PERIOD-VI

M10CH10

TOPIC

10

Rigid Motion

10.1 RIGID MOTION

A *rigid body* which does not deform under the influence of forces is known as rigid body.

In real life, no object is a rigid body. A bridge, however, does not deform under the influence of a single man, but it deforms under the influence of a truck or trucks. So, the bridge is not a rigid body.

A *rigid motion* is an action of taking an object and moving it to a different location without altering its shape or size.

In rigid motion, the distance between any two points of the rigid body remains constant before and after applying forces on it.

Types of Rigid Motion

The following are the types of a rigid motion:

(*a*) translation (*b*) reflection (*c*) rotation

We shall discuss here translation and reflection of rigid body motions in details in our subsequent sections.

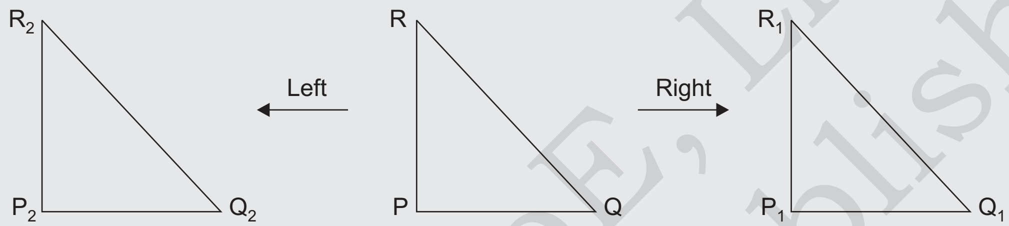
10.2 TRANSLATION

ACTIVITY 1

- To demonstrate as a movement in a straight line, draw a triangle on a piece of cardboard and cut it out.
- Place the triangle on a sheet of paper on a table and draw the outline of the triangle on the paper.
  Label this outline PQR.

- Put the triangular card on the outline again and place a straight edge along the base PQ.
- Slide the triangular card along the straight edge to the right and draw the outline on the sheet of paper to give the image $\Delta P_1Q_1R_1$.
- Again slide it to the left and draw the image $\Delta P_2Q_2R_2$.
- Measure the lengths and angles of $\Delta P_1Q_1R_1$, and $\Delta P_2Q_2R_2$.

What do you observe about the corresponding lengths and angles of the triangles?



This activity shows that the movement of triangle ABC is a translation. When you walk from one place to another, you are making a tranalation. When you push a table away from a place or when you lift a bucket of water, you are making a translation.

Thus, a rigid motion which drags an object in a specified direction and by a specified amount is known as translation.

A translation is always described by a *vector.* The direction and amount of dragging can be represented by a vector known as *translation vector* or *displacement vector*. It is denoted by $\begin{pmatrix} a \\ b \end{pmatrix}$ where a is the horizontal displacement either to right or to left and b is the vertical displacement either upward or downward. Thus, if a point P(x, y) is translated to a point P′ with translation vector $\begin{pmatrix} a \\ b \end{pmatrix}$, then the coordinates of P′ are P′($x + a$, $y + b$). In other words,

$$\begin{pmatrix} x \\ y \end{pmatrix} \xrightarrow{\text{translation}} \begin{pmatrix} x+a \\ y+b \end{pmatrix}.$$

Remark: The point P′ is called the *image* of P and P is called the *pre-image* of P′ under translation.

A move upward or to the right is indicated by +ve sign and downward or to the left is indicated by –ve sign.

For example: A point P is translated (moved) by the vector $\begin{pmatrix} -2 \\ -9 \end{pmatrix}$ to give its image P′ (as shown in the figure (*i*)).

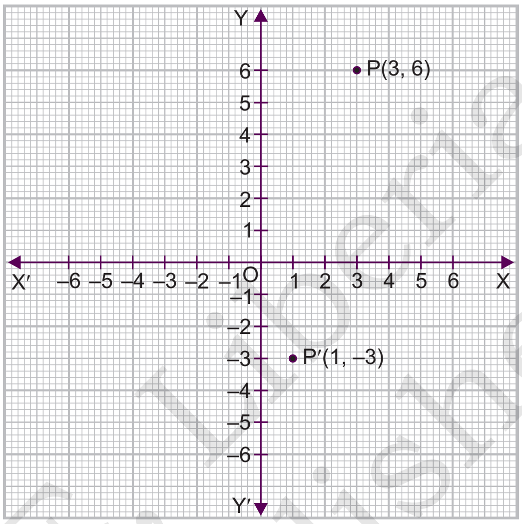


Figure (*i*)

Explanation: Here the coordinates of the point P are P(3, 6) and the translation vector is $\begin{pmatrix} -2 \\ -9 \end{pmatrix}$ therefore, the coordinates of P are P′(3 – 2, 6 – 9) or P′(1, –3)

For example: A line AB has been translated (moved) –2 units to the left (horizontal displacement) and –9 units downward (vertical displacement) to get the line A′B′ (as shown in the figure (*ii*)).

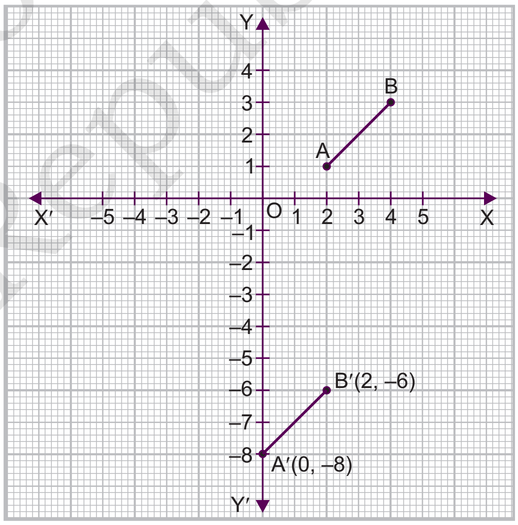


Figure (*ii*)

Explanation: The end points of the line AB are A(2, 1) and B(4, 3). The translation vector is $\begin{pmatrix} -2 \\ -9 \end{pmatrix}$.

