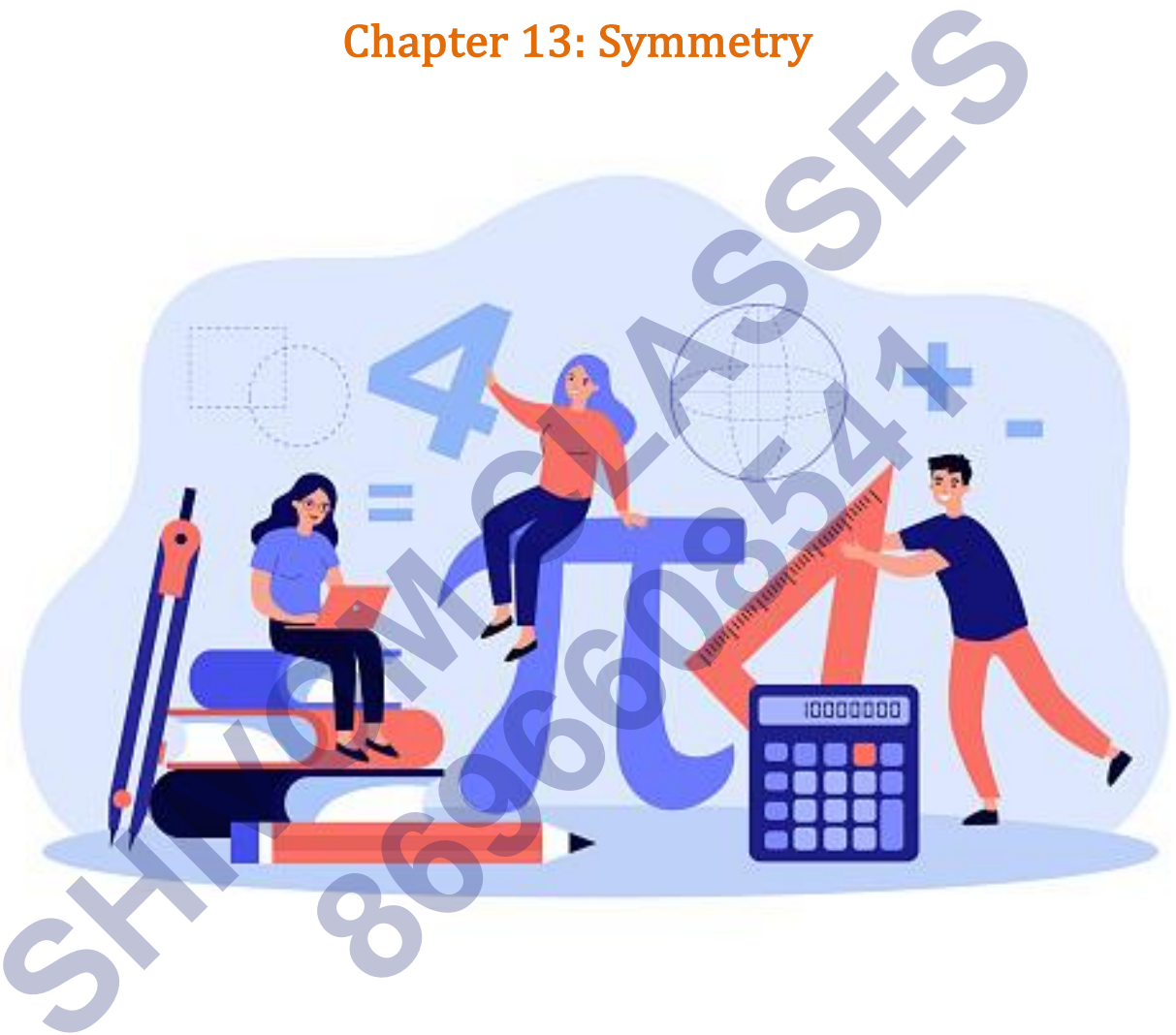


# MATHEMATICS

## Chapter 13: Symmetry

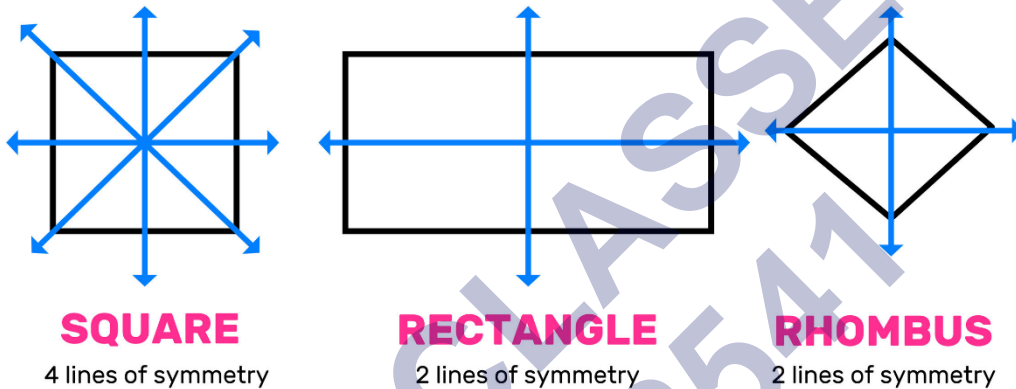


## SYMMETRY

### Symmetry And Line Of Symmetry Definition

The symmetry of an object is defined as one half of the object is a mirror image of the other half. When an object is split into half, both the sides are exactly the same. The line which divides them is called the line of symmetry. One simple example is reflection symmetry. The object can be divided into one or more than one lines of symmetry.

