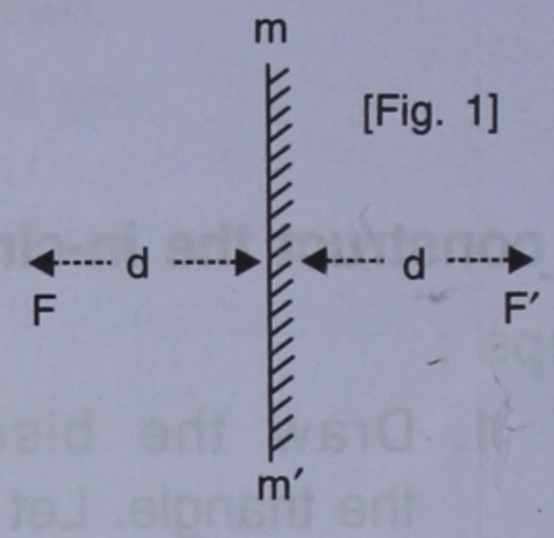
CHAPTER 22

LINEAR SYMMETRY

(Including Constructions On Symmetry)

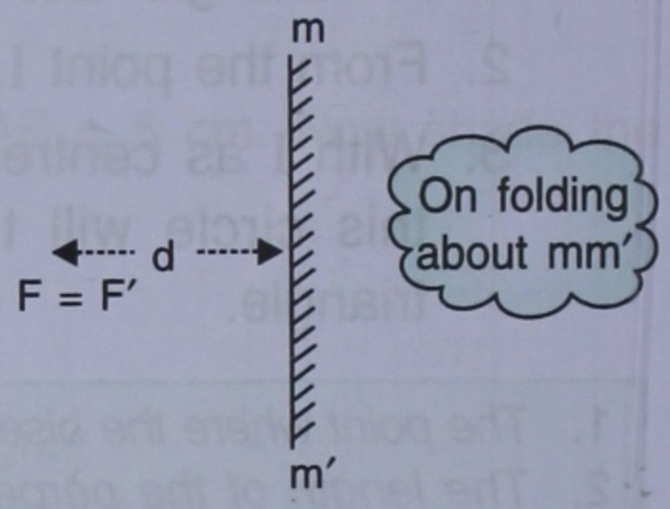
22.1 CONCEPT OF SYMMETRY (LINEAR SYMMETRY)



[Fig. 1]

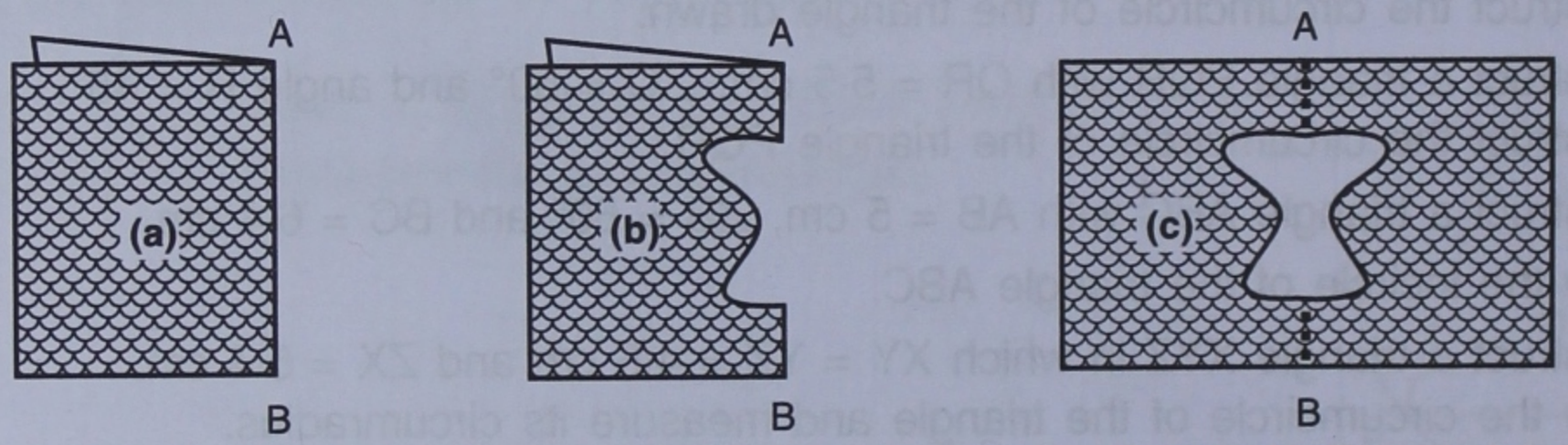
Consider a plane mirror *mm′*. If an object *F* is kept at a distance 'd' in front of the mirror; the image of the object, *F′* as seen in the mirror, is formed at distance 'd' behind the mirror.

