# Symmetry and Patterns

Symmetry is all around us in nature. It is an important geometrical concept seen in nature and is useful in every field of our life. On looking ourselves in the mirror, we find our ears and eyes symmetrical about a vertical line.

When a shape or a figure is divided into two parts of equal shape and size, we call the shape or figure symmetrical. The phenomenon is called symmetry.

(a) Human Face

(b) Butterfly

(c) Crab

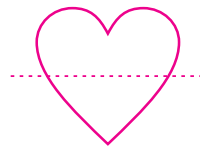All the shapes given are symmetrical. In each of the figures, a line is dividing the figures into two equal halves.
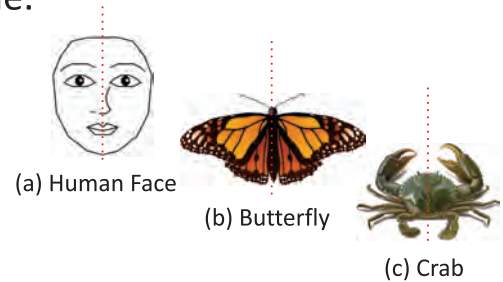
The line which divides a shape or figure into two identical halves is called the axis of symmetry.

Look at the shape of the heart given below. Draw an imaginary line passing horizontally through the centre.
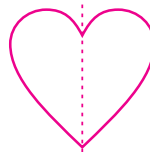
Are both sides the same?

No.

Now, draw a line passing vertically through the centre.

Are both sides the same?

Yes.

The heart shape has only one axis of symmetry.

The shapes can have vertical axis of symmetry, horizontal axis of symmetry or both.
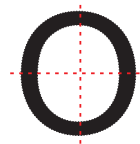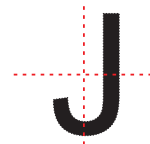
Look at the few letters of the English alphabet.

A
Vertical axis of symmetry

B
Horizontal axis of symmetry

O
Both axis of symmetry

J
No axis of symmetry

Let us try to make a word using letters with vertical axis of symmetry.

H A T

Let us now make a word using letters with horizontal axis of symmetry.

C H O I C E

There are some figures and objects like stones, rocks, few English alphabets (F, G, J, etc.), which do not show any symmetry.

Exercise 14.1

1. **List the following.**

   a. All the capital letters of the English alphabet that are symmetrical about a vertical axis (such as A).

   b. All the capital letters of the English alphabet that are symmetrical about a horizontal axis (such as B).

   c. All the capital letters of the English alphabet that are symmetrical about both the axis.

2. **Draw the line of symmetry for each of the following.**

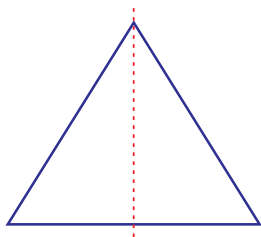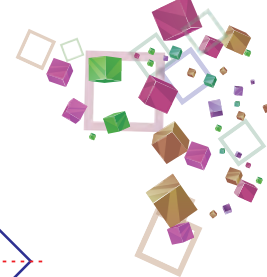   a.   b.   c.   d.

Symmetry in Plane Shapes

Plane shapes also have symmetry. A plane shape is said to be symmetrical about a line, if the line divides the shape into two equal halves.
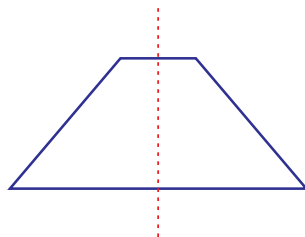
Some shapes have one line of symmetry, some have two and some have even more.

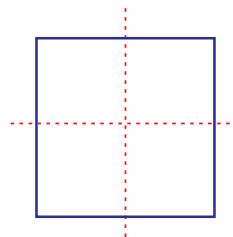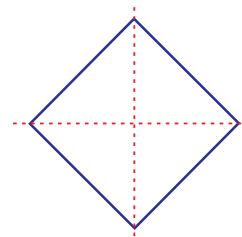There are some shapes which are not symmetrical at all.