Therefore,

A(2, 1) $\rightarrow$ A′(2 – 2, 1 – 9) = A′(0, –8)

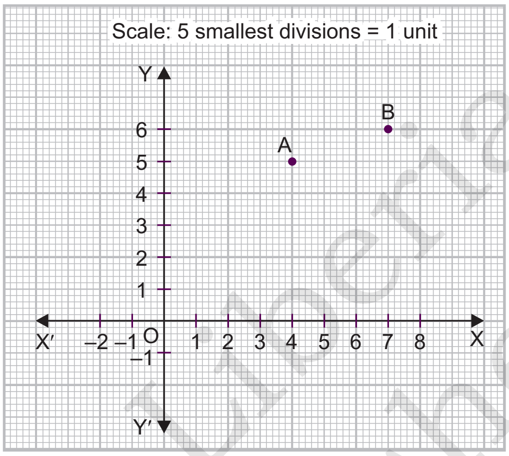
B(4, 3) $\rightarrow$ B′(4 – 2, 3 – 9) = B(2, –6)

Hence, the translated line A′B′ is shown in the above figure (*ii*).

Finding the Image When the Point and the Translation Vector are Given

Example 1. *Translate the point A(4, 5) to the point (image) B by the translation vector* $\begin{pmatrix} 3 \\ 1 \end{pmatrix}$.

Solution. Plot the point A(4, 5) on a graph sheet. Move A, 3 units horizontally and 1 unit vertically to the position B. The coordinates of this new position are (7, 6) as shown in the figure.



Alternate method

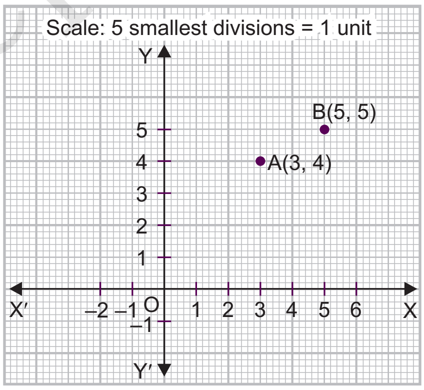
Under a translation by the vector $\begin{pmatrix} 3 \\ 1 \end{pmatrix}$

$$\begin{pmatrix} 4 \\ 5 \end{pmatrix} \to \begin{pmatrix} 4+3 \\ 5+1 \end{pmatrix} = \begin{pmatrix} 7 \\ 6 \end{pmatrix} \quad \text{or} \quad (7, 6)$$

Therefore, the image of $A(4, 5)$ under the translation vector $\begin{pmatrix} 3 \\ 1 \end{pmatrix}$ is B(7, 6) (see the figure).

Finding the Point When Image and Translation Vector are Given

Example 2. *If B (5, 5) is the image of a point A under the translation by the vector* $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$, *then find the point A.*



Solution. Suppose the coordinates of A are (x, y).

Under a translation by the vector $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$,

$$\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} x+2 \\ y+1 \end{pmatrix} = \begin{pmatrix} 5 \\ 5 \end{pmatrix}$$

Therefore, from the equality of vectors,

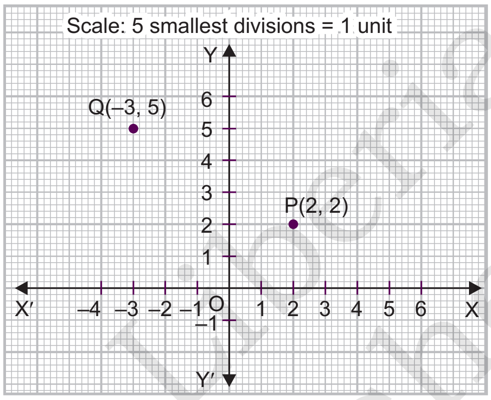
$$x + 2 = 5 \quad \text{and} \quad y + 1 = 5$$

$$\Rightarrow \quad x = 3 \quad \Rightarrow \quad y = 4$$

Hence, the point A has coordinates (3, 4) (see the figure).

Finding the Translation Vector

Example 3. *If Q (–3, 5) is the image of a point P(2, 2) under a translation by a vector as shown on the number plane, find the translation vector (see the figure).*



Solution. Let the translation vector be

$\begin{pmatrix} a \\ b \end{pmatrix}$, then $\begin{pmatrix} 2 \\ 2 \end{pmatrix} \rightarrow \begin{pmatrix} 2+a \\ 2+b \end{pmatrix} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$

Therefore, from the equality of vectors,

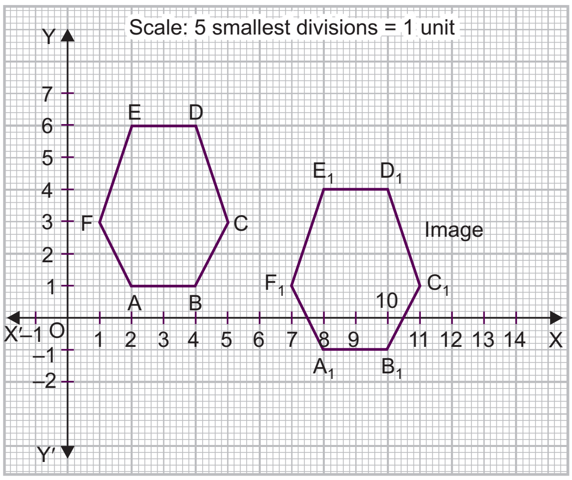
$$2 + a = -3 \quad \text{and} \quad 2 + b = 5$$
$$\Rightarrow \quad a = -5 \quad \Rightarrow \quad b = 3$$

Hence, the translation vector is $\begin{pmatrix} -5 \\ 3 \end{pmatrix}$.

Translation of Plane Figures

Example 4. *Draw a hexagon ABCDEF having vertices A(2, 1), B(4, 1), C(5, 3), D(4, 6), E(2, 6) and F(1, 3). Also draw its image under the translation vector* $\begin{pmatrix} 6 \\ -2 \end{pmatrix}$.

Solution. The vertex A(2, 1) of ABCDEF is translated into vertex A_1 of $A_1B_1C_1D_1E_1F_1$ using the translation vector $\begin{pmatrix} 6 \\ -2 \end{pmatrix}$ as:



$$\begin{pmatrix} 2 \\ 1 \end{pmatrix} \rightarrow \begin{pmatrix} 2+6 \\ 1-2 \end{pmatrix} = \begin{pmatrix} 8 \\ -1 \end{pmatrix}$$

Similarly, the other vertices can be calculated. These are $B_1(10, -1)$; $C_1(11, 1)$; $D_1(10, 4)$, $E_1(8, 4)$; $F_1(7, 1)$.