Now, if Figure 1, given alongside, is folded about the mirror *mm′*, the object *F* and its image *F′* coincide. Since the two parts of the figure coincide when the figure is folded along the mirror line *mm′*, we say that the figure is symmetrical about the mirror line *mm′*. For this reason, the mirror line *mm′* is called the **line of symmetry** of the whole figure, *i.e.* the object *F*, its image *F′* and the mirror *mm′* taken as a whole.



Making the concept more clear :

Fold a rectangular piece of paper as shown in Figure (a) below. Then cut a piece of any design from the folded side of the paper as shown in Figure (b) below.



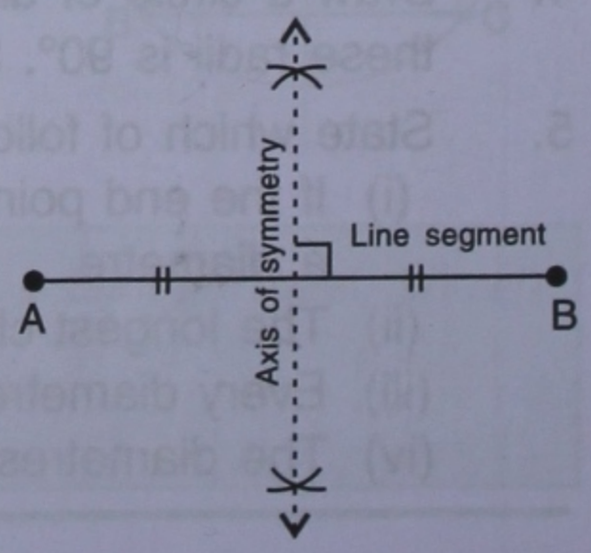
When we unfold the paper, there emerges a design, as shown in Figure (c) above. It is clear that the pattern of the design is identical on both the sides of the folding line (crease) of the paper, as shown here by the dotted line AB. So, AB is the line of symmetry here.

A figure that is identical on both the sides of a line in it is said to be *symmetrical about that line*, and *the line* about which the figure is *symmetrical* is called the *line of symmetry* or the *axis of symmetry*.

In order to find whether or not a given figure is symmetrical about a line in it, fold the figure about that line. If the part of the figure that lies on one side of the line coincides with the part of the figure on the other side of the line, the figure is symmetrical about that line.

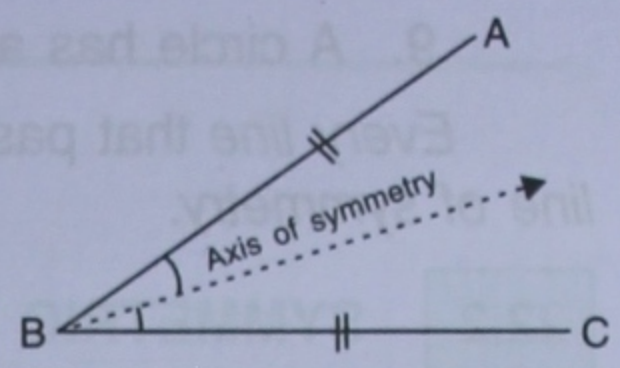
Examples :