A Gateway to Mathematics-5
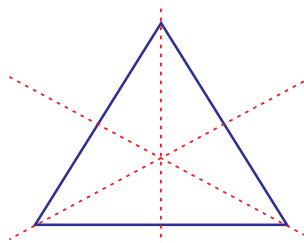
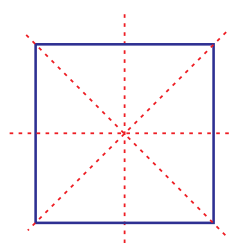| One line of symmetry | One line of symmetry | Two line of symmetry | Two line of symmetry |

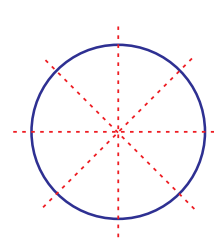## Figures with more than two lines of symmetry

Look at the below given figures. You will observe more than two lines of symmetry.
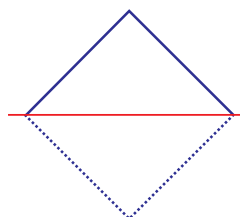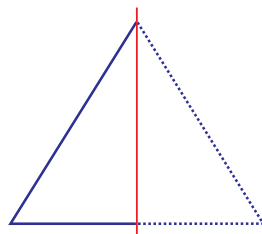

| Three lines of symmetry | Four lines of symmetry | A circle has infinite lines of symmetry |

When a figure is symmetrical, the other half of the figure can be drawn by looking at the given half.

Exercise 14.2

1. **Draw the line (s) of symmetry for each of the following.**

   a.   b.   c.   d.   e.
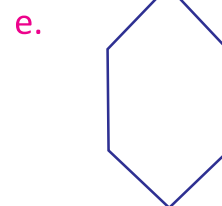
2. **Complete the following symmetrical shapes.**

   a.   b.   c.

d.   e.   f.
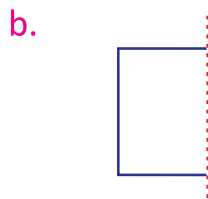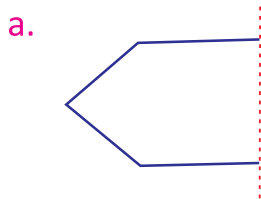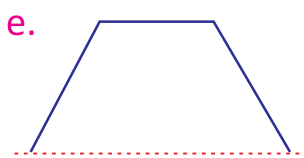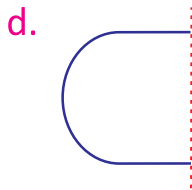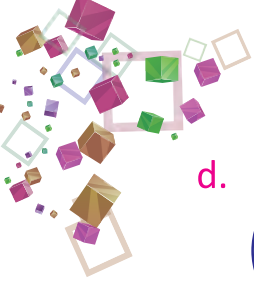
Tessellation

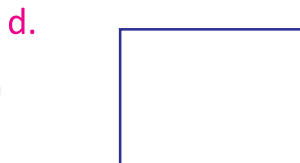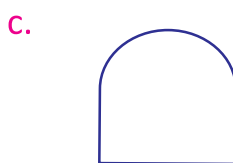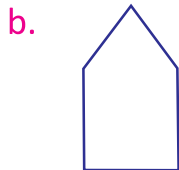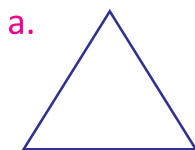A tessellation is a collection of plane or simple figures that fill the plane to form a pattern without leaving any space or overlaps in between.

Notice how the shapes fit together to form a pattern. This is called tessellation.
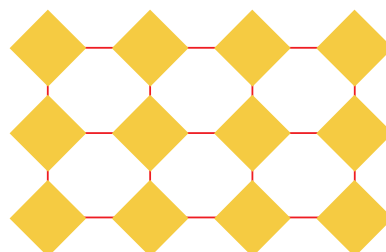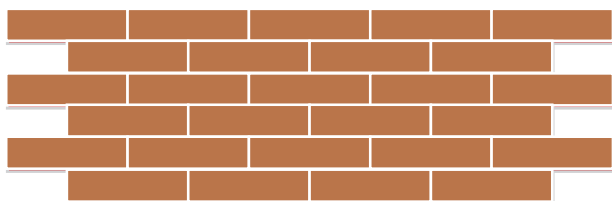
Reflection