The hexagon ABCDEF and its image $A_1B_1C_1D_1E_1F_1$ are shown in the figure.

EXERCISE 10.1

1. Find the image A′ if A(3, 4) is translated by the vector $\begin{pmatrix} -2 \\ 5 \end{pmatrix}$.
2. Find the image of (*a*) (1, 2) and (*b*) (– 2, – 4) under the translation by the vector $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$.
3. P′(4, 6) is the image of a point P under the translation by the vector $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$. Find the point P.
4. P′(–2, 4) is the image of a point P(1, 2) under a translation by a vector. Find the translation vector.
5. Under the translation, the image of the point (5, 4) is (7, 1). What is the image of the point (1, – 4) under the same translation.
6. Q′ is the image of Q(2, 1) under a translation which maps P(3, 4) onto P′(7, 6). Find the coordinates of Q′.
7. P′(8, –2) is the image of the point P(5, 2) by the translation vector v. Find
   (*a*) the vector v
   (*b*) the coordinates of the point Q whch maps onto the point Q′(5, –2) under v
   (*c*) $\overrightarrow{PP'}$

10.3 REFLECTION

A reflection is the image you see when you look in a mirror. The mirror forms the line of symmetry (Discussed further in section 10.4) between the object and the image. Reflection conserves angles, lengths and area but reverses the figure. To define a reflection you need to know the position of the line which the figure is to be reflected.

When an object is reflected in a line, the *image* point is at the opposite side of the line and the perpendicular distance from the point to the line is equal to the perpendicular distance from the image point to the line. The line is called the *mirror line* or line of reflection.

i.e., object distance from mirror line = image distance from mirror line.

In the figure, OABC has been reflected in the y-axis to give $O_1A_1B_1C_1$.

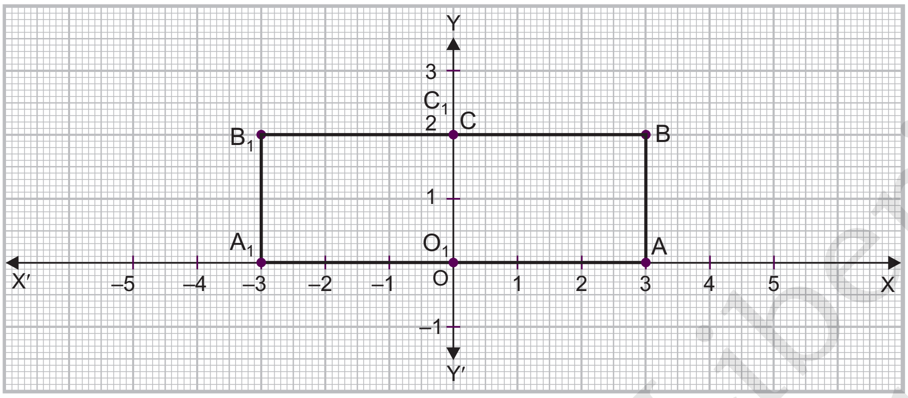


Figure (i)

Also in figure (*ii*), OXYZ has been reflected in the line $y = -x$ to give $O_1X_1Y_1Z_1$

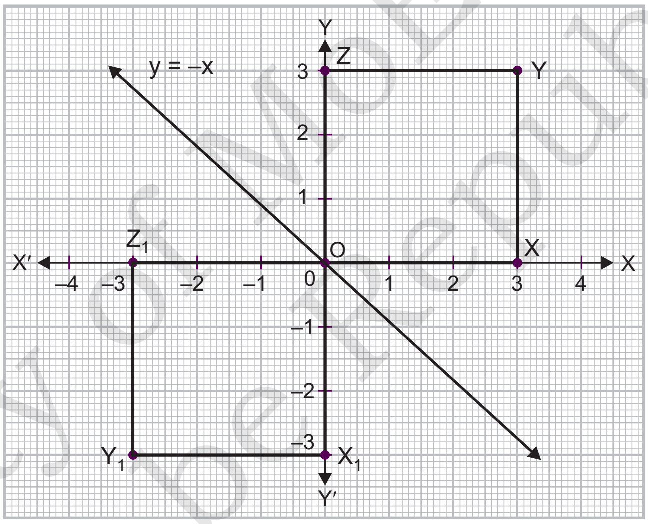


Figure (ii)

Example 5. *What are the properties of objects under reflection with respect to its similarity, congruence and orientation?*

Solution. When an object is reflected, there is no change in the lengths and angles; *i.e.,* the lengths and angles of the object and the corresponding lengths and angles of the image are same.

In other words, *the object and its image are similar as well as congruent.*

There is a change in one aspect between the object and the image, *i.e.,* the left-right changes in the orientation (the shape is same, but the other way round).

We shall consider reflection in the following mirror lines.

(*i*) **Reflection in the x-axis (*i.e.* $y = 0$)**

If the point (x, y) is reflected in the x-axis or the line $y = 0$, the image point is $(x, -y)$.

The mapping is: $\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} x \\ -y \end{pmatrix}$ or $(x, y) \to (x, -y)$.

(*ii*) **Reflection in the y-axis (i.e. $x = 0$)**

If the point (x, y) is reflected in the y-axis or the line $x = 0$, the image points is $(-x, y)$. The mapping is:

$$\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} -x \\ y \end{pmatrix} \text{ or } (x, y) \to (-x, y)$$

The general rule is to negate the x-coordinate and maintain the y-coordinate.

For example: Under reflection in the y-axis, $(3, 4) \to (-3, 4)$ and $(-1, -2) \to (1, -2)$.

(*iii*) **Reflection in the line $x = k$ or $x - k = 0$**

Using the same procedure as describe above we can obtain a rule for reflection in the line $x = k$. If the point (x, y) is reflected in the line $x = k$ or the line $x - k = 0$, the image point is $(2k - x, y)$.