1. A *line segment* is *symmetrical* about its *perpendicular bisector.*

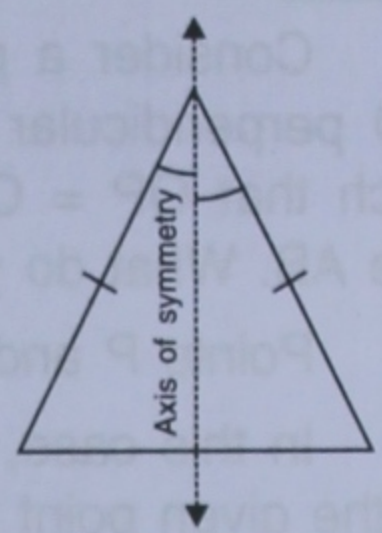


2. An *angle* (with equal arms) is *symmetrical* about its *bisector.*

In each figure, the line of symmetry is represented by the dotted line

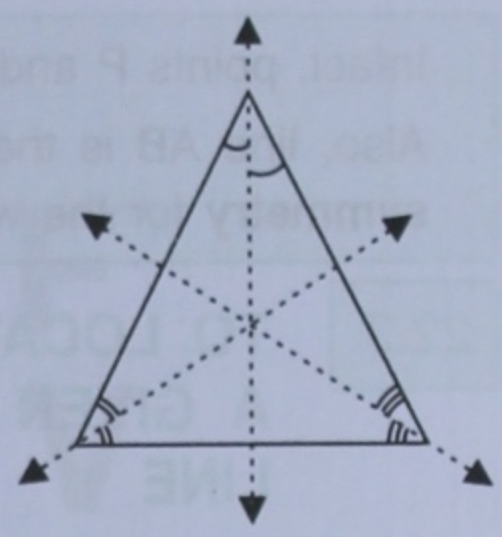


3. An *isosceles triangle* has *one line of symmetry.* The line of symmetry is the bisector of the angle contained by the two equal sides.



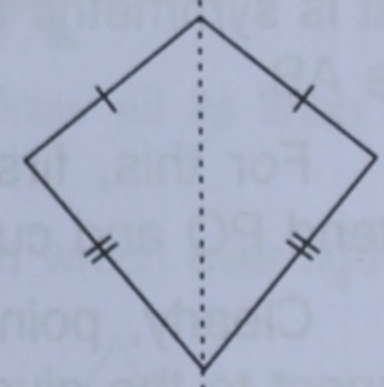
4. An equilateral triangle has *three lines of symmetry.* Each of the three *bisectors* of *angles* is a line of symmetry.

A scalene triangle has no line of symmetry

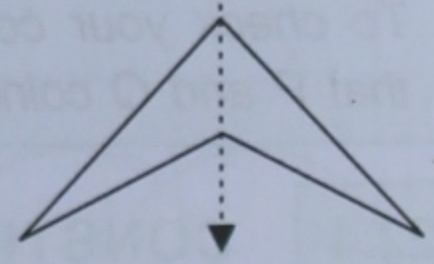


A figure may have many lines of symmetry, e.g. a circle.

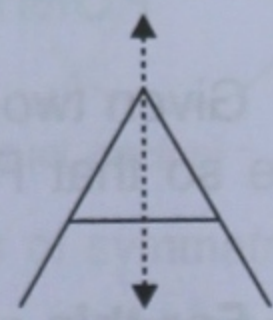
5. A *kite-shaped* figure has *one line* of symmetry.



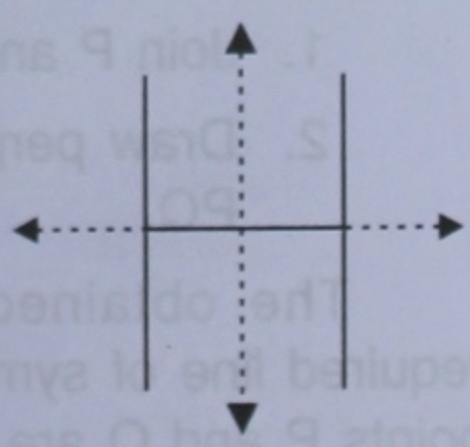
6. A figure of the shape of an *arrow-head* has *one line of symmetry.*



