



- Identify the symmetrical objects by observing the environment.
- Draw line of symmetry by examining a planar (2D) geometrical shapes and concept of reflected symmetry

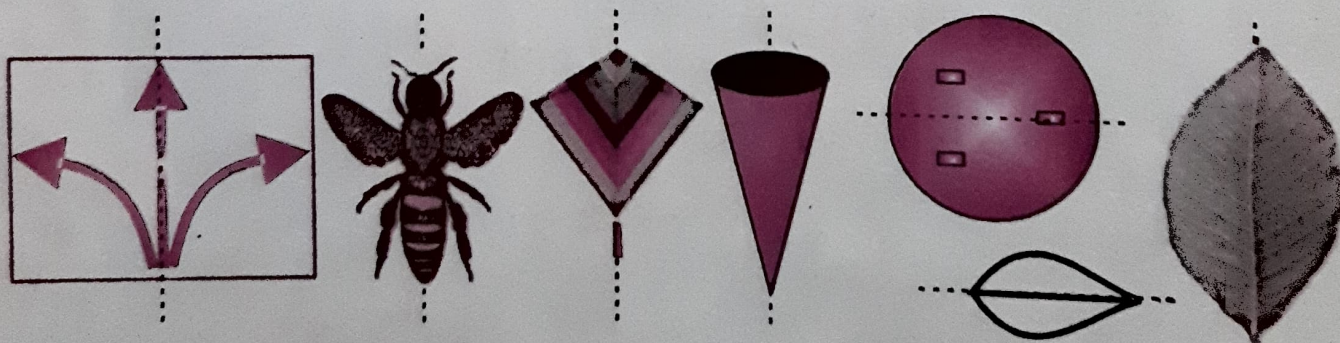
15.1 Introduction

You see many objects and living things of nature around you in day to day life. Observe your own physical structure. If you draw a line from top of the head going between the eyes and nose to the feet below, you observe that figures on the both sides are similar to each one. This type of feature is commonly found in all living organism. You can see leaves of mango, peepal, banana, ashok etc., generally in daily life. There is a thick sturdy ridge between the leaves, which have similar features on both the sides.

These figures are called symmetrical shapes relative to the middle ridge. The ridge itself is called axis of symmetry.

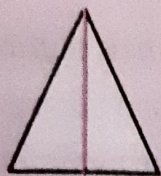
Look at these shapes carefully, if each figure is at the middle, folded relative to the drawn line one part covers the other completely, or if you place a plane mirror on the folded line, the image of one part of the figure covers the other completely. Such types of shapes are called symmetrical shapes. The curve or line is called symmetric line, axis of symmetry or mirror line. We can classify symmetrical objects into two parts on the basis of numbers of symmetric axes.

1. A symmetric axis shapes

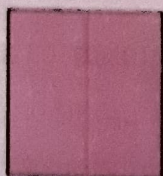


Let's Practise :

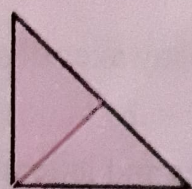
Draw four figures on the page of your exercise book and show the axis of symmetry. The axes of symmetry are shown in the figure by dotted lines. How many more axis of symmetry can be drawn in which figure ? Show them.



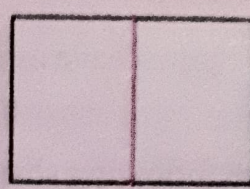
Isosceles triangle



Square

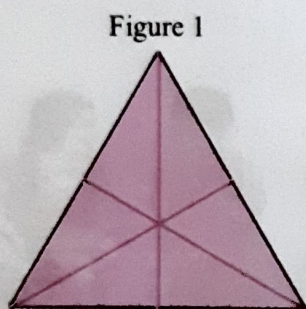


bilateral right angled triangle

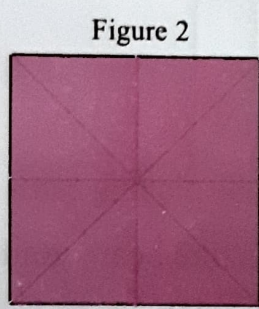


Rectangle

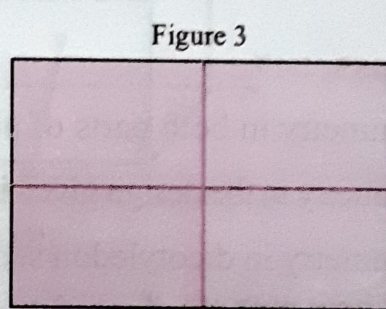
1. Many symmetrical axis shapes



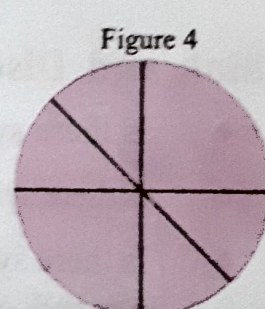
Equilateral



Sqaure



Rectangular



Circle

Let's Understand :

Observe the the shapes with two or more axes of symmetry.