### Lines of Symmetry

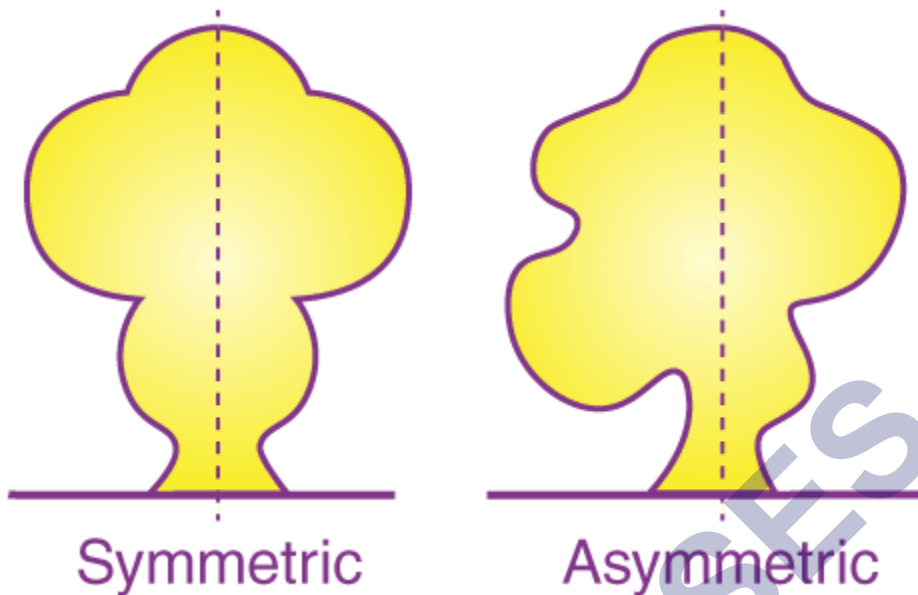


Below are some types of line of symmetry along with examples-

S.NO	Type	Example
1	No line of symmetry	Scalene triangle
2	1 line of symmetry	Isosceles triangle
3	2 lines of symmetry	Rectangle
4	3 lines of symmetry	Equilateral triangle

### Introduction to Symmetry

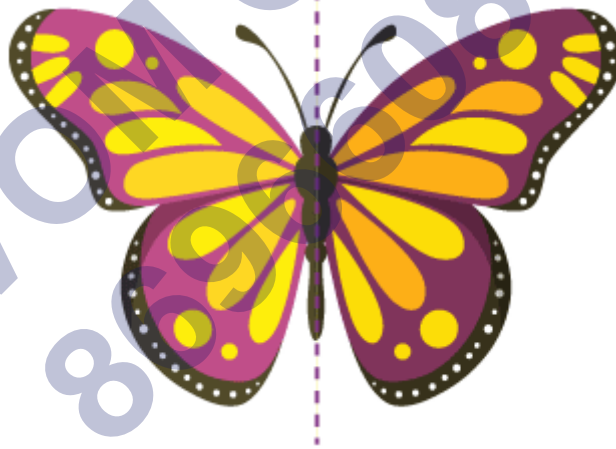
When figures have equally balanced proportions, they are said to be symmetrical.



