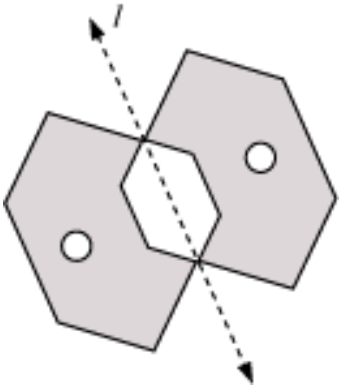
Symmetry

- A figure is said to be symmetrical, if it is in an evenly balanced proportion.
- A figure has line of symmetry, if a line can be drawn dividing the figure into two identical parts in such a way that the two parts are image to each other with respect to the line. The line is called the **line of symmetry.**

  Example:

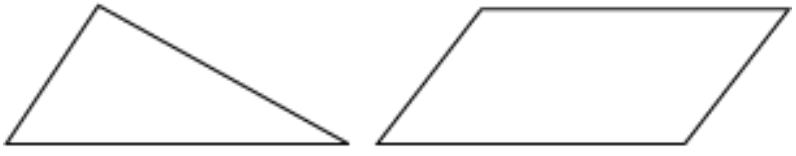


In this figure, the line *l* divides the above figure into two identical parts such that the two parts are image to each other with respect to the line. This line *l* is known as the line of symmetry. So, this figure has a line of symmetry.

- A figure may have no line of symmetry, only one line of symmetry, or multiple lines of symmetry.

  Example:

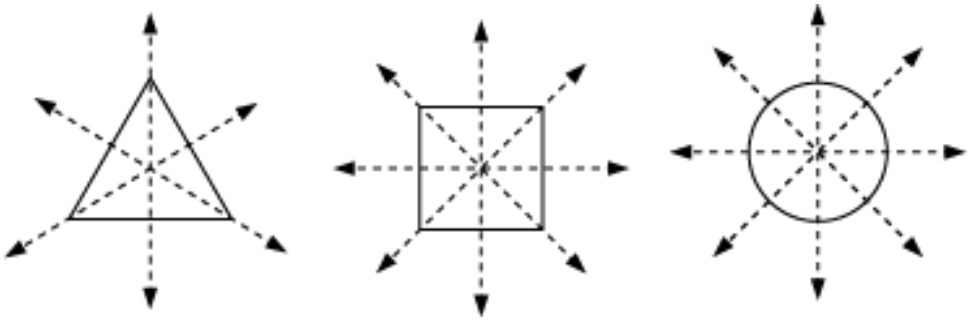
  - A scalene triangle and a parallelogram has no line of symmetry.



Scalene triangle Parallelogram

- An isosceles triangle, English alphabets A, B etc. shows one line of symmetry.

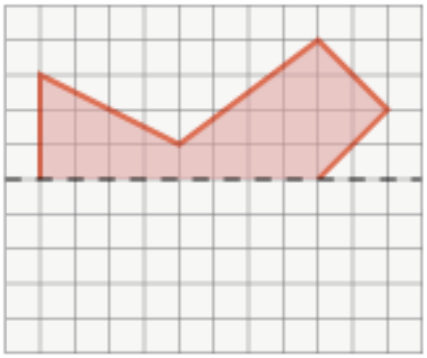
- An equilateral triangle, a square, a circle, etc., show multiple lines of symmetry.



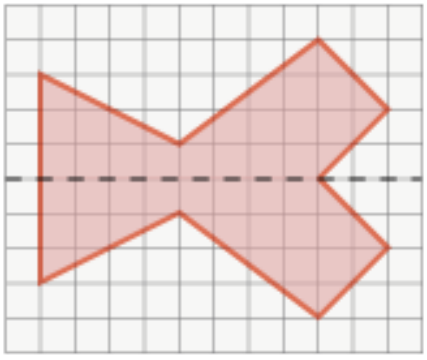
- If a vertical line divides the figure into two identical parts such that the two parts are image to each other with respect to the line, then we say that the figure has a vertical line of symmetry.
  Example: In the previous example, the isosceles triangle and the English alphabet A have vertical lines of symmetry.