7. The letter 'A' has *one line of symmetry.*

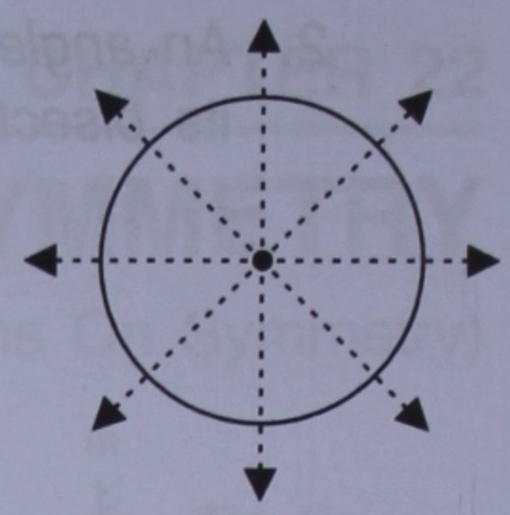


8. The letter 'H' has *two* lines of symmetry.



9. A circle has an *infinite* number of *lines* of *symmetry*.

Every line that passes *through the centre of a circle* is a *line of symmetry*.

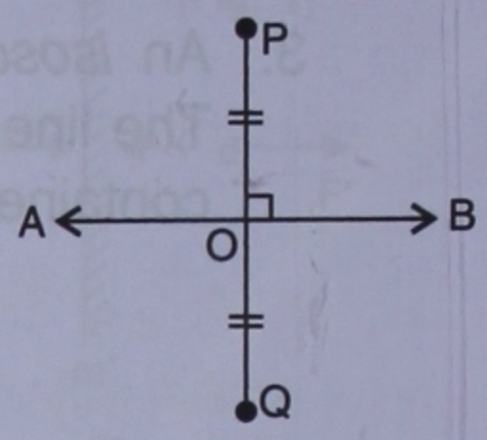


22.2 SYMMETRIC POINT

Consider a point P and a line AB. From point P, draw PO perpendicular to AB and then extend PO up to point Q such that OP = OQ. Now fold the figure obtained about the line AB. What do you observe ?

Points P and Q coincide.

In this case, point Q is said to be the **symmetric point** of the given point P with respect to the given line AB.

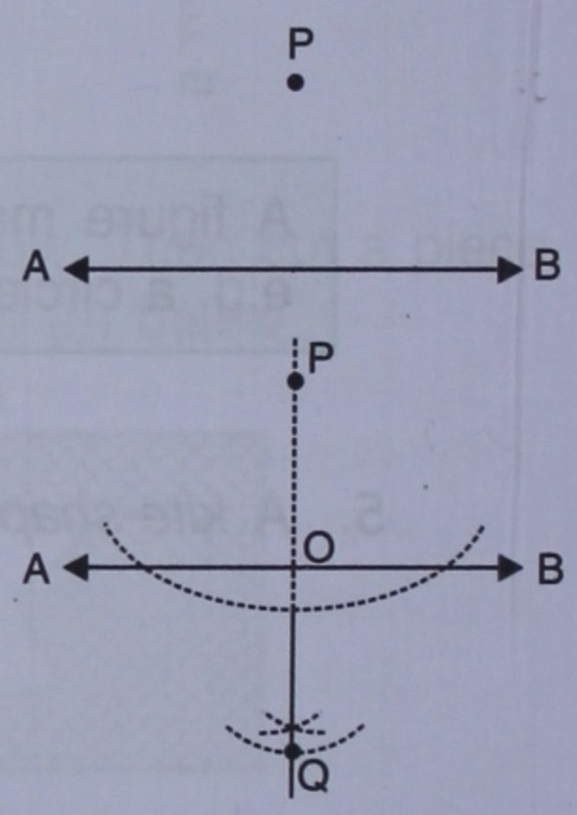


Infact, points P and Q are symmetric to each other with respect to the line AB.