### Bilateral symmetry

If a figure is divided into two halves by only one line and these halves overlap each other completely, then the figure is said to have bilateral symmetry.

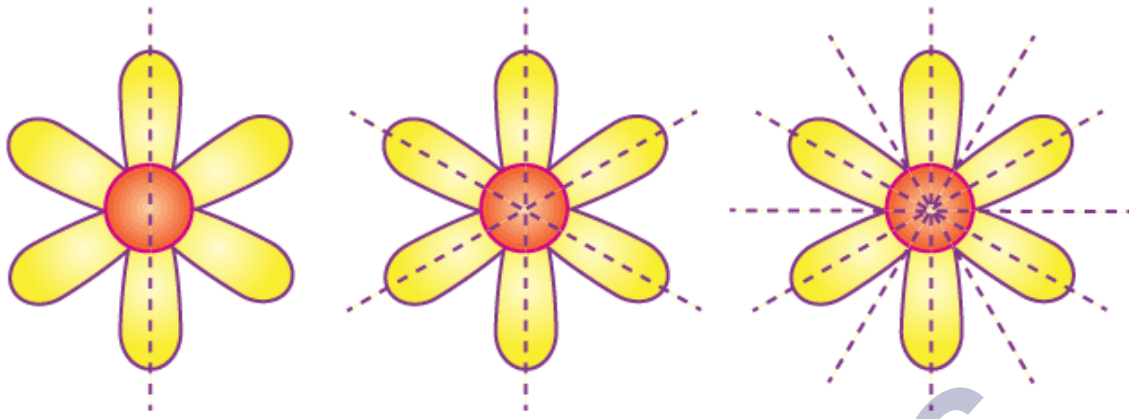
Example: A butterfly shows bilateral symmetry.



### Line symmetry

A figure has line symmetry if a line can be drawn dividing the figure into two symmetrical parts. The line is called a line of symmetry.

Example: The dotted lines in the following figures show line symmetry.



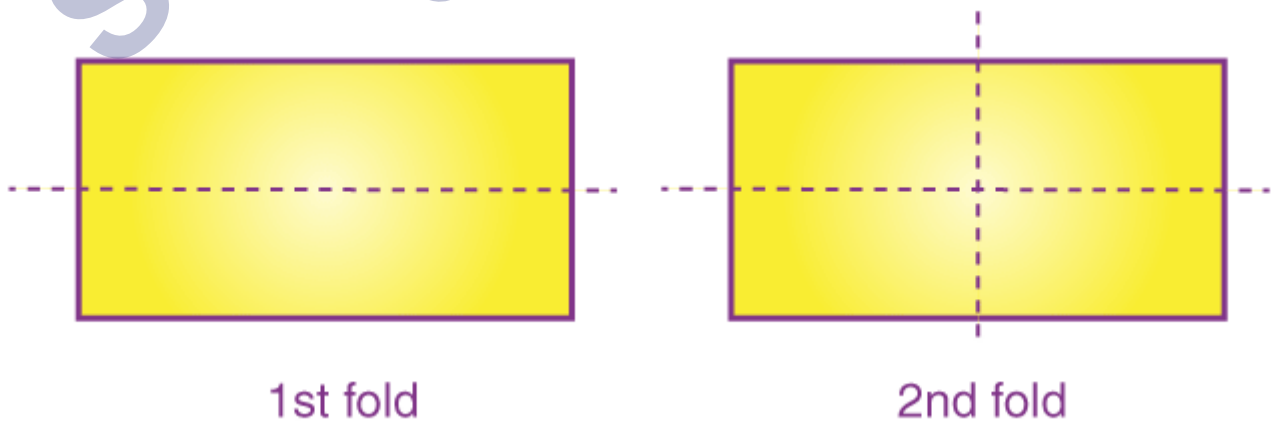
### Lines of symmetry

A figure can have any number of lines of symmetry passing through it. Some can have one, two or even multiple lines of symmetry.

