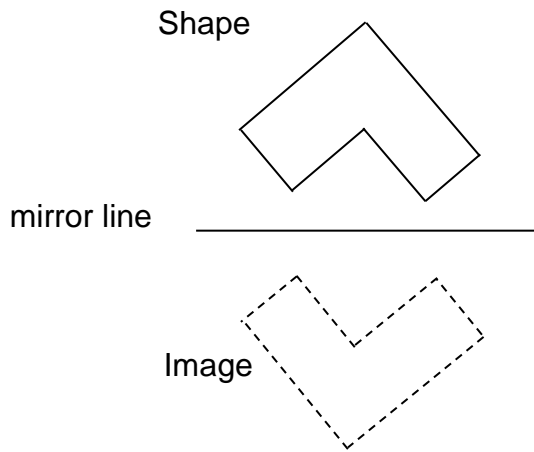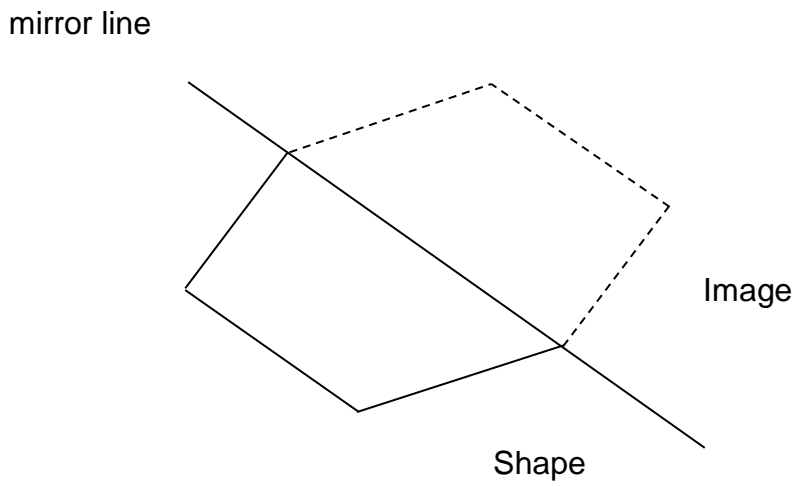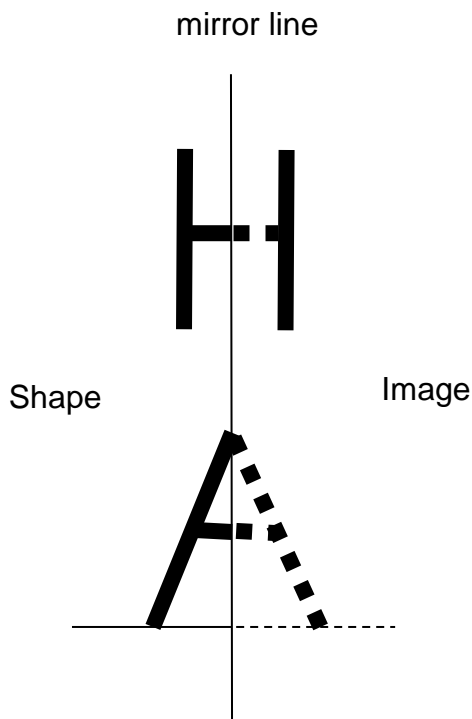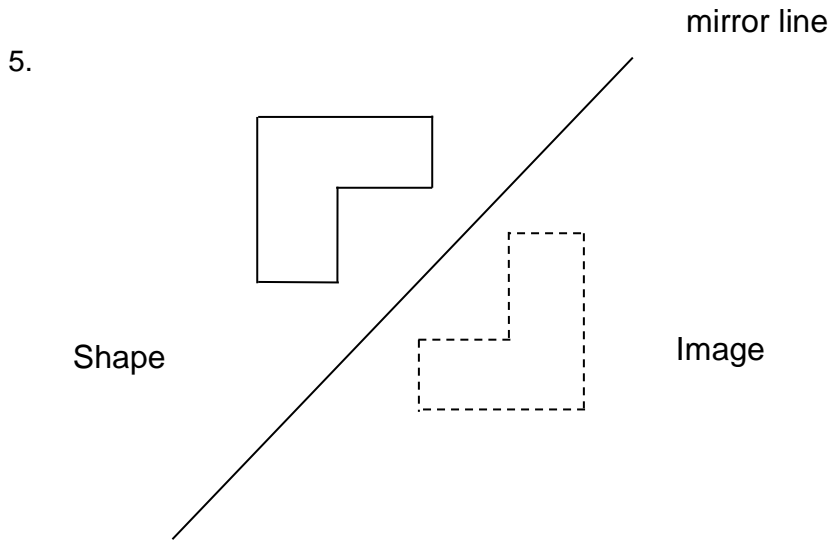
**Exercise 3**