Also, line AB is the perpendicular bisector of the line segment PQ. **Line AB is the line of symmetry** for the whole figure obtained.

22.3 TO LOCATE A POINT THAT IS SYMMETRIC TO A GIVEN POINT WITH RESPECT TO A GIVEN LINE

Given a point P and a line AB, we want to find the point that is symmetric to the given point P with respect to the given line AB.



For this, first draw PO perpendicular to AB, and then extend PO and cut OQ = OP.

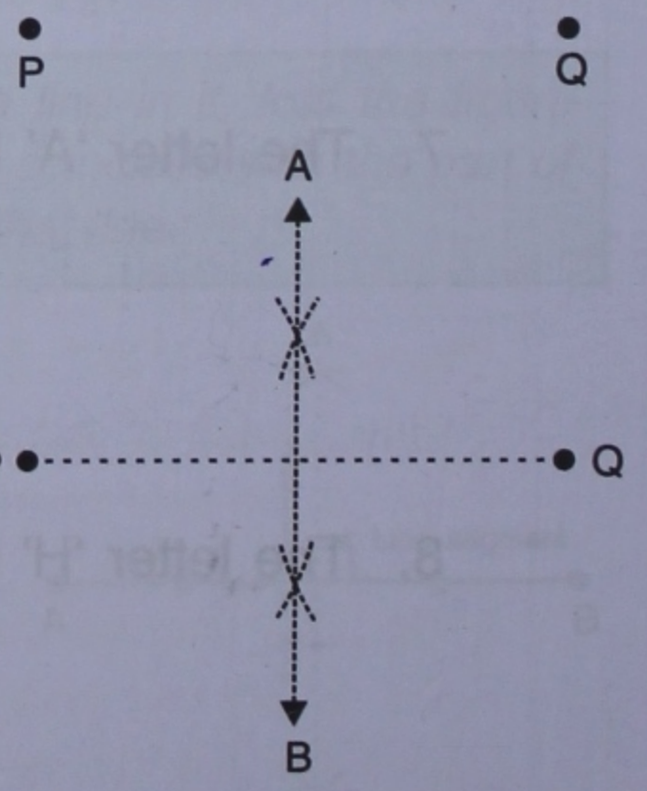
Clearly, point Q is symmetric to the given point P with respect to the given line AB.

Thus, AB is the line of symmetry.

To check your construction, fold the figure about the line of symmetry AB; you will find that P and Q coincide, i.e. they occur at the same point.

22.4 CONSTRUCTING THE LINE OF SYMMETRY WHEN TWO FIXED POINTS ARE SYMMETRIC WITH RESPECT TO THE REQUIRED LINE

Given two fixed points P and Q, we want to construct a line so that P and Q are symmetric with respect to this line.

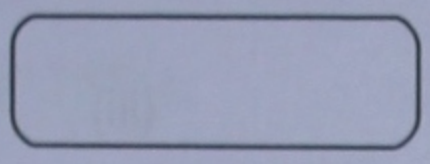
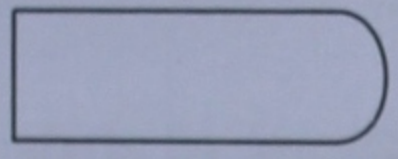


For this :

1. Join P and Q.
2. Draw perpendicular bisector of the line segment PQ.

The obtained perpendicular bisector AB is the required line of symmetry, *i.e.* with respect to AB, the two points P and Q are symmetric.

EXERCISE 22

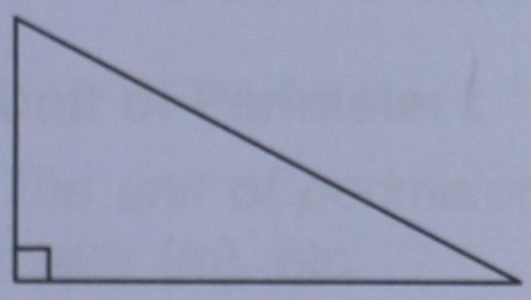
1. State **true** or **false** :
   (i) The letter B has one line of symmetry.
   (ii) The letter F has no line of symmetry.
   (iii) The letter O has only two lines of symmetry.
   (iv) The figure  has no line of symmetry.
   (v) The letter N has one line of symmetry.
   (vi) The figure  has one line of symmetry.
   (vii) The letter D has only one line of symmetry.
   (viii) A scalene triangle has three lines of symmetry.