Try it :

Count and tell the number of symmetric lines in the given figure. Does it give a sense of the reflection symmetry ?

Look at the following objects :

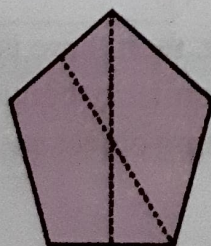


Figure 1

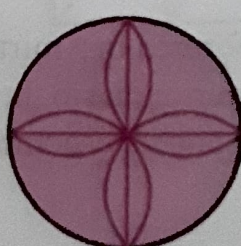


Figure 2

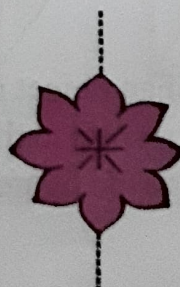


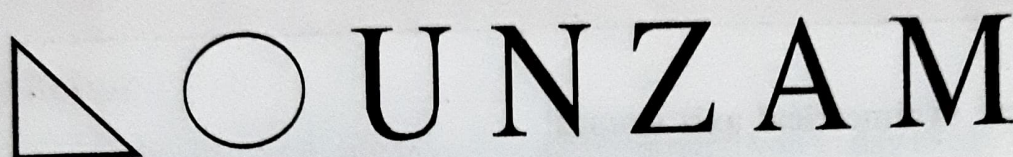
Figure 3

Two axes of symmetries have been drawn in Fig. 1. How many more axes of symmetry can be drawn in this figure? Trace a regular pentagon with its all symmetric axes similar to Fig. 1. In the same way Trace shapes like Fig. 1 and Fig. 3. in your practise book and draw their possible axis of symmetry.

Pay Attention

All regular figures have as many axes of symmetries as their number of sides. Check it yourself and see.

Observe the following shapes and letters and identify the symmetrical objects among them. Trace the symmetrical objects in your exercise book and draw their axes of symmetries.



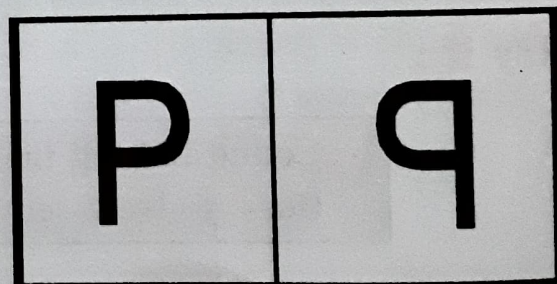
Think and Discuss :

- Is there symmetry in both parts of part ?
- Is there symmetry in the design given in the playing cards ?
- Is there symmetry in dicotyledon seeds like bean, gram, almond, cashew nuts etc. ?
- Draw a imaginary line through the middle of your body from top of the head to the feet. Is there symmetry in both your parts?



15.2 Image and Symmetry :

Observe the image obtained by placing an object in front of a mirror. What you see ? Is there similarity between object and image ? Where are the symmetric lines ?



Pay Attention

When an image of an object is formed in a mirror, then there is no change in the size and angles of image. i.e., respect to the mirror due to the similarity between the size and angles of the object and the image the figure obtained by combining object and image is symmetrical with.

Symmetry in three dimensional structures

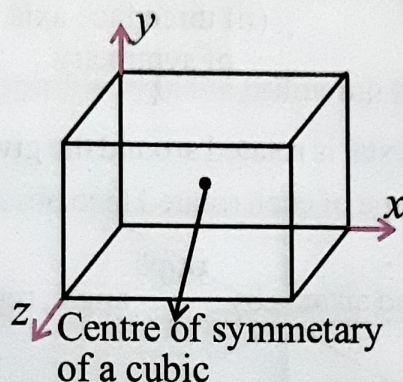
As per our study about symmetry on 2-D structures in the chapter of symmetry we will now study about symmetry on 3-D structures.

For this we have to know about centre of symmetry, plane of symmetry and axis of symmetry in 3-D structures.

Centre of symmetry:

In any crystal or solid body, an imaginary point whose distance from each point of its surface and vertices is same called centre of symmetry of it.

