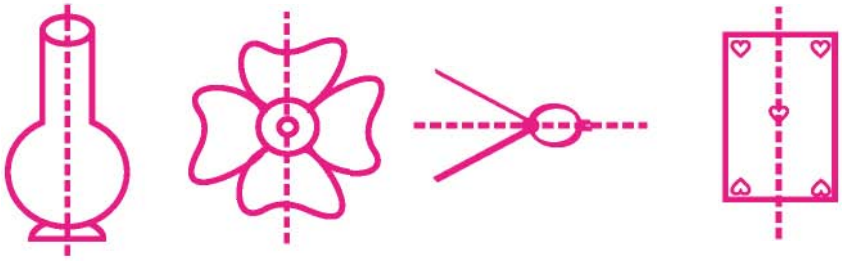
Chapter 11

SYMMETRY

11.1 We see many things, pictures etc. around us. Different types of geometry are seen in all these things.



If these figures may be cut or folded along the line drawn in the center then both the parts superimpose each other completely. Such figures are known as symmetric figures. We studied about symmetric figures, symmetry, and symmetrical axis in the previous classes. In this chapter we will study about identification and formation of symmetrical axis, reflection symmetry and rotational symmetry in the given figures.

Do and Learn

To show symmetry

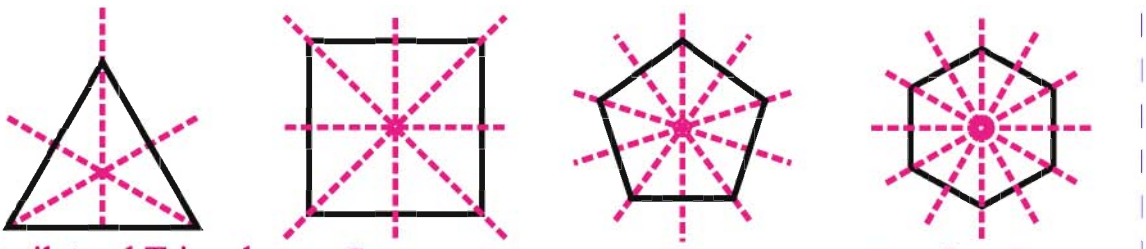
1. Make a diagram showing symmetry.
2. Make some paper cut designs.
3. Make a rangoli.

11.2 Linear Symmetry

The symmetry which we have discussed above is linear symmetry. In these diagrams there is such a straight line about which the figure may be folded so that the two parts of a figure will coincide (superimpose each other). Are you familiar with regular polygon? If no, then try to understand by discussing with your friends and teacher.

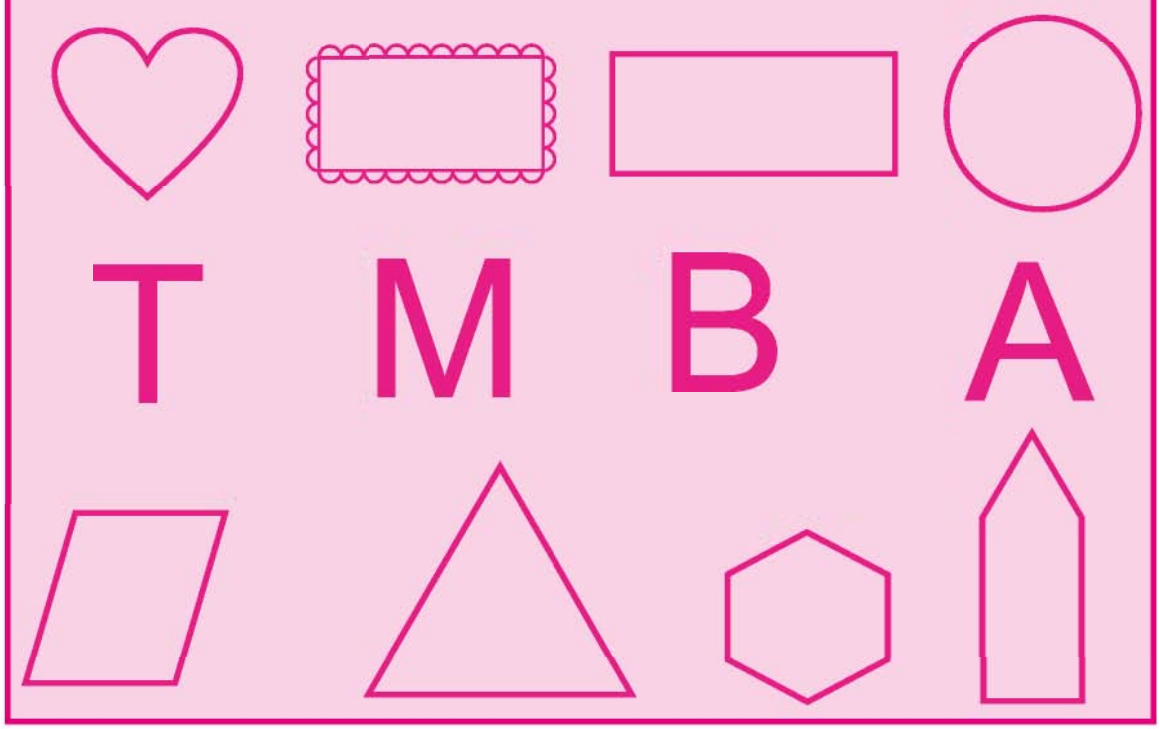
Regular polygons are symmetric figures. This is an interesting conclusion that each regular polygon has as many lines of symmetry as it has sides.