Reflection shows the image of a surface (object or shape) corresponding in appearance. When any object is placed in front of a mirror, its image can be seen with same shape and size. To reflect an object means to produce its mirror image.
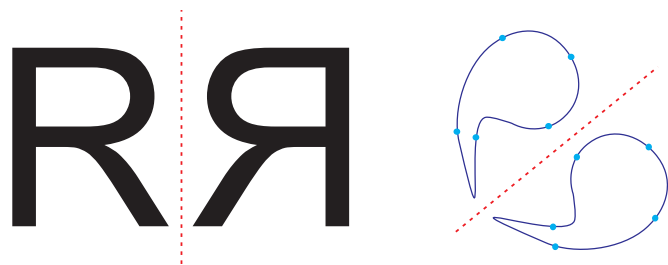
In the same way, a right shoe or a right glove is the opposite to its pair.
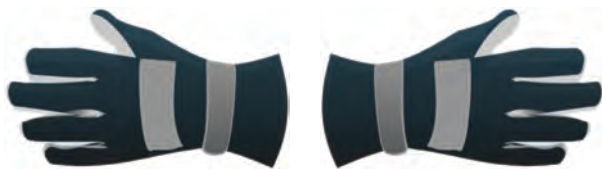
Gloves

Shoes

Slides, Flips and Turns

Slide : A slide takes place when a shape moves in one direction from one place to another.

Flip : A flip takes place when a shape is flipped across a line and faces the opposite direction.

Turn : A turn takes place when a shape is turned through an angle.

| Original position | $\frac{1}{4}$ turn | $\frac{1}{2}$ turn | $\frac{3}{4}$ turn |

| Original position | $\frac{1}{4}$ turn | $\frac{1}{2}$ turn | $\frac{3}{4}$ turn |
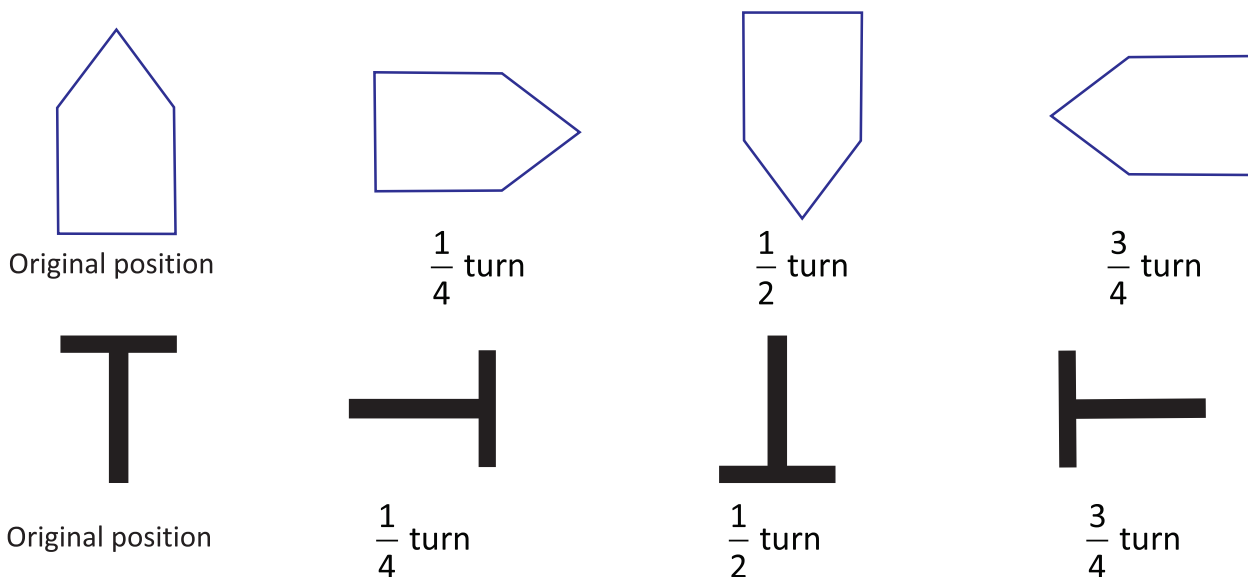
Exercise 14.3

1. Draw a tessellation with pentagons or hexagons.
2. Draw a tessellation by combining two plane shapes.
3. Write the letters B, E, C, L and N and read their image through a mirror. What does each letter look like?

4. Complete the following.

	Shape	Flip	Slide	Turn
a.				
b.				
c.				
d.				
e.				

5. Draw your own shape, then flip, slide and turn it to make a pattern.

Patterns

A pattern is a series or a sequence of repeated objects, sounds or numbers.