The mapping is: $\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} 2k - x \\ y \end{pmatrix}$ or $(x, y) \to (2k - x, y)$

For example, under reflection in the line $x = 1$ or $x - 1 = 0$, the value of $k = 1$. Therefore, the mapping becomes $\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} 2 - x \\ y \end{pmatrix}$. The image of the point (3, 4) under the reflection in the line $x = 1$ is:

$$\begin{pmatrix} 3 \\ 4 \end{pmatrix} \to \begin{pmatrix} 2 - 3 \\ 4 \end{pmatrix} = \begin{pmatrix} -1 \\ 4 \end{pmatrix} \text{ i.e. } (-1, 4).$$

Example 6. *Find the images of the points A(3, 4) when reflected in the line $x - 2 = 0$.*

Solution. Note that $x - 2 = 0 \quad \Rightarrow \quad x = 2$

$\therefore \quad k = 2$ and the mapping becomes $\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} 4 - x \\ y \end{pmatrix}$

$$\begin{pmatrix}3\\4\end{pmatrix} \rightarrow \begin{pmatrix}4-3\\4\end{pmatrix} = \begin{pmatrix}1\\4\end{pmatrix}$$

$\therefore$ The image of A(3, 4) is (1, 4).

(*iv*) **Reflection in the line $y = k$ or $y - k = 0$**

If the point (x, y) is reflected in the line $y = k$ or the line $y - k = 0$, then the image point is $(x, 2k - y)$. The mapping is:

$$\begin{pmatrix}x\\y\end{pmatrix} \rightarrow \begin{pmatrix}x\\2k-y\end{pmatrix} \text{ or } (x, y) \rightarrow (x, 2k - y) \text{ where } k \text{ is an integer.}$$

Example 7. *Find the images of the points A(3, 4) when reflected in the line $y + 1 = 0$.*

Solution. Note that $y + 1 = 0 \Rightarrow y = -1$

$\therefore$ $k = -1$ and the mapping becomes

$$\begin{pmatrix}x\\y\end{pmatrix} \rightarrow \begin{pmatrix}x\\-2-y\end{pmatrix}$$

i.e.,

$$\begin{pmatrix}3\\4\end{pmatrix} \rightarrow \begin{pmatrix}3\\-2-4\end{pmatrix} = \begin{pmatrix}3\\-6\end{pmatrix}$$

$\therefore$ The image of A(3, 4) is (3, – 6).

(*v*) **Reflection in the line $y = kx$ or $y - kx = 0$**

If the point (x, y) is reflected in the line $y = kx$ or the line $y - kx = 0$, then the image point is $\left(\frac{1}{k}y, kx\right)$. The mapping is:

$$\begin{pmatrix}x\\y\end{pmatrix} \rightarrow \begin{pmatrix}\frac{1}{k}y\\kx\end{pmatrix} \text{ or } (x, y) \rightarrow \left(\frac{1}{k}y, kx\right)$$

where k is an integer.

Note: $y = kx \Rightarrow x = \frac{1}{k}y$. Therefore the x-coordinate of the image becomes $\frac{1}{k}y$ and the y-coordinate also becomes $2k$.

(*vi*) **Reflection in line $y = x$**

When $k = 1$, we have *reflection in line $y = x$,* which is given by the mapping

$$\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} y \\ x \end{pmatrix} \text{ or } (x, y) \to (y, x).$$

For example, (3, 4) → (4, 3) and (–1, –2) → (–2, –1).

(*vii*) **Reflection in the line $y = -x$**

Again, when $k = -1$, we have *reflection in the line $y = -x$,* which is given by the mapping:

$$\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} -y \\ -x \end{pmatrix} \text{ or } (x, y) \to (-y, -x)$$

For example, (3, 4) → (–4, –3) and (–1, –2) → (2, 1).

Example 8. *Find the images of the points A(3, 4) when reflected in the line $y = 2x$.*

Solution. $k = 2$, therefore the mapping:

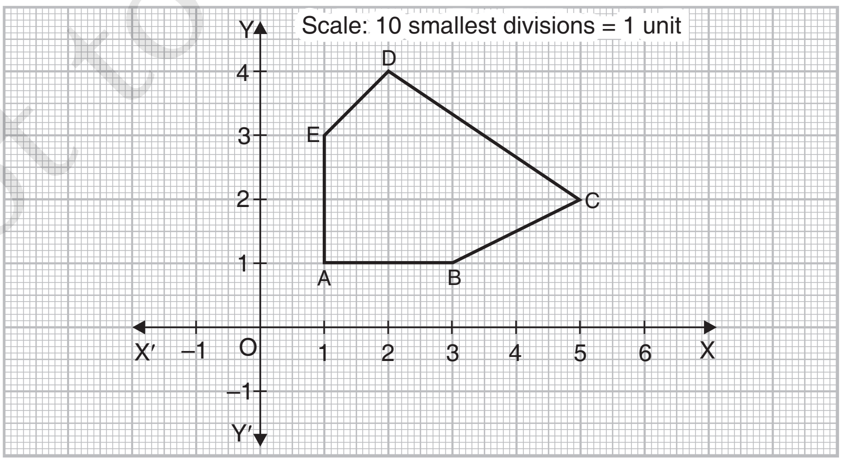
$$\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} \frac{1}{k}y \\ kx \end{pmatrix} \text{ becomes } \begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} \frac{1}{2}y \\ 2x \end{pmatrix}$$

$$\begin{pmatrix} 3 \\ 4 \end{pmatrix} \to \begin{pmatrix} \frac{1}{2}(4) \\ 2(3) \end{pmatrix} = \begin{pmatrix} 2 \\ 6 \end{pmatrix} \text{ or } (2, 6).$$

Reflection of Plane Figures

The reflection of a plane figure in a given mirror line can be done in the Cartesian plane by reflecting the *vertices* of the plane figure in the given mirror line.