Three symmetric lines **Four symmetric lines** **Five symmetric lines** **Six symmetric lines**



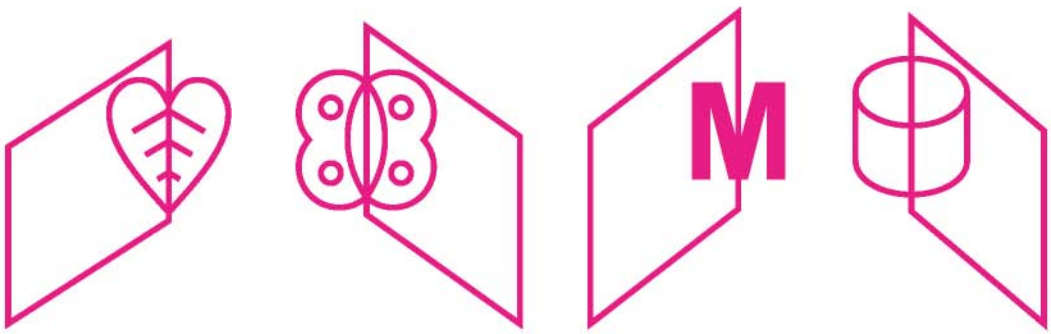
Equilateral Triangle Square Regular Pentagon Regular Hexagon

Do and Learn Draw lines of symmetry in the diagrams given below. figures



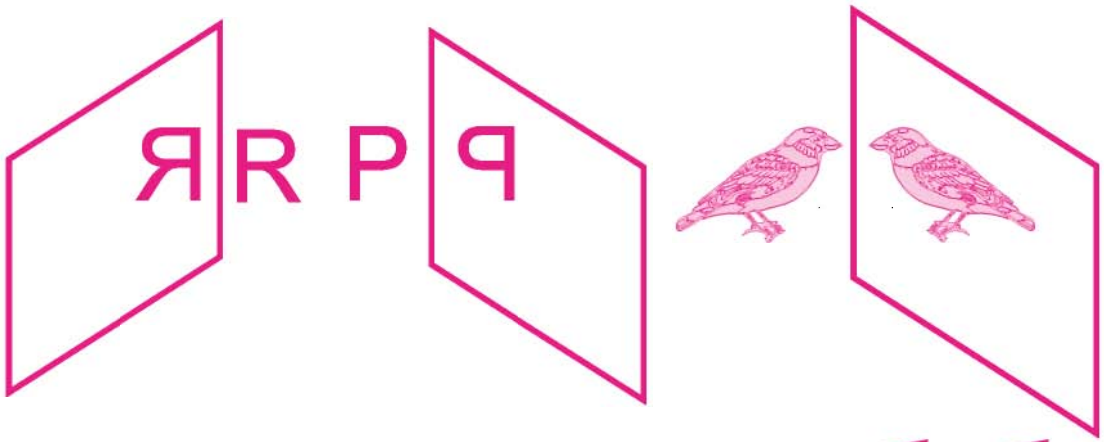
11.3 Reflection Symmetry

Take a plane mirror and see the different things opposite to it. We can see images of things in the mirror. Place the mirror on the diagrams given below such that half portion remains opposite to the mirror. We see that half of the portion lies opposite to the mirror and half of the portion lies in the mirror. On combining both the portions the diagram can be seen completely. This is reflection symmetry. Have a look at these images made in the mirror.