❖ They can be repeated decorative designs.

❖ They can be a regular form or order in which a series of things occur.

Patterns in Nature

Patterns in nature are beautiful to observe.

❖ Cut an onion and see the patterns formed.

❖ Look at a leaf and its patterns.

❖ Look at the sky and you will find the patterns formed by the clouds.

Patterns in Numbers

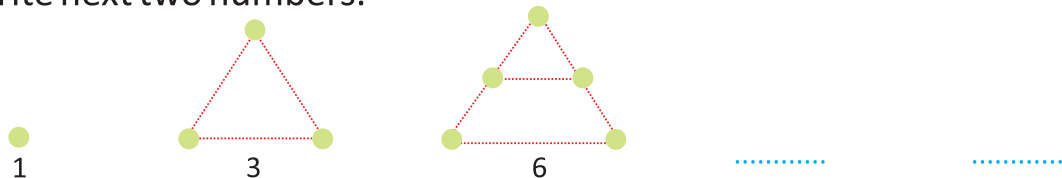Numbers also reflect beautiful patterns.

Triangular Numbers

Numbers like 1, 3, 6 etc., which can be arranged as points in the shape of a triangle are called triangular numbers.
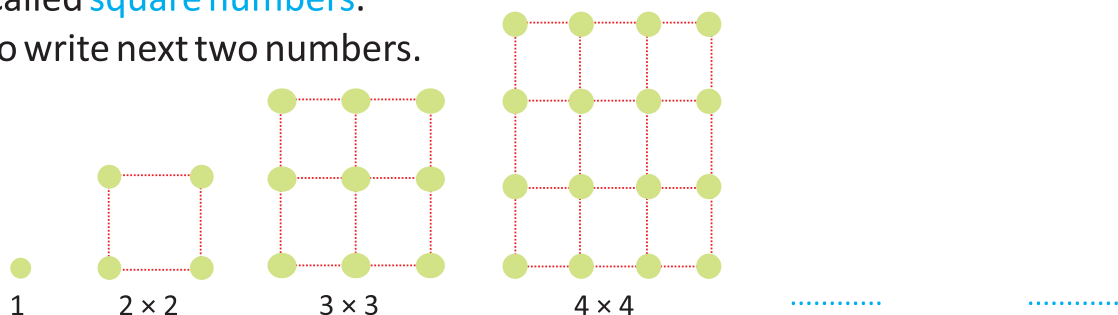
Try to write next two numbers.

1   3   6   ....

Square Numbers

Numbers like 1, 4, 9, 16 etc., which can be arranged as points in the shape of a square are called square numbers.
Try to write next two numbers.

1   2 × 2   3 × 3   4 × 4   ....

Some More Patterns
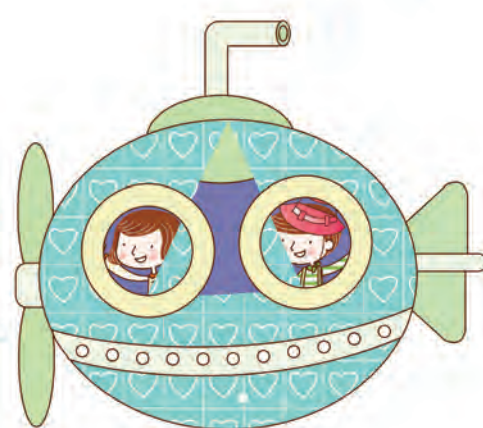
Observe the patterns given below and try to write the entries which will come next.

1.
$$9 \times 1 = 9 + 1 = 10$$
$$9 \times 12 = 108 + 2 = 110$$
$$9 \times 123 = 1107 + 3 = 1110$$
$$............ = ... = ...$$
$$............ = ... = ...$$
$$............ = ... = ...$$

2.
$$9 \times 9 = 81$$
$$99 \times 9 = 891$$
$$999 \times 9 = 8991$$
$$9999 \times 9 = 89991$$
$$99999 \times 9 = 899991$$
$$999999 \times 9 = 8999991$$
$$9999999 \times 9 = 89999991$$

3.
$$7 \times 9 = 63$$
$$77 \times 99 = 7623$$
$$777 \times 999 = 776223$$
$$7777 \times 9999 = 77762223$$
$$............ = ...$$
$$............ = ...$$
$$............ = ...$$
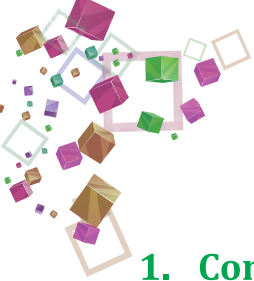
1. **Complete the following patterns.**

   a. 9, 27, 81, 243 , ..., ... , ...

   b. 6, 11, 16, 21, 26, ..., ... , ...

   c. 6, 16, 26, 36, ..., ... , ...