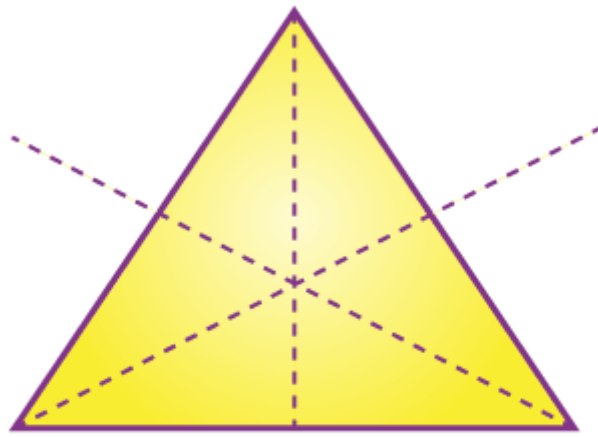
Example of a single line of symmetry: A door lock.



Example of two lines of symmetry: A rectangle.



Example of multiple lines of symmetry (two or more): an equilateral triangle.



3 lines of symmetry for an equilateral triangle

### Point Symmetry and Reflection Symmetry

#### Reflection Symmetry

Reflection symmetry is very similar to line symmetry except for the change in orientation.



For example, when you view yourself in the mirror, your right hand becomes the left hand in the mirror.

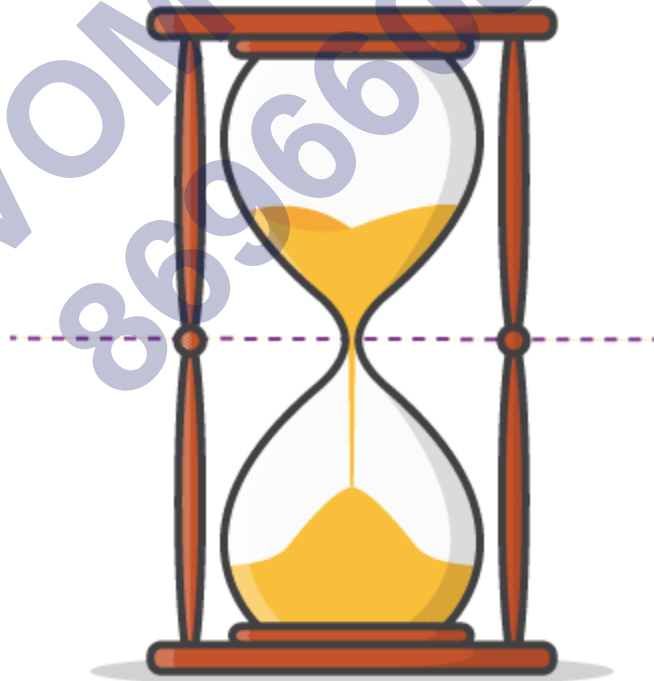


### Point Symmetry

Point symmetry exists when a figure is drawn around a single central point.

It is for figures having a point through which the symmetry can be established. This point is called the centre of symmetry.

For example, the hourglass shows point symmetry.



### Kaleidoscope

A kaleidoscope uses mirrors to produce images that have several lines of symmetry.



Usually, two mirror strips forming a V-shape are used.

The angle between the mirrors determines the number of lines of symmetry.

The figure below shows the pattern formed by a kaleidoscope.



### Principle Of Kaleidoscope

The basic principles used in the kaleidoscope are the law of reflection, and white light is a combination of VIBGYOR. When the white light hits the surface of the mirror, it gets reflected at an angle such that the angle of incidence is equal to the angle of reflection. Due to these multiple reflections of light, there is a creation of these beautiful patterns.

According to the second principle, white light passes through the coloured objects present in the kaleidoscope so that most of the light is absorbed by these objects.

### Kaleidoscope Uses

Kaleidoscope is an optical toy consisting of two mirrors at a particular angle. Some common uses of the kaleidoscope are:

Kaleidoscope produces beautiful patterns that are used by fashion designers.

A kaleidoscope is used as a toy for entertainment.

### How to Make A Kaleidoscope?

Create a kaleidoscope and enjoy the various colours and patterns. Kaleidoscope works on the principle of reflection. Let us learn how to make a kaleidoscope.