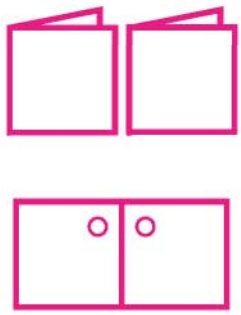
Mirror image of these diagrams is half portion of the diagram. The edge of the mirror is in the form of symmetric axis. Thus the concept of linear symmetry is closely related to reflection in a mirror. A mirror line, thus helps us to visualise a line of symmetry.

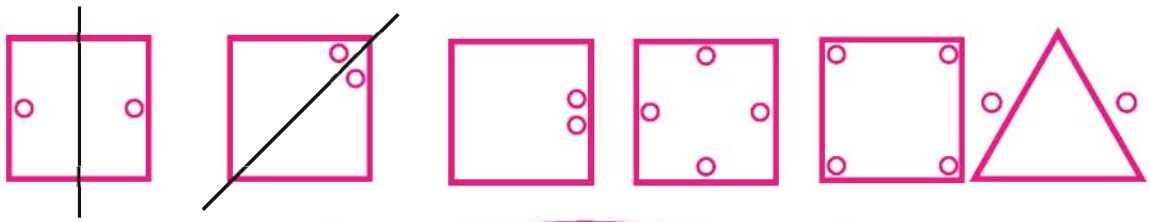
There is a mirror reflection of R,P and bird in the diagram given below. Here left-right changes in the orientations of the figure or its lateral reflection in the mirror reflection can be seen.



Activity

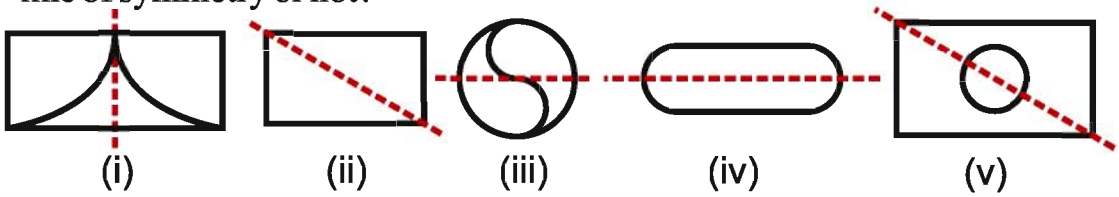
Take a simple quare paper. Fold this paper into two halves as shown in the figure. Now, punch a hole in the paper. Now open the paper. Fold of paper is a line of symmetry and the hole made in the paper is in the form of symmetric figure. Try to find out the line of symmetry in the punched figures which are formed like this.





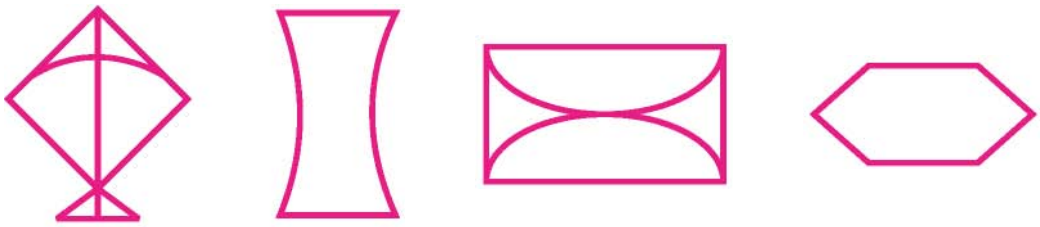
Exercise 11.1

1. There is a dotted line in the figure (s) given below. Find whether this line is line of symmetry or not?



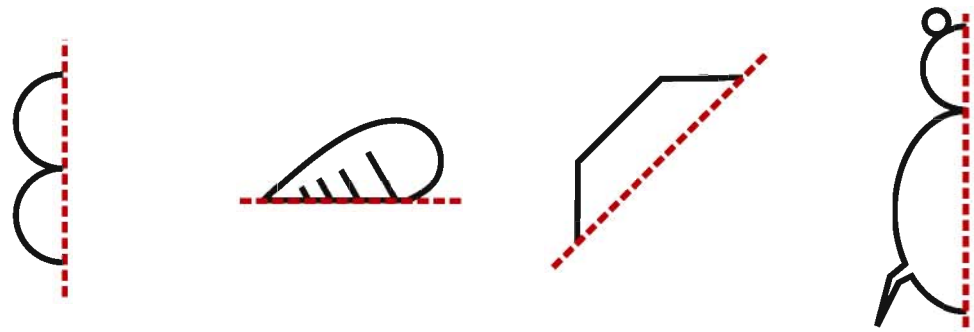
(i) (ii) (iii) (iv) (v)

2. Draw line of symmetry in the figures given below.



(i) (ii) (iii) (iv)