Example 9. *Draw and state coordinates of the image of the shape ABCDE in reflection in (i) X-axis (ii) Y-axis in the coordinates plane.*



Solution. (*i*) The reflection of the point (x, y) across the X-axis is the point $(x, -y)$, *i.e.*, $P(x, y) \to P'(x, -y)$

$\therefore$ $A(1, 1) \to A_1(1, -1)$; $B(3, 1) \to B_1(3, -1)$;
$C(5, 2) \to C_1(5, -2)$; $D(2, 4) \to D_1(2, -4)$;
$E(1, 3) \to E_1(1, -3)$

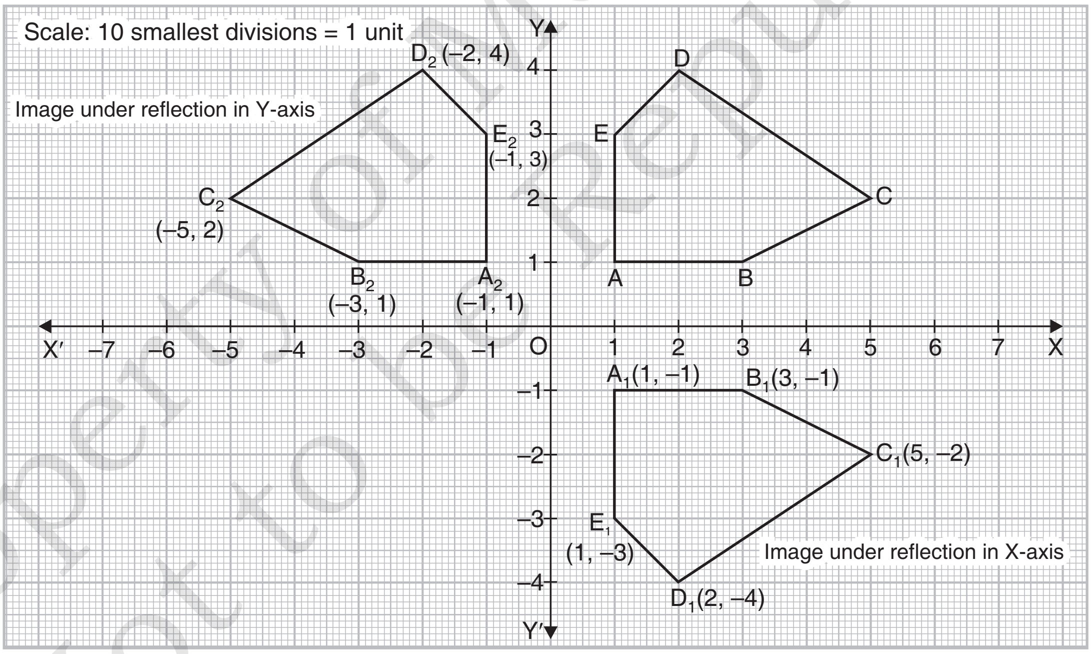
The image of the shape ABCDE in X-axis is $A_1B_1C_1D_1E_1$.

(*ii*) The reflection of the point (x, y) across the Y-axis is the point $(-x, y)$, *i.e.*, $P(x, y) \to P'(-x, y)$.

$\therefore$ $A(1, 1) \to A_2(-1, 1)$; $B(3, 1) \to B_2(-3, 1)$;
$C(5, 2) \to C_2(-5, 2)$; $D(2, 4) \to D_2(-2, 4)$;
$E(1, 3) \to E_2(-1, 3)$

The image of the shap ABCDE in Y-axis is $A_2B_2C_2D_2E_2$.

The following figure illustrates the images of the shape ABCDE in both the axes:



EXERCISE 10.2

1. Find the image of the points

(*a*) B(1, –5) (*b*) P(–1, 2)

when reflected in the line $x - 2 = 0$.

2. Find the image of the points

(*a*) B(1, –5) (*b*) P(–1, 2)

when reflected in the line $y + 1 = 0$.

3. Find the image of the points

(*a*) B(1, –6) (*b*) P(–1, –2)

when reflected in the line $y = 2x$.

4. The coordinates of a rectangle PQRS are P(–4, 1), Q(–1, 1), R(–1, 5), S(–4, 5). Draw and state coordinates of its image in Y-axis.

5. The coordinates of a triangle ABC are A(–3, 4), B(–4, 1) and (–1, 2). Draw and state coordinates of its image in X-axis.

6. Draw and state coordinates of the image of triangle ABC having coordinates A(–1, 4), B(–2, 2), C(4, 3) in the X-axis in the coordinates plane.

7. The coordinates of the image of a shape under reflection in Y-axis are: P_1(–2, 3), Q_1(–5, 0), R_1(–3, –2).

Draw the original shape in the coordinates plane.

8. The coordinates of the image of a shape under reflection in X-axis are: A_1(1, –3), B_1(4, –3), C_1(1, –5), D_1(4, –5).

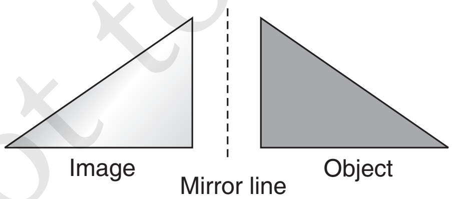
Draw the original shape in the coordinates plane.

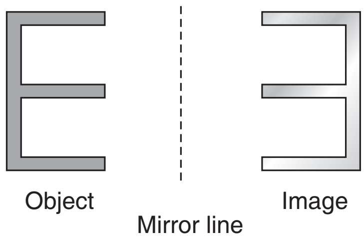
10.4 SYMMETRY

Line of symmetry and mirror reflection are naturally related and linked to each other.

When an object is reflected in a mirror line, the object and its image form a symmetrical shape, with the mirror line as the axis of symmetry.

Look at these figures and their mirror images.





When a mirror is used to reflect an image, the mirror serves as the line of symmetry. Each point on the image will be directly opposite the object and at the same distance on the other side of the mirror line. If a fold were to be made on the mirror line, the object would fall exactly on to the reflected image.

Remember that a reflection is a flip.

Note: Under reflection, an object and its image are congruent but the left-right changes in the orientation.