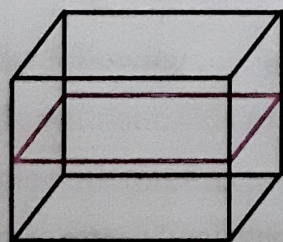
In adjacent figure centre of symmetry of a cuboidal crystal is shown.



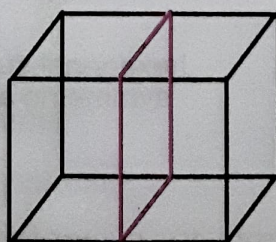
Note: Any solid shape or crystal will have either only one point of symmetry or no point of symmetry.

Plane of Symmetry:

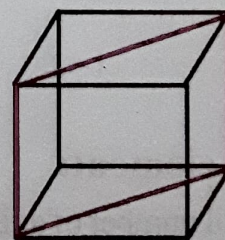
An imaginary plane passing centre of crystal or solid shape which divides it into two equal parts is called plane of symmetry to it. In other words if this plane is plane mirror two parts obtained will be images to each other.



(i) Horizontal Plane of symmetry in a cubical crystal



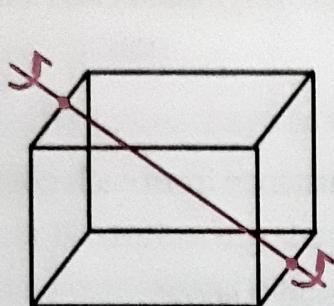
(ii) Vertical Plane of symmetry in a cubical crystal



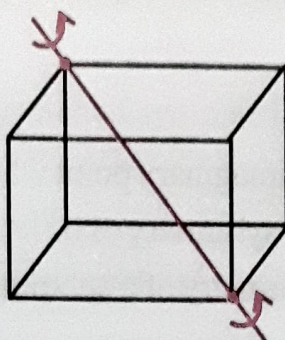
(iii) diagonal plane of symmetry in a cubical crystal

Axis of symmetry:

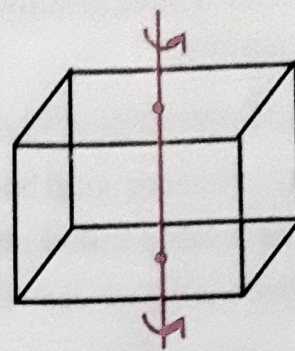
It is also named as axis of rotation. It is an imaginary line passing through the crystal such that if crystal is rotated about it then a complete rotation is observed same in every repetition.



(i) two face axis of symmetry



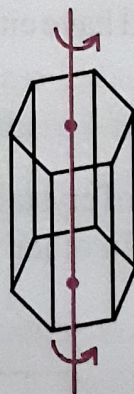
(ii) three face axis of symmetry



(iii) four face axis of symmetry

In the adjacent figure if crystal is rotated around the given axis then equal shape is observed in every rotation and shape of each rotated face observed is same.

If a crystal is rotated around an axis by $\frac{360^\circ}{x}$ angle, repeats it in same manner then x is called fold/face of that axis.



hexagonal surface symmetric axis

Symmetry element:

Sum of all number of axis of symmetry; plane of symmetry and centre of symmetry in any crystal or solid shape is called symmetry element of that crystal or solid shape.

i.e.

$$\text{Symmetry Element} = \text{No. of axis of symmetry} + \text{No. of plane of symmetry} + \text{No. of centre of symmetry}$$

In case of a cube crystal

No. of plane of symmetry = 9

No. of centre of symmetry = 1

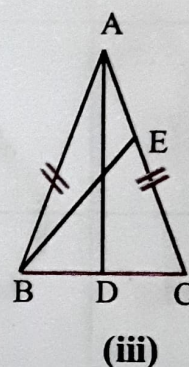
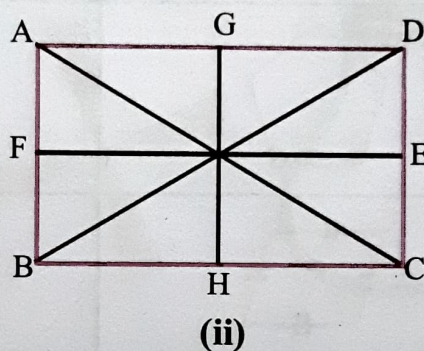
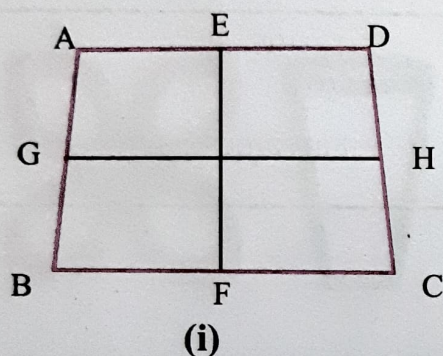
No. of axis of symmetry = $3 + 4 + 6 = 13$

$\therefore$ In a cube crystal total No. of symmetrical element = $9 + 1 + 13$
= 23

$\therefore$ A cube crystal has 23 symmetry element.