1.  Draw the reflection of the shapes in the mirror. Draw the shapes on squared    paper, then their reflections.

a)

Shape

mirror
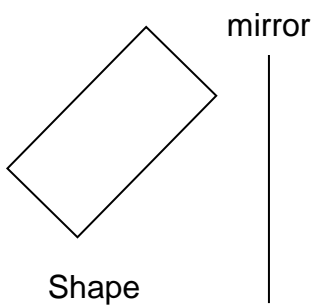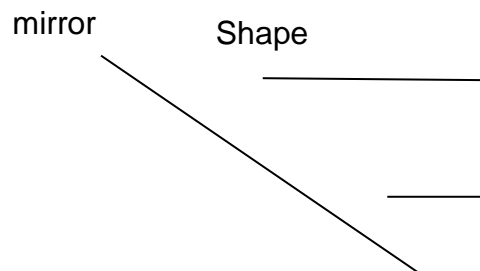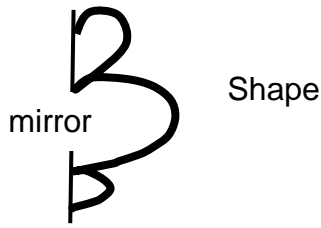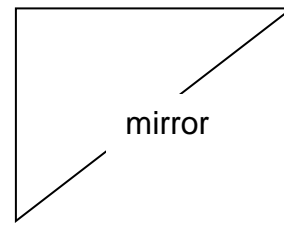
b)

mirror

Shape

c)

mirror

Shape

d)

mirror      Shape

e)



f)