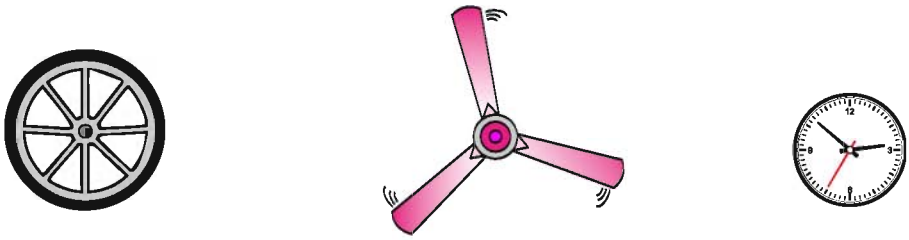
3. Complete the incomplete figure given below along the line of symmetry.



(i) (ii) (iii) (iv)

11.4 Rotational Symmetry

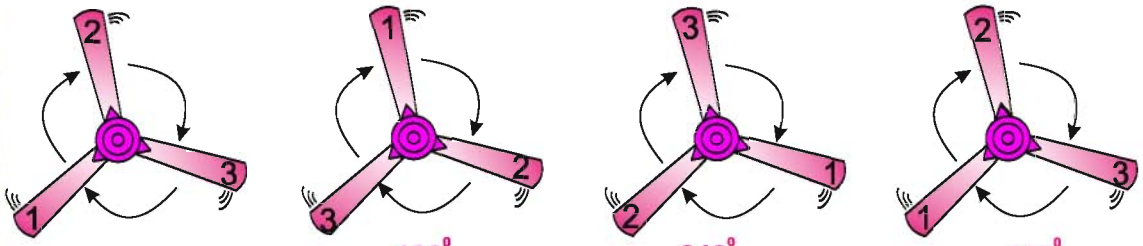
Hands of a clock, the wheel of a bicycle and ceiling fans etc. are said to be in motion when they rotate. The rotation takes place on both the directions in some things, while the hands of a clock rotate in only one direction. The direction in which the hands of a clock move is called clockwise rotation.Otherwise it is said to be anticlockwise rotation. The wheel of a bicycle rotates in both the directions.



Do and Learn

1. Give any two examples of clockwise rotation.
2. Give any two examples of anticlockwise rotation.

Think. Is there any change in size and shape of things like wheel of a bicycle, arms of a clock when they rotate? No. The rotation turns an object about a fixed point without change in size and shape. This fixed point is the center of rotation. The angle of turning during rotation is called the angle of rotation. The angle made on the centre formed by blades of ceiling fan is shown below.



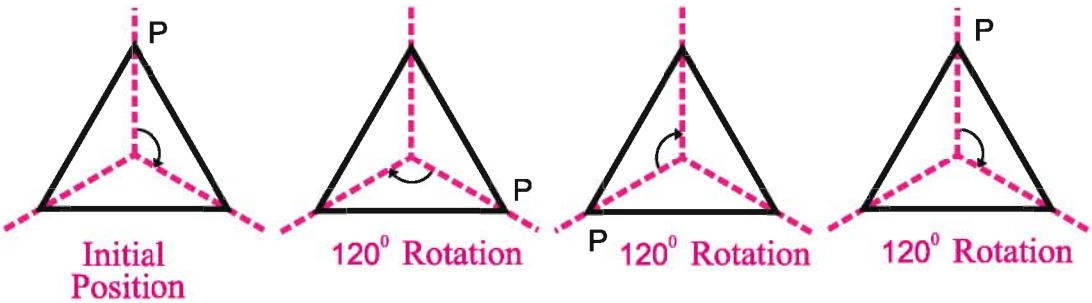
Here we see that on rotating the ceiling fan by 120° the blades look the same. Similarly the position remains same by rotation of 240° and 360°. Hence, we can say that ceiling fan has rotational symmetry and order of rotational symmetry is 3.

In a complete turn (360°) the number of times an object looks exactly the same is called the order of rotational symmetry e.g. In the example of ceiling fan given above the order of rotational symmetry comes out to be 3 as there are 3 same positions in a complete turn. Similarly order of rotational symmetry is 4 in a square.

Every object (shape) comes in its initial position after completing a complete turn means rotating 360°. Hence, order of rotational symmetry is definitely 1 in every object.