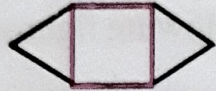
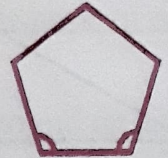
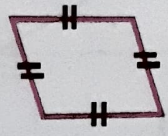
Exercise 15

1. Write capital letters of English alphabet. Identify the axis of symmetry among the symmetrical letters.
2. Identify and write all axes of symmetry in the following figures :

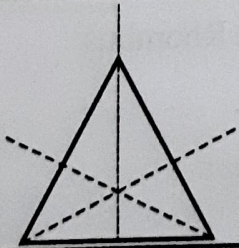


3. How many axes of symmetry are there in the following :
(i) Equilateral triangle
(ii) Isosceles triangle
(iii) Square
(iv) Rhombus
(v) Circle
4. Construct the following :
(i) A triangle with one axis of symmetry.
(ii) A triangle with three axes of symmetry.
(iii) A triangle with no axis of symmetry.
5. Draw a regular hexagon and draw all its axes of symmetry.
6. Identify the symmetrical objects by examining them in the environment and make a list of them.

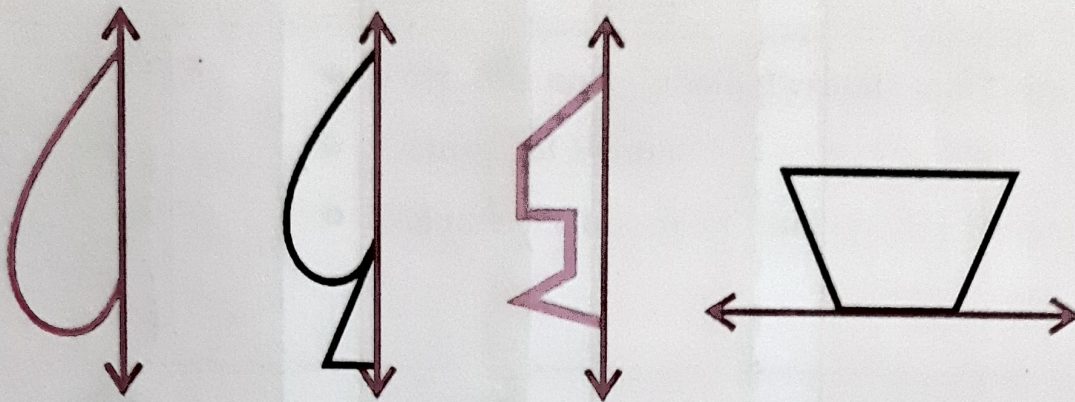
7. Complete the following table :

S.No.	Figure	No. of axes of symmetry
(i)		
(ii)		
(iii)		
(iv)		
(v)		

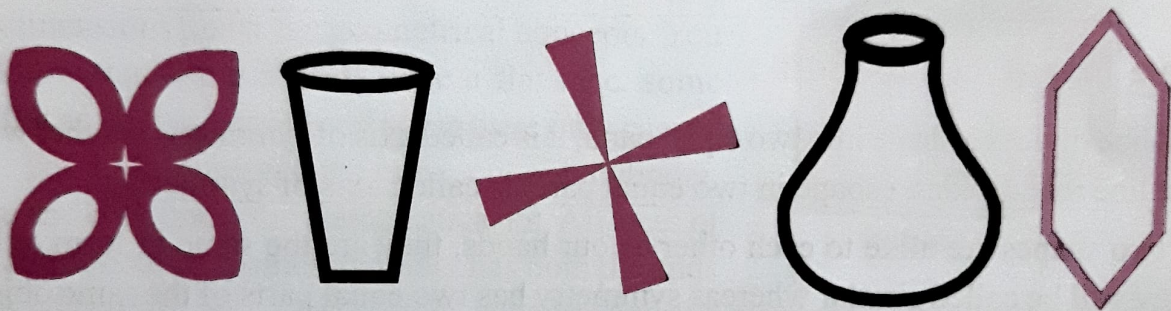
8. Complete the following table :

Object	Figure	No. of axes of symmetry
Equilateral triangle		
Square		
Rectangle		
Isosceles triangle		
Rhombus		
Circle		

9. List ten symmetrical objects of your home and school that are symmetrical.
10. Complete the following symmetrical figures :



11. Draw symmetric lines in the following figures and find out their number.



Activity

1. Take a rectangular piece of paper and fold it from the length side in such a way that one part of it is completely covered the other part. Is this fold an axis of symmetry ? Why ? Open it, and fold it again from the breadth side in the same way. Is second fold, also the axis of symmetry too ? Why ?