Shape



mirror
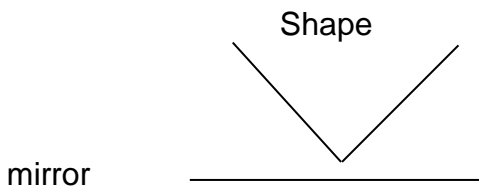
## ROTATION

You may also be asked to rotate a shape through $90^0$, $180^0$ etc about some given point. Tracing paper can be helpful here.
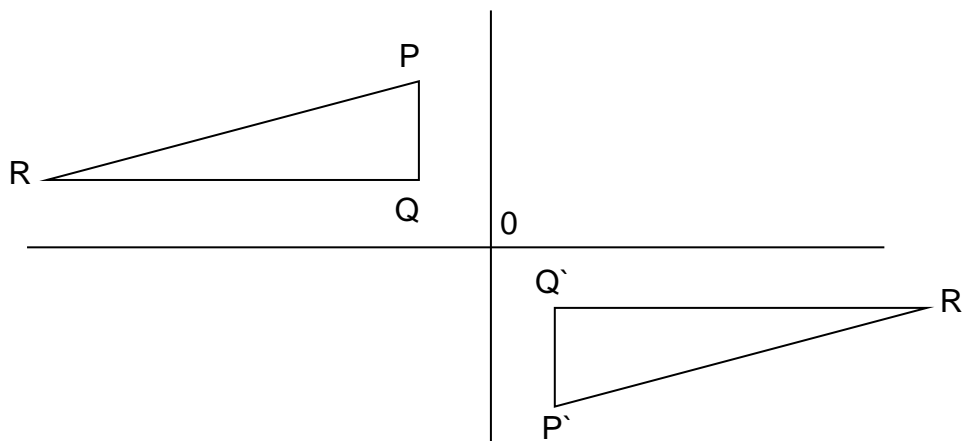
### Example 1
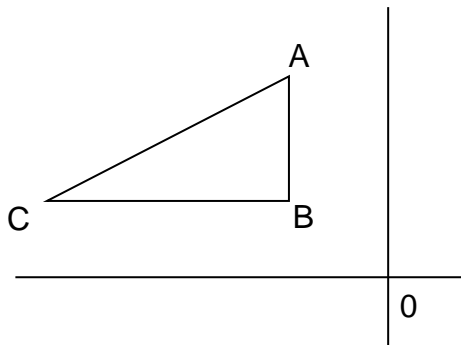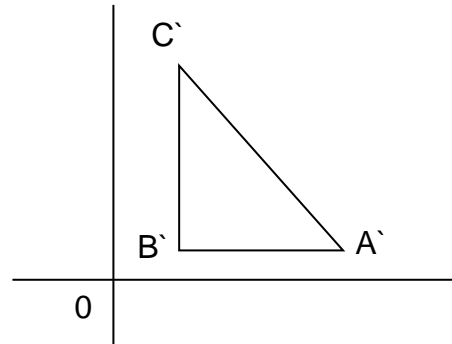


Before Fig (i)                                         After Fig (ii)

Rotate Δ ABC $90^0$ clockwise about O.

You may like to trace fig (i). Put a pin through tracing paper and your original drawing at O and then spin the tracing paper $90^0$.
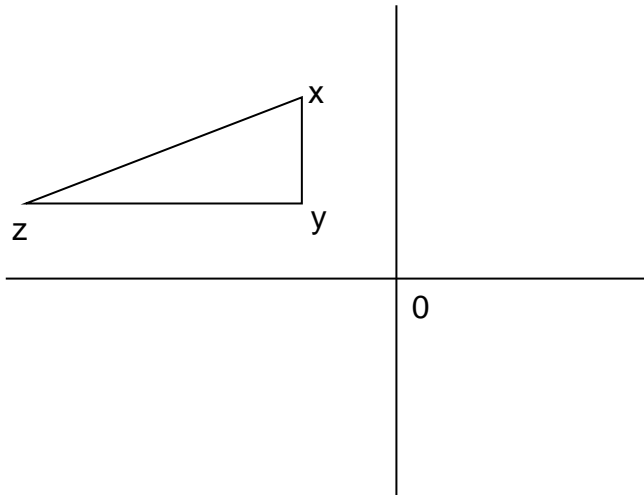
### Example 2

Rotate Δ PQR $180^0$ about O. It can save space to draw the "before" and "after" positions on the same diagram.

**Exercise 4**

1.      Rotate Δ xyz through 90$^0$ anticlockwise about O.



2.      Repeat for a clockwise rotation of 90$^0$ about O.

3.      Repeat for a rotation of 180$^0$ about O.
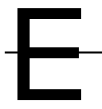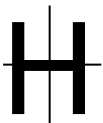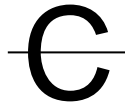
4.      Rotate square ABCD through 90$^0$ clockwise about O.
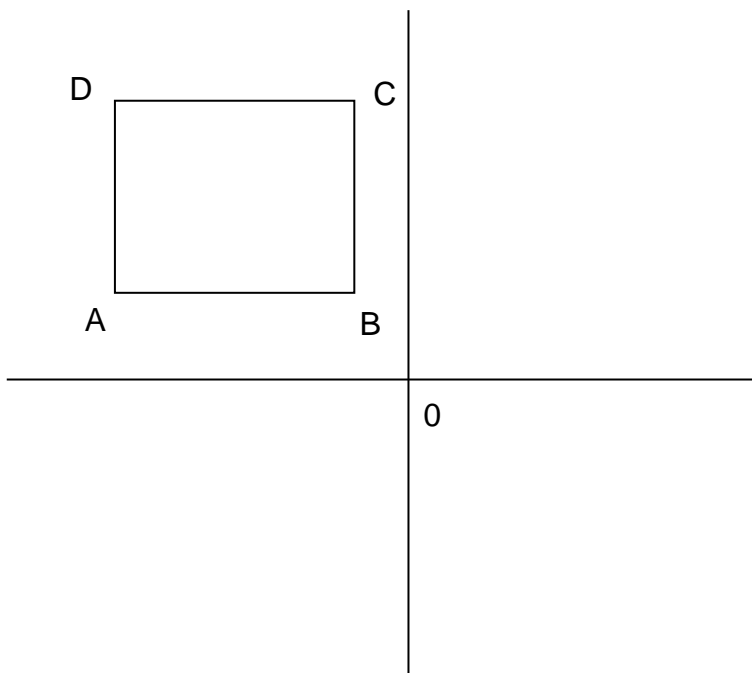