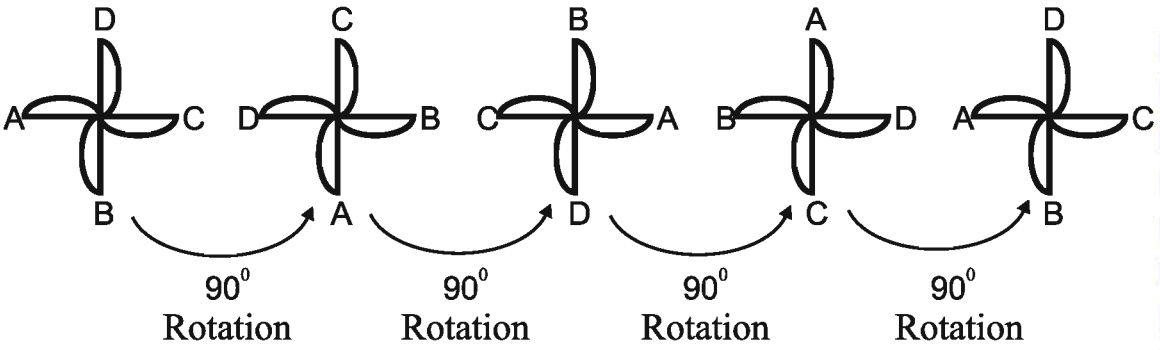
11.4.1Some examples of rotation

An equilateral triangle comes in its initial position three times in a complete turn in clockwise direction. This is known as rotation of third order.The angle of rotation is 120° because after rotating 120° from its initial position, the triangle comes back in its former position, so its angle of rotation is 120°.



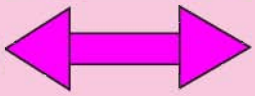
Rotation of disc

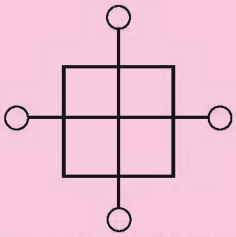
Have a look at the disc. The disc occupies its initial position 4 times in a complete turn. Hence the order of rotation of the disc is 4 and it comes back in its initial position on every 90°. Hence the angle of rotation of the disc is 90°.



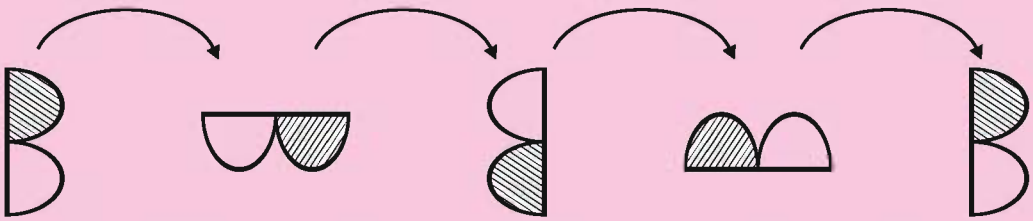
Do and Learn

1. Determine the order of rotation and angle of rotation for the rotational symmetry in the figures given below.

(i) 

(ii) 

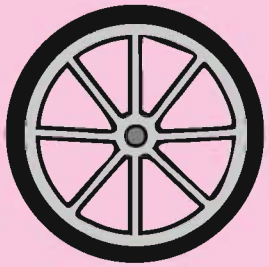
2. Determine the order of rotation, angle of rotation and direction of rotation of B.



3. Have a look of rotational symmetry in cross-section of fruits, traffic signals and wheel etc. Determine the order of rotation of all these.

Cross-section of fruits

Traffic signal



Wheel

Exercise 11.2

1. Determine the order of rotational symmetry in the figures given below.

(i) (ii) (iii) (iv) (v)

2. Give names of 2 such figures which have linear symmetry and rotational symmetry of order more than 1.
3. Name the quadrilaterals which have both linear symmetry and rotational symmetry of order more than 1.
4. After rotating by 60° about its axis, a figure looks exactly the same as its original position. At what other angles will this happen for the figure.

We Learnt

1. A figure has line symmetry, if there is a line about which the figure may be folded so that the two parts of the figure will coincide.
2. Regular polygons have equal sides and equal angles. They have multiple (more than one) lines of symmetry.
3. Each regular polygon has as many lines of symmetry as it has sides.

Regular Polygon	Regular hexagon	Regular pentagon	Square	Equilateral triangle
No. of lines of symmetry	6	5	4	3

4. Mirror reflection leads to symmetry, under which the left-right orientation have to be taken care of.
5. Rotation turns an object about a fixed point. This fixed point is called as centre of rotation. The angle by which the object rotates is the angle of rotation.
6. If, after a rotation, an object looks exactly the same as it was before, we say that it has a rotational symmetry.
7. In a complete turn (of 360°), the number of times an object looks exactly the same as before is called the order of rotational symmetry.