Designs (or objects) with Reflectional (or fold) Symmetries

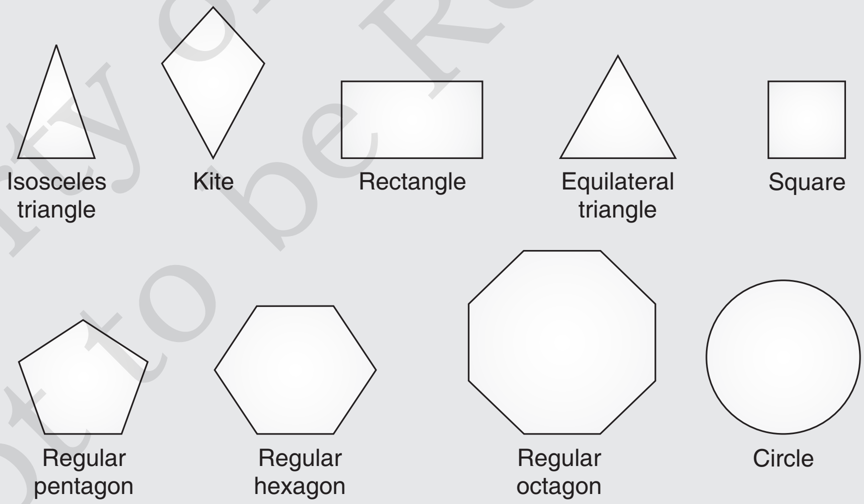
Symmetry is an important geometrical concept, commonly exhibited in nature and is used almost in every field of activity. Artists, professionals, designers of clothing or jewellery car manufacturers, architects and many others make use of the idea of symmetry. The beehives, the flowers, the tree-leaves, religious symbols, rugs, and handkerchiefs—everywhere you find symmetrical designs.

ACTIVITY 2

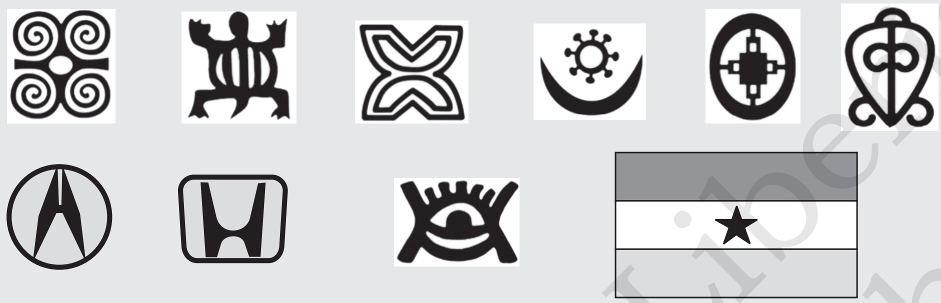
Designs or Objects Used in Everyday Life that have Reflectional (or Fold) Symmetries

Pupils can work individually or in groups to give examples:

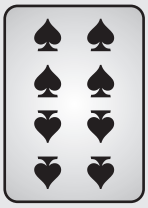
- A person's face is one example of symmetry in the real World.
- Many plane shapes have reflectional (fold) symmetries. Here, are a few:



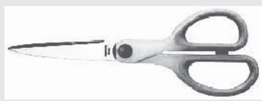
- The designs in adinkra symbols, logos etc. have reflectional symmetry. Here, are a few:



- The designs on some playing cards and artifacts have reflectional (or fold) symmetries as shown below:

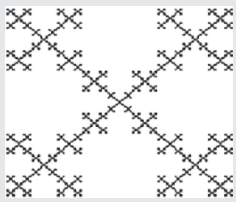


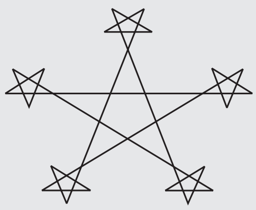
- The manufacturers of some items we use daily have the concept of reflectional (or fold) symmetries. Here, are a few:

- Observe the following beautiful figures. These are symmetrical patterns known as fractals (If you have access to a computer, browse through the topic "Fractals" and find more such beauties):


Barnsley ferm


Box fractal


Star fractal

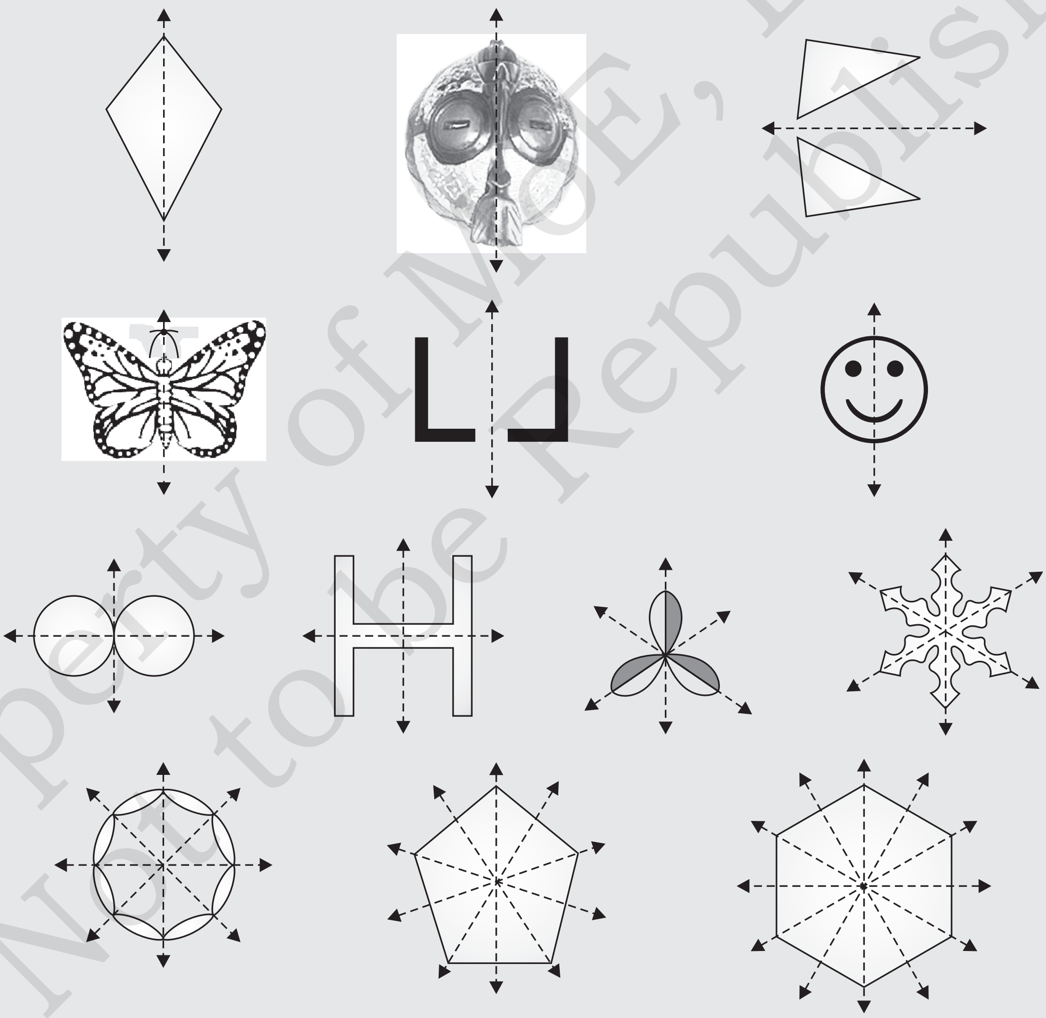
Example 10. *Give some examples of designs or objects in everyday life that have reflectional (or fold) symmetries.*

Solution. Adinkara symbols, logos, light signals at crossings, paper-cut designs etc. are the examples of designs that have reflectional symmetries.