2. Write the first nine multiples of 11 and discover the pattern.

3. Write the first ten multiples of 12 and discover the pattern.

4. **Look at this symmetry in numbers. Write the next three terms.**

$$6 \times 6 = 36$$
$$66 \times 66 = 4356$$
$$666 \times 666 = 443556$$
$$6666 \times 6666 = 44435556$$
$$66666 \times \text{.................} = \text{...................}$$
$$666666 \times \text{.................} = \text{...................}$$
$$6666666 \times \text{.................} = \text{.................}$$

5. **Study the pattern and complete the next two terms.**

$$3 \times 37,037 = 1,11,111$$
$$6 \times 37,037 = 2,22,222$$
$$9 \times 37,037 = \text{......................}$$
$$12 \times 37,037 = \text{......................}$$

Points to Remember

- ❖ When a figure is divided into two parts of equal shape and size, the figure is said to be symmetrical.
- ❖ The line which divides a figure into two identical halves, is called the axis of symmetry.
- ❖ A tessellation is a collection of plane figures that fill the plane to form a pattern without leaving any space or overlaps in between.

1. **Multiple Choice Questions (MCQs)**
   Tick (✓) the correct option:

   a. The line which divides a shape into two identical halves is called the axis of ....

   (i) equality   (ii) proportion

   (iii) symmetry   (iv) none of these

   b. The letter 'O' of the English alphabet has .... lines of symmetry.

   (i) 2   (ii) 1

   (iii) 3   (iv) many

   c. To reflect an object means to produce its .... image.

   (i) mirror   (ii) different

   (iii) outline   (iv) none of these

   d. How many lines of symmetry does a circle have?

   (i) Two   (ii) Infinite

   (iii) One   (iv) Four

   e. Which alphabet is symmetrical?

   (i) G   (ii) P

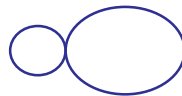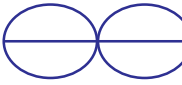   (iii) A   (iv) R

2. Draw any two triangles which have no lines of symmetry.

3. Draw only two objects from your neighbourhood that have no lines of symmetry.

4. Draw two English alphabets which show both horizontal as well as vertical symmetry.

5. Define tessellation.

6. **Draw lines of symmetry of the following figures, if possible.**

   a.   b.   c

   d.   e.   f.

7. Observe the patterns given below and try to write the entries which will come next.

$$1 \times 9 + 2 = \quad 11$$
$$12 \times 9 + 3 = \quad 111$$
$$123 \times 9 + 4 = \quad 1111$$
$$1234 \times 9 + 5 = \quad 11111$$

.... = ...

.... = ...

.... = ...

Make 6 words with the 1st letter possessing horizontal axis of symmetry.

Lab Activity

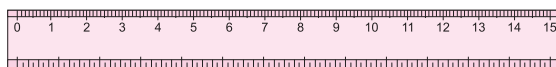|		
Objective	:	To understand that figures having same shapes and size are always symmetrical.
Materials Required	:	Ruler, pencil, scissors and a sheet of paper

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
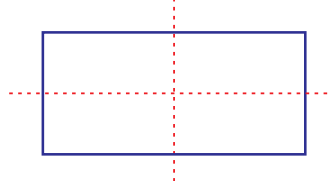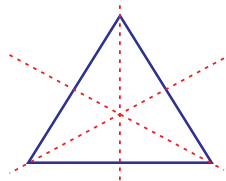
Sheet of paper   Ruler   Scissors   Pencil

Activities :

❖ Draw some figures, such as a triangle or a rectangle, having vertical/horizontal/more than two/infinite lines of symmetry on the sheet of paper.

❖ Cut them out.
❖ Fold them along the lines of symmetry to see if they are symmetrical or not.
❖ From this activity, you will understand that congruent figures (having same shape and same size) are always symmetrical.