#### Things you will need:

Plastic (See-through and coloured)

Overhead Transparency Paper

Pencil

Masking/Duct tape (One Roll)

Mirrored Perspex (3 Pieces)

#### Procedure

Use the three pieces of mirrored perspex and roll them as tape in the form of a triangle. Try to ensure that it has a solid and it is taped on the outside of the triangle.

Sketch the small triangle located at the edge of the kaleidoscope to the overhead transparency paper (set aside 1 cm extra around the triangle to allow folding of the paper).

Keep the transparency paper to the kaleidoscope edge and cut the narrow openings at the corners, which would facilitate the folding of the corners easily.

Attach the paper into a separate place.

Make another triangle by drawing it, and this time it should be 2 cm larger than the earlier one

Choose the kind of plastic colour you would like to put inside the kaleidoscope. Take off small paper cuttings that would sit well on the transparent paper.

Place the coloured plastic at the end of the kaleidoscope that has a transparency paper and add another transparency paper (triangle) a little bigger than the earlier one. Keep the second triangle upside down so that there would be ample space for plastic to shift between the two transparencies.

Once you have finished making the kaleidoscope, design it beautifully with colours, glitters and so on.

#### What Happens Next?

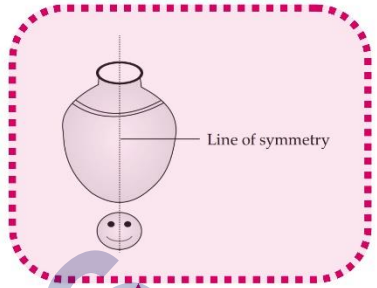
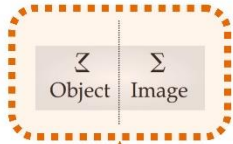
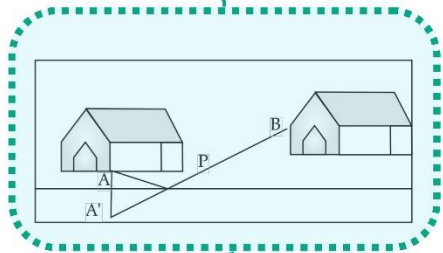


You might have noticed that the kaleidoscope works on white light shifting through the mirrors inside. When students look through the mirror, they will find different colour patterns owing to the symmetrical design formed by the mirrors placed at the right places.

Hope you have understood how to make a kaleidoscope. Give it a try and enjoy creating your kaleidoscope.

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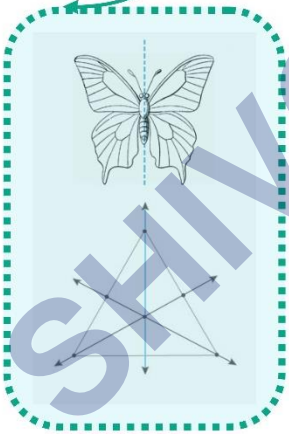
P is the ideal place for paper boy to park his cycle and deliver paper to both A and B (both with least walking distance).



If by folding a figure along a line, its left and right side coincide exactly, it is called a symmetrical figure.

Mirror

Application of Reflection and symmetry



Symmetry

Reflection and symmetry

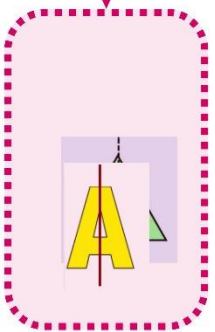
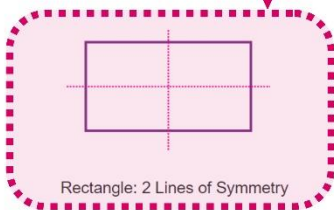
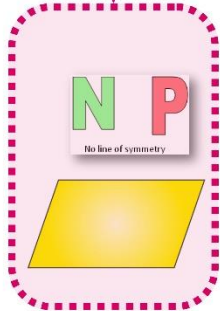
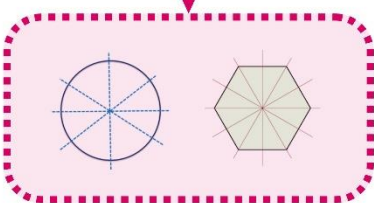
Line of symmetry