ACTIVITY 3

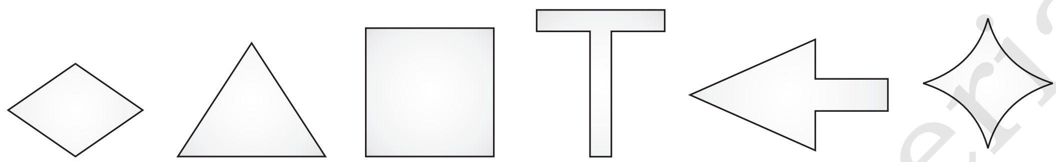
Identifying the Line(s) of Reflection (or Fold) in Objects or Designs

Look at the following objects or designs in the figure.



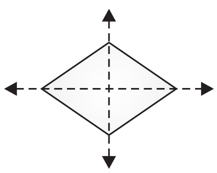
Note: All the dotted lines are the mirror line(s).

Example 11. *Draw and describe the line(s) of symmetry of the following geometric shapes:*

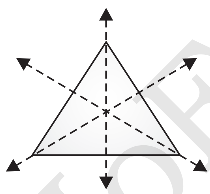


(a) (b) (c) (d) (e) (f)

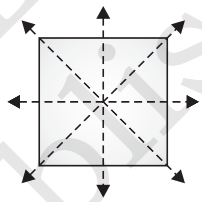
Solution. The line(s) of symmetry of the given geometrical shapes are drawn and described as shown below:



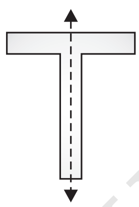
(a) Two lines of symmetry



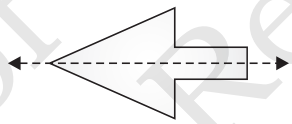
(b) Three lines of symmetry



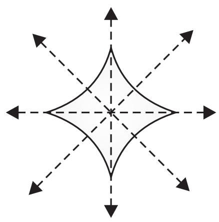
(c) Four lines of symmetry



(d) One line of symmetry

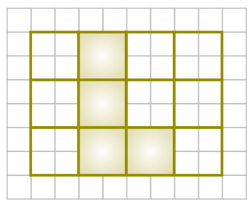


(e) One line of symmetry

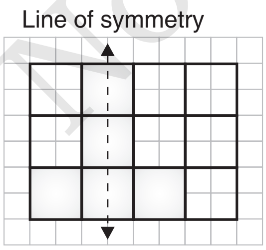


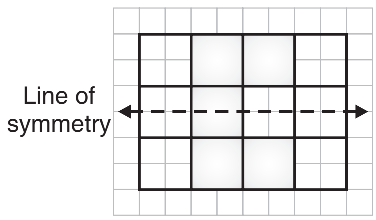
(f) Four lines of symmetry

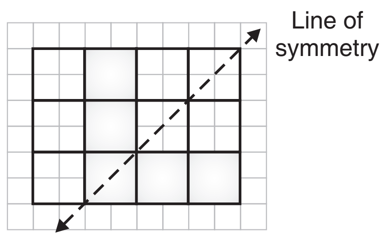
Example 12. *How many different ways can one more square be shaded in this shape to have a line of symmetry?*



Solution. In the given shape, we can shade one more square in the following different ways to have a line of symmetry:





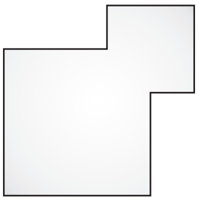
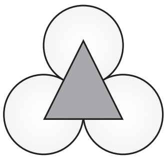
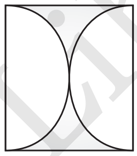
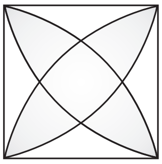
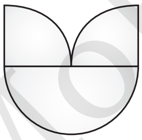
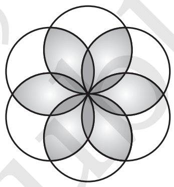


EXERCISE 10.3

1. Which of the following does not have reflection symmetry.

(*a*) T (*b*) V (*c*) A (*d*) R

2. Draw and describe the line(s) of symmetry of the following geometric shapes:


(a)

(b)

(c)

(d)

(e)

(f)

3. Identify which of the following designs in everyday life have reflectional symmetries:


(a)

(b)

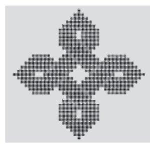
(c)

(d)

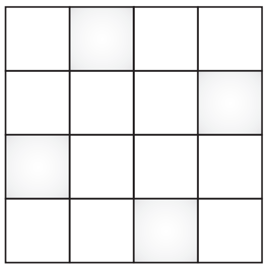
(e)

(f)

(g)


(h)

(i)

4. How many different way(s) can four more squares be shaded in this shape to have both the diagonals as line of symmetry? Show the shaded shape also.



REVIEW EXERCISE

1. Given the translation vector $\begin{pmatrix}5\\3\end{pmatrix}$ and the coordinates of the image $P_1Q_1R_1S_1T_1$ of shape PQRST as $P_1(6, 1)$, $Q_1(9, 1)$, $R_1(10, 3)$, $S_1(6, 5)$ and $T_1(4, 4)$. Draw the original shape PQRST in the coordinates plane.

2. (*a*) Using a scale of 2 cm to 1 unit of each axis draw on a graph sheet two perpendicular axes OX and OY.