5.      Rotate square ABCD through 90$^0$ clockwise about **D**.

**ANSWERS**

**Exercise 1**

1.

A          C

F  none    X

Z  none    W

S  none    T

H          E

**Exercise 2**

1.     X, Z, S and H have rotational symmetry.
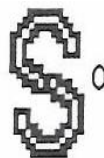


order 2          order 2          order 2          order 2

The letters look the same when turned through $180^0$, and so, have rotational symmetry order 2.

A, C, E, W and T have to be turned around completely, before they look the same, and so, have no rotational symmetry.
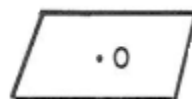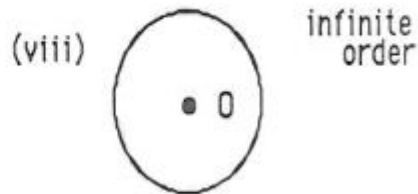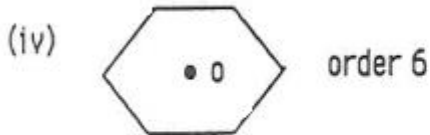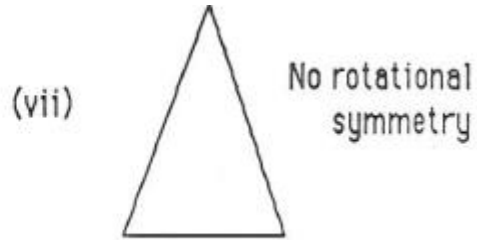
2.

(i)          •O    order 2          (v)     •O    order 2

(ii) order 2

(vi) no rotational symmetry

(iii) order 4
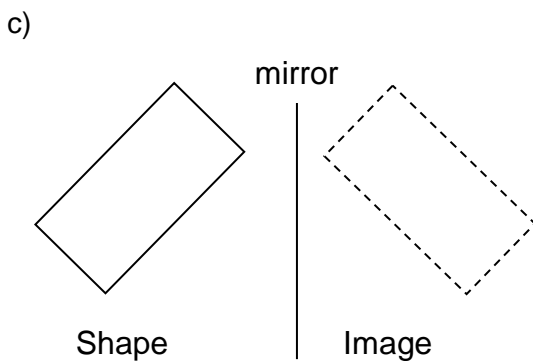
(vii) No rotational symmetry
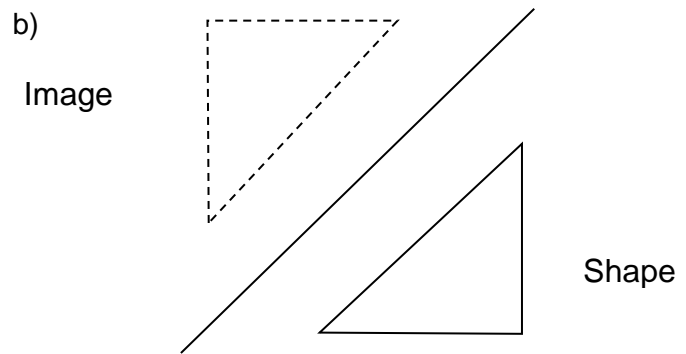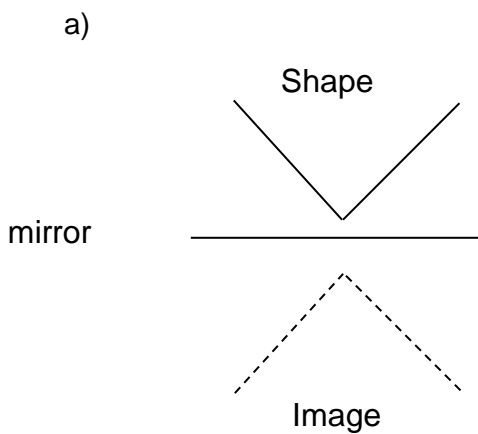
(iv) order 6