Figures with 1 line of symmetry

Figures with 2 line of symmetry

Figures with more than 2 lines of symmetry

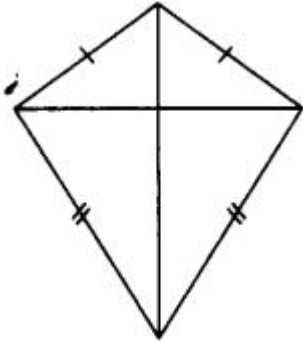
Figures with no line of symmetry



## Important Questions

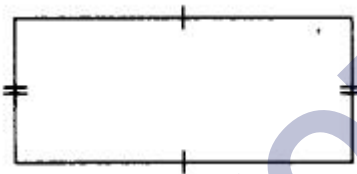
### Multiple Choice Questions:

Question 1. How many lines of symmetry does the figure have?



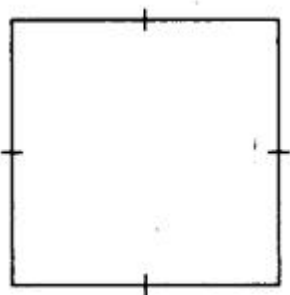
- (a) 1
- (b) 2
- (c) 3
- (d) 4

Question 2. How many lines of symmetry does the figure have?



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

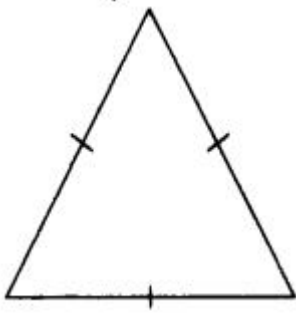
Question 3. How many lines of symmetry does the figure have?



- (a) 1
- (b) 2
- (c) 3

(d) 4

Question 4. How many lines of symmetry does the figure have?



(a) 1

(b) 2

(c) 3

(d) 4

Question 5. How many lines of symmetry does the figure have?



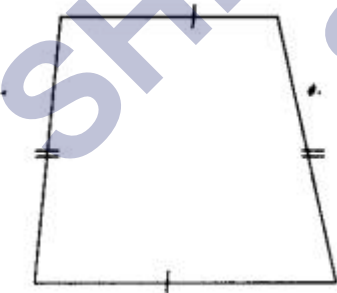
(a) 1

(b) 2

(c) 3

(d) 4

Question 6. How many lines of symmetry does the figure have ?



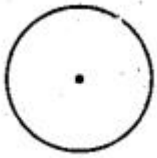
(a) 1

(b) 2

(c) 3

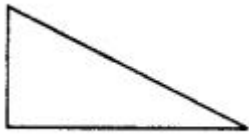
(d) no line of symmetry

Question 7. How many lines of symmetry does the figure have?



- (a) 1
- (b) 2
- (c) 3
- (d) Countless.

Question 8. How many lines of symmetry does the figure have?



- (a) 0
- (b) 1
- (c) 2
- (d) countless

Question 9. How many lines of symmetry does the figure have?



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

Question 10. How many lines of symmetry does a regular hexagon have?

- (a) 1
- (b) 3
- (c) 4
- (d) 6

Question 11. Which of the following letters has horizontal line of symmetry?

- (a) C
- (b) A
- (c) J
- (d) L.

Question 12. Which of the following letters has horizontal line of symmetry?

- (a) Z
- (b) V
- (c) U
- (d) E.

Question 13. Which of the following letters has horizontal line of symmetry?

- (a) S
- (b) W
- (c) D
- (d) Y.

Question 14. Which of the following letters has vertical line of symmetry?

- (a) R
- (b) C
- (c) B
- (d) T.

Question 15. Which of the following letters has vertical line of symmetry?

- (a) N
- (b) K
- (c) B
- (d) M.

### Match The Following:

	Column I		Column II
1.	Taj Mahal	A.	Horizontal & Vertical
2.	Scissor	B.	Symmetric Monument
3.	Letter 'l'	C.	No line of symmetry
4.	Scalene triangle	D.	One line of symmetry

### Fill in the blanks:

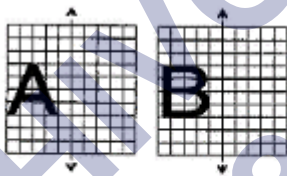
1. The geometrical figure \_\_\_\_\_ has 2 lines of symmetry.
2. The alphabet 'A' has \_\_\_\_\_ line of symmetry.
3. The circle has \_\_\_\_\_ line of symmetry.
4. The flower which has lines of symmetry is \_\_\_\_\_.