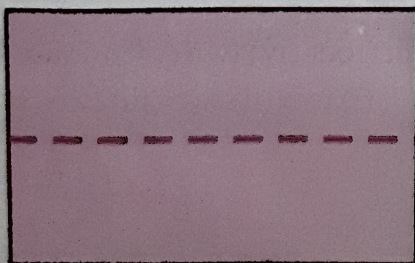


Fig. 1 : First Fold

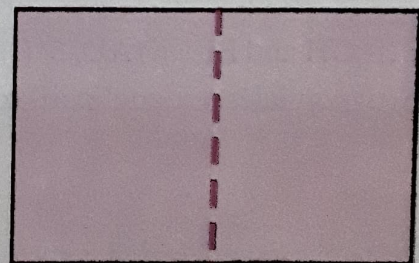
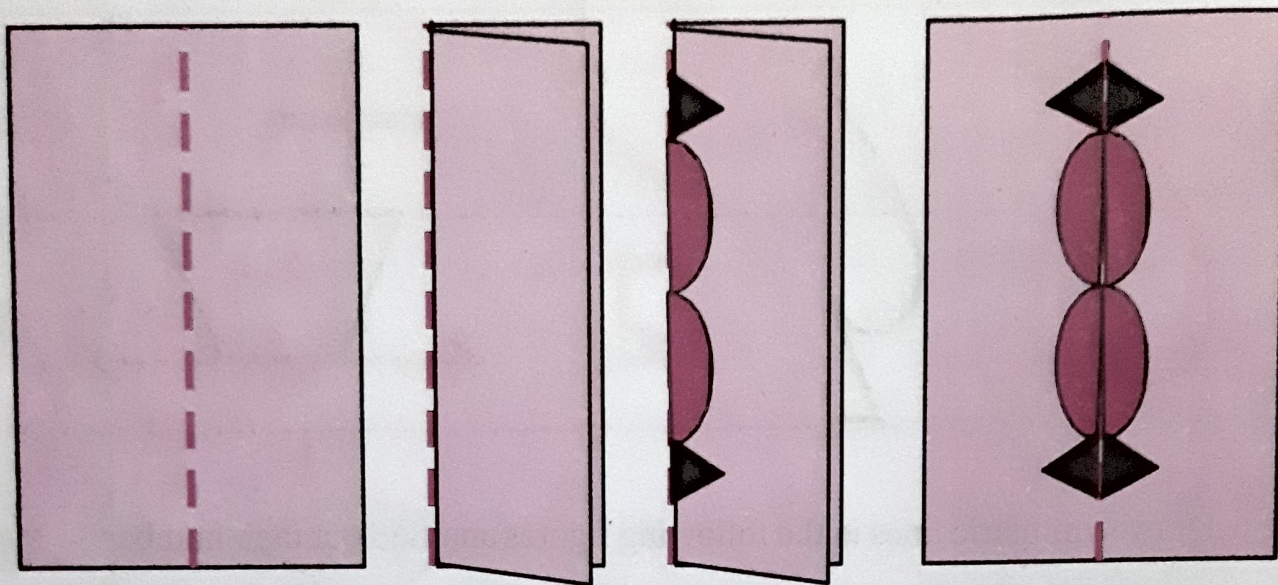


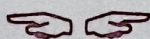
Fig. 2 : Second Fold

2. Fold and cut it as shown in the figure and observe, is the shape symmetrical ?



We have learnt in this unit :

1. If a line divides a shape into two equal parts, it is called axis of symmetry. In other words, the line that divides a shape in two equal parts is called axis of symmetry.
2. If two shapes are alike to each other as our hands, they are the same in form or size, they will be called similar whereas symmetry has two equal parts of the same object.
3. Symmetry has great importance in our daily life. Like art, crafts, creation of different types of designs, symmetry of the beauties of the nature has contributed a lot. If it would be removed, the beauty of the world will be finished.



ANSWERS

Exercise 15

2. (i) EF (ii) GH and EF (iii) AD, 3. (i) three (ii) one (iii) four (iv) two (v) infinite; 4. (i) isosceles triangle (ii) equilateral triangle (iii) scalene triangle; 7. (i) two (ii) two (iii) two (iv) five (v) two.