- If a horizontal line divides a figure into two identical parts such that the two parts are image to each other with respect to the line, then we say that the figure has a horizontal line of symmetry.
  Example: In the previous example, the English alphabet B has a horizontal line of symmetry.

- The complete figure can be obtained by tracing the given figure below its line of symmetry.



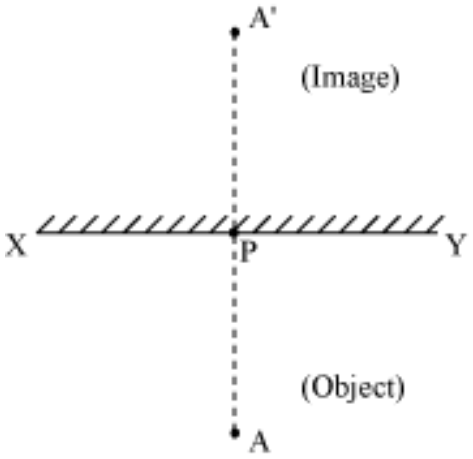
Here, the dotted line is the line of symmetry of the figure.Thus, the complete figure will be represented as:



- Some figures look exactly similar after drawing a dotted line i.e., the left half of the figure is exactly same as the right half of the figure. These figures are known as **symmetrical figures** and the dotted line through which the figure is divided is called **line of symmetry.**
- The line of symmetry is closely related to mirror reflection. When we deal with mirror reflection, we have to take into account that the object and image are symmetrical with reference to the mirror line. There is no change in the length and angle of the object and the corresponding length and angle of the image, with respect to the mirror line; only the left-and-right alignment changes.

- **Axis of reflection** or **mediator**

  Let XY be a mirror. Let A be a point (object) placed in front of it. We obtain its image A′ as shown below:



We can notice that:

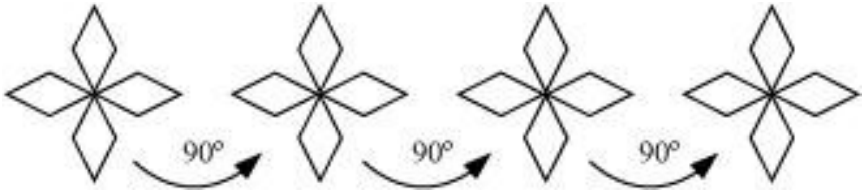
1. The distance of the image (A′) behind the mirror is same as the distance of the object (A) from it i.e., PA = PA′
2. The mirror line XY is perpendicular to the line joining the object and the image i.e., XY ⊥ AA′

Here, XY (the mirror line) is called the **axis of reflection** or **mediator**.

If the point A lies on XY, then its image will be this point itself. In such case, A is called an **invariant point** with respect to mirror line XY.

- Rotational symmetry
  - Rotation means turning of an object about a fixed point.
  - The fixed point is known as the centre of rotation.
  - The angle of turning during the rotation is called the angle of rotation.
  - If an object looks exactly the same after rotation, it is said to have rotational symmetry.
  - A complete rotation means a rotation of 360°.
  - In a complete rotation, the number of times an object looks exactly the same is known as the order of rotational symmetry.

    For example: Consider the rotation of the following floral design.



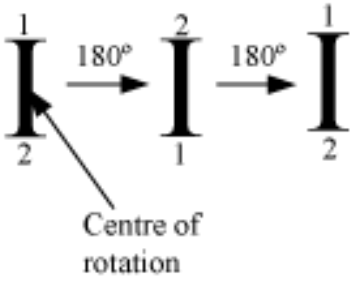
Here, the angle of rotation is 90° and in a full turn, there are precisely four positions when the figure looks exactly the same. Therefore, it has a rotational symmetry of order four.

- The order of rotational symmetry of a square is 4.
- The order of rotational symmetry of an equilateral triangle is 3.

- Some figures have both lines of symmetry and rotational symmetry. If a figure has more than one line of symmetry then it has rotational symmetry of order equal to the number of its lines of symmetry.

  For example, the letter I has both line symmetry and rotational symmetry.

2 line symmetry



Rotational symmetry

The letter I has two lines of symmetry and rotational symmetry of order two about its centre.

- When the lines of symmetry do not exist for a figure, the figure can still have rotational symmetry.