### True /False:

1. Number 'zero' has no line of symmetry.
2. Alphabet 'Z' has horizontal line of symmetry.
3. An image in the mirror is as far behind the mirror as the object in front of mirror.
4. Symmetrical objects are identical to each other.

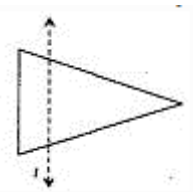
### Very Short Questions:

1. Name 2 symmetrical pulses
2. What is another name of line of symmetry?
3. In each figure alongside, a letter of the alphabet is shown along with a vertical line. Take the mirror image of the letter in the given line. Find which letters look the same after reflection (i.e., which letters look the same in the image), and which do not. Can you guess why?



Try for O E M N P H L T S V X

4. In the figure, l is the line of symmetry. Draw the image of the triangle and complete the diagram so that it becomes symmetric.

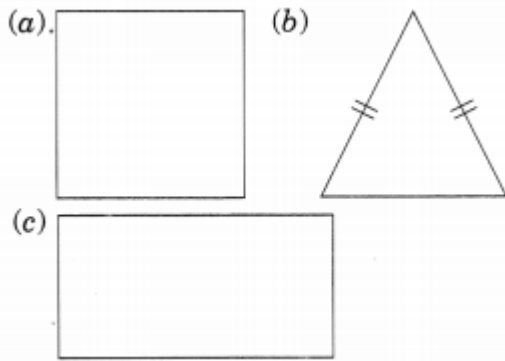


5. Draw 3-shape which is not polygon. Draw line of symmetry in it.
6. In environment butterfly are found colourful butterfly are the gift of nature. Does all butterfly have the line of symmetry?
7. What is symmetry? Name all type of symmetry.

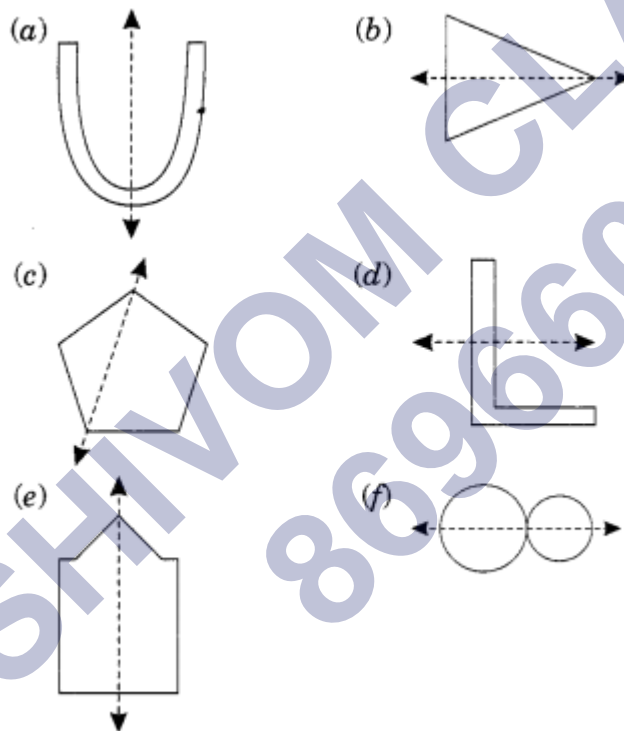
8. Write four such English letters which have no line of symmetry.
9. Write 5 such English letters which have horizontal line of symmetry.
10. Write 4 English letters which have vertical lines of symmetry.