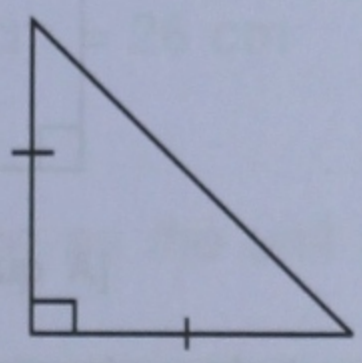
2. Draw all the possible lines of symmetry if for each of the following letters,

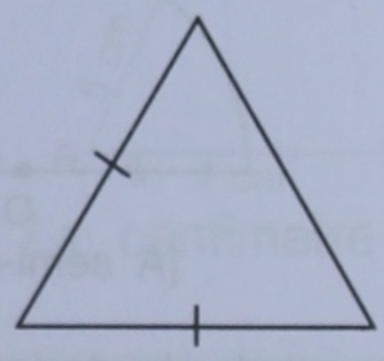
(i) **C**	(ii) **E**	(iii) **F**
(iv) **I**	(v) **K**	(vi) **V**
(vii) **M**	(viii) **Y**	(ix) **X**

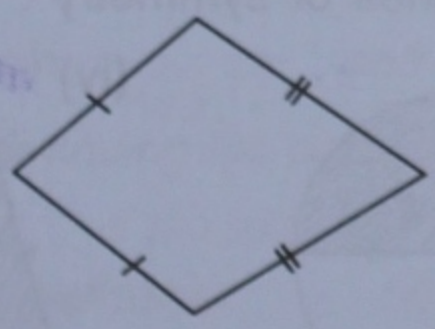
3. Construct a triangle ABC in which AB = AC = 5 cm and BC = 6 cm. Draw all its lines of symmetry.

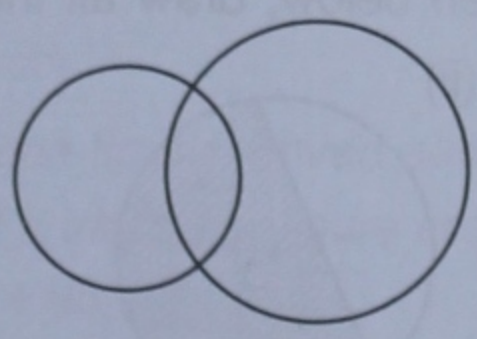
4. Examine each of the following figures carefully, draw line(s) of symmetry in which ever figure possible :

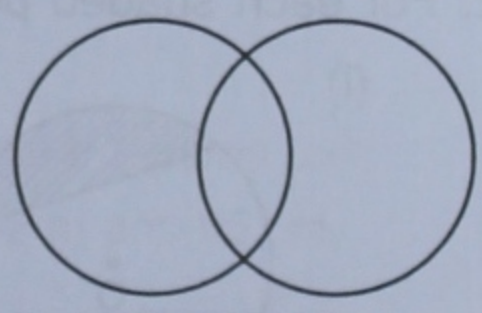
(i) 

(ii) 

(iii) 

(iv) 

(v) 

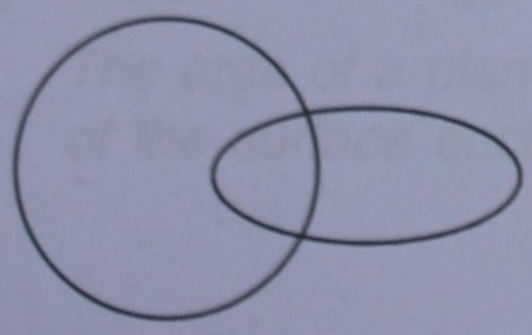
(vi) 