(*b*) On this graph, mark the x-axis from – 5 to 5 and the y-axis from – 5 to 5.

(*c*) Plot the point A(–1, –1), B(3, 4) and C(2, –1). Join the points to form a triangle.

(*d*) Draw the image of the triangle ABC under the translation by the vector $\begin{pmatrix}-1\\-2\end{pmatrix}$ such that $A \to A_1$, $B \to B_1$ and $C \to C_1$.

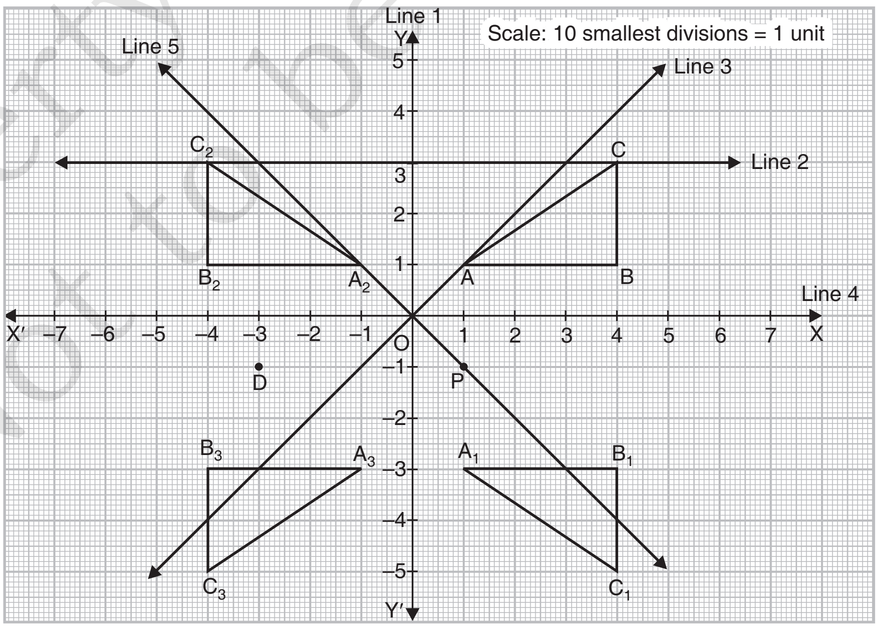
3. The coordinates of the image of a shape under reflection in Y-axis are: $A_1(5, -1)$, $B_1(2, -1)$, $C_1(1, 2)$, $D_1(3, 4)$, $E_1(5, 4)$, $F_1(6, 1)$. Draw the original shape in the coordinates plane.

4. The vertices of a triangle are A(1, 2), B(1, 5) and C(3, 2). Find the vertices A′, B′ and C′ after reflection about

(*a*) $y = x$ (*b*) $y = -x$

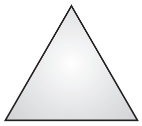
Also, draw the triangles ABC and A′B′C′ in each case.

5. Label the lines shown in the following figure:

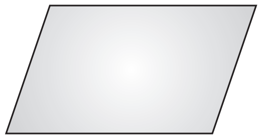


6. State the object coordinates and their corresponding image coordinates in the reflection figure given in question 5.

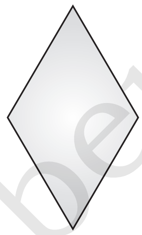
7. Draw and describe the mirror line of the following geometrical shapes:



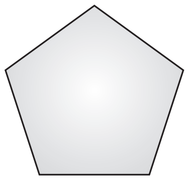
(*a*) Equilateral triangle



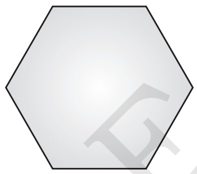
(*b*) Parallelogram



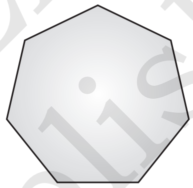
(*c*) Rhombus



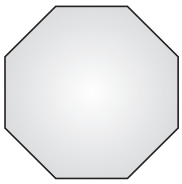
(*d*) Regular pentagon



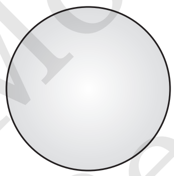
(*e*) Regular hexagon



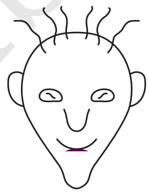
(*f*) Regular heptagon



(*g*) Regular octagon



(*h*) Circle



(*i*) Human face

MULTIPLE CHOICE QUESTIONS (MCQs)

1. Which of these has the least number of lines of symmetry?

(a) An equilateral triangle (b) A rectangle

(c) A square (d) A circle

2. How many lnes of symmetry does a rectangle have?

(a) 1 (b) 2 (c) 3 (d) 4

3. How many lines of symmetry has a square?

(a) 0 (b) 1 (c) 2 (d) 4

4. How many lines of symmetry has an isosceles triangle?

(a) 1 (b) 2 (c) 3 (d) 4

5. If $(x, y) \rightarrow (x, 2y)$, find the image of $\left(2\frac{1}{2}, -\frac{1}{4}\right)$ under the same mapping

(a) $\left(2\frac{1}{2}, -2\right)$ (b) $\left(2\frac{1}{2}, -\frac{1}{2}\right)$ (c) $(2, -2)$ (d) $\left(2, -\frac{1}{4}\right)$

6. Find the image of the point, (6, 3) when translated by the vector $\begin{pmatrix} -4 \\ -1 \end{pmatrix}$

(a) (–2, –2) (b) (2, –2) (c) (–2, 2) (d) (2, 2)

7. Find the image of the point K(3, 5) when it is reflected in the *x*-axis.

(a) (3, 5) (b) (5, 3) (c) (3, –5) (d) (–3, –5)

8. A point (2, 1) is reflected in the *y*-axis. Find its image.

(a) (–1, 2) (b) (1, –2) (c) (–2, 1) (d) (2, –1)

RECAP AT A GLANCE

- A *rigid body* which does not deform under the influence of forces is known as rigid body.
- A *rigid motion* is an action of taking an object and moving it to a different location without altering its shape or size.
- A reflection is the image you see when you look in a mirror.
- Line of symmetry and mirror reflection are naturally related and linked to each other.
- Under reflection, an object and its image are congruent but the left-right changes in the orientation.

❑ ❑ ❑