(viii) infinite order
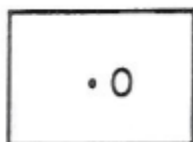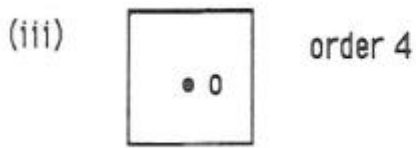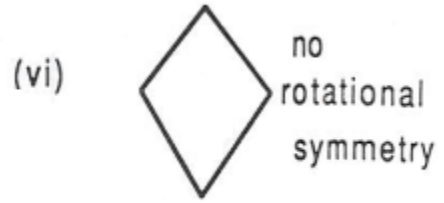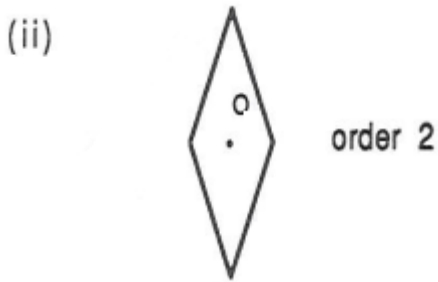
**Exercise 3**
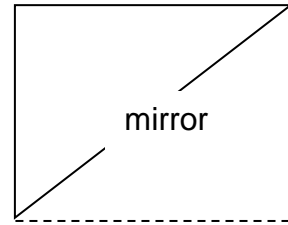
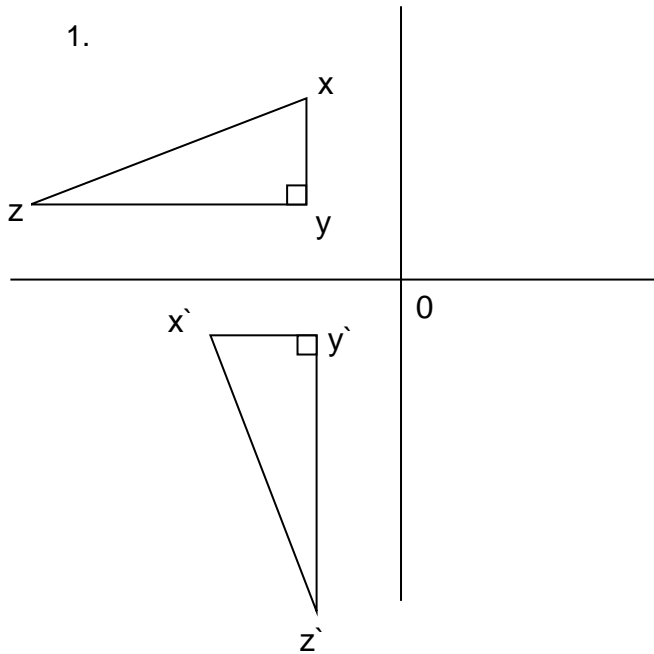1.   (Draw question and answer on **SQUARED** paper.)

a)

Shape

mirror

Image

b)

Image

Shape

c)

mirror

Shape    Image

d)

mirror    Shape

Image

e)

mirror

Shape

Image

f)

Shape

mirror

Image

**Exercise 4**

1.

x

y

z

0

x`

y`

z`

2.

z`

x

z

y

y`

x`

0