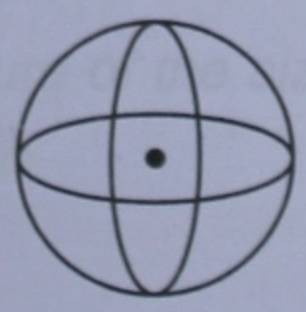
[Equal circles]

5. Construct a triangle XYZ in which XY = YZ = ZX = 4·5 cm. Draw all its lines of symmetry.

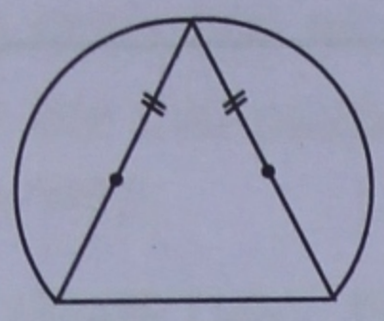
6. Construct a triangle ABC in which AB = BC = 4 cm and ∠ABC = 60°. Draw all its lines of symmetry.

7. Draw the line(s) of symmetry for each figure drawn below :

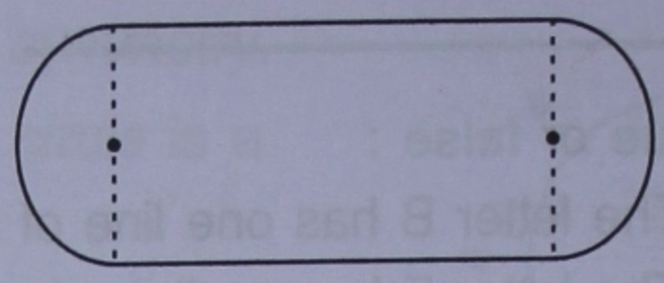
(i) 

(ii) 

(iii)

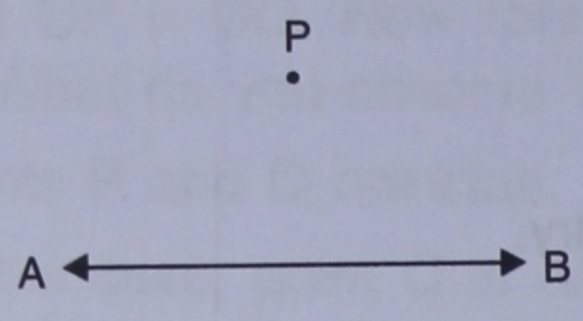


(iv)

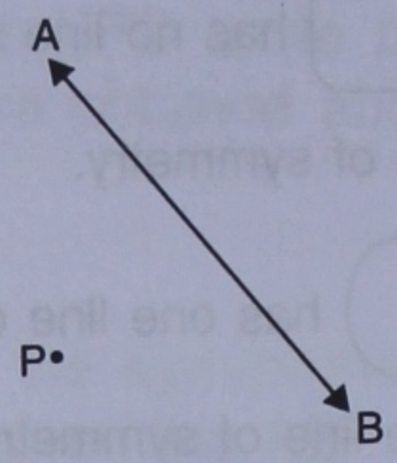


8. In each of the following case, construct a point that is symmetric to the given point P with respect to the given line AB.

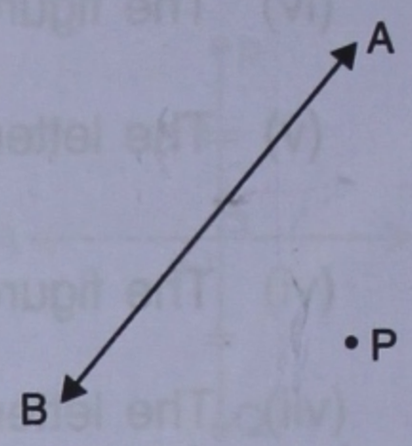
(i)



(ii)



(iii)

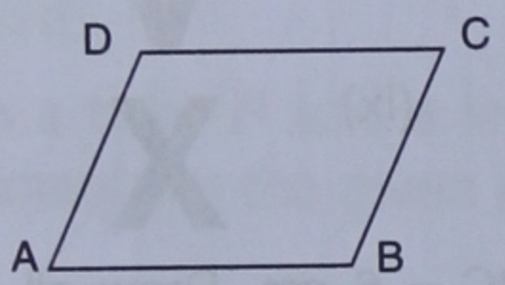


9. Mark two points A and B 5·5 cm apart. Draw a line PQ so that A and B are symmetric with respect to the line PQ. Give a special name to line PQ.

10. For each letter of the English alphabet, draw the maximum possible number of lines of symmetry.

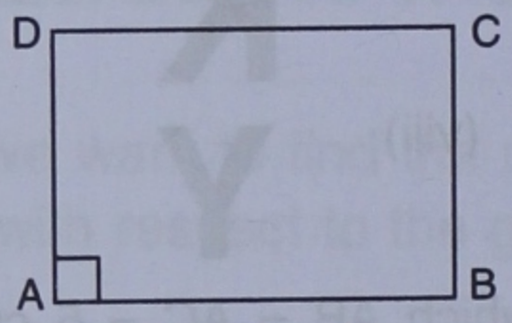
11. Draw all the possible lines of symmetry for each figure given below :

(i)



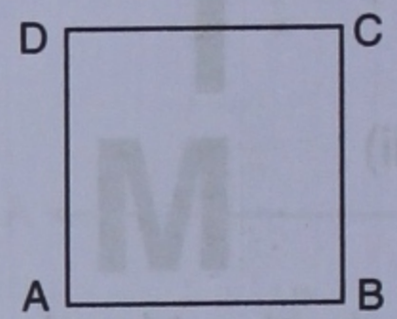
[Parallelogram]

(ii)



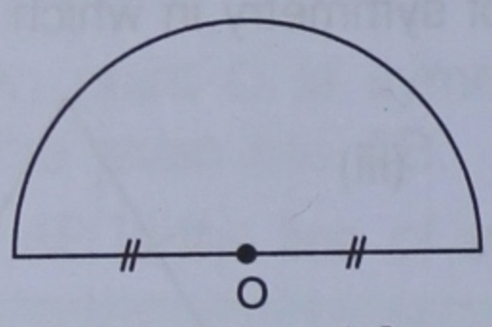
[Rectangle]

(iii)



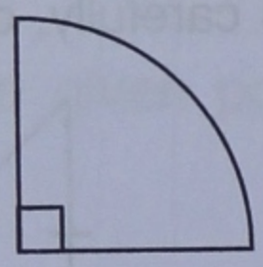
[Square]

(iv)



[A semi-circle]

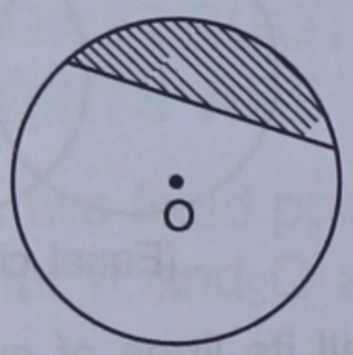
(v)



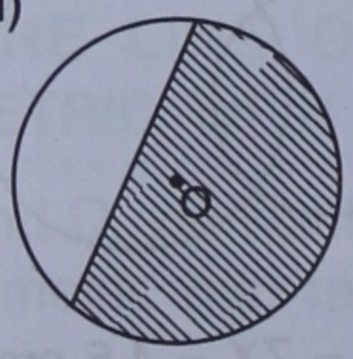
[A quadrant]

12. For each shaded portion given below, draw all the possible lines of symmetry :

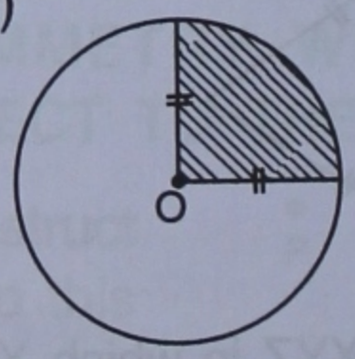
(i)



(ii)



(iii)



(iv)