### Short Questions:

1. How many symmetrical lines do they have?

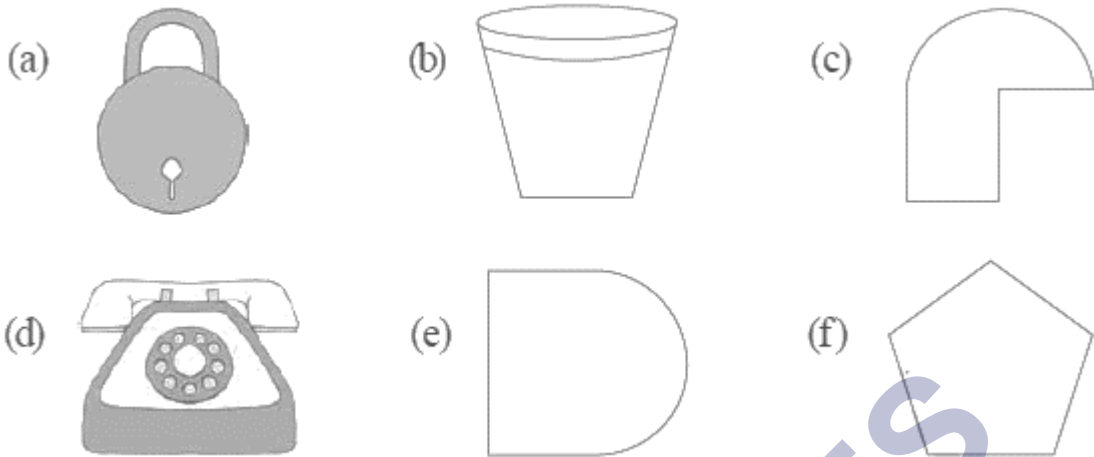


2. Find in which of the following, the dotted line is a line of symmetry.



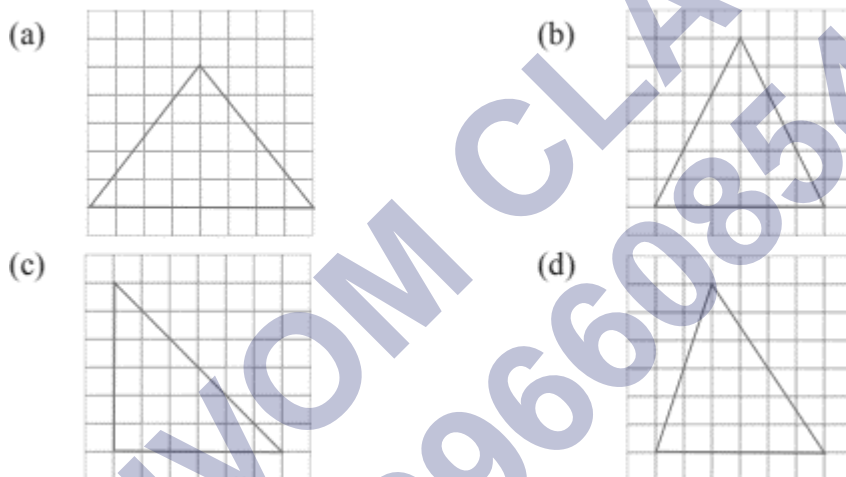
3. How many lines of symmetry does (a) a rectangle (b) a square (c) a parallelogram have? What about right angled triangle?
4. Show by figure the English alphabets which look the same in their reflected image.
5. Identify the shapes given below. Check whether they are symmetric or not. Draw the line of symmetry as well.





### Long Questions:

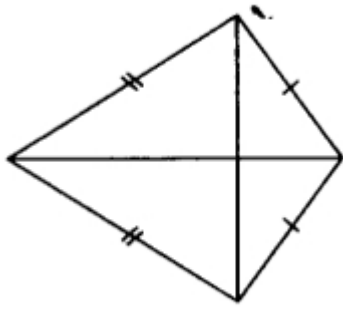
- Copy the triangle in each of the following figures on squared paper. In each case, draw the line(s) of symmetry, if any and identify the type of triangle. (Some of you may like to trace the figures and try paper-folding first!)



- Can you draw a triangle which has
  - exactly one line of symmetry?
  - exactly two lines of symmetry?
  - exactly three lines of symmetry?
  - no lines of symmetry
- Consider the letters of English alphabets, A to Z. List among them the letters which have
  - vertical lines of symmetry (like A)
  - horizontal lines of symmetry (like B)
  - no lines of symmetry (like Q)

### Assertion and Reason Questions:

- Assertion (A) –



**Reason (R)** – The *symmetry* of an object is defined as one half of the object is a mirror image of the other half

- a) Both A and R are true and R is the correct explanation of A
- b) Both A and R are true but R is not the correct explanation of A
- c) A is true but R is false
- d) A is false but R is true

**2.) Assertion (A)** –



**Reason (R)** – The *symmetry* of an object is defined as one half of the object is a mirror image of the other half

- a) Both A and R are true and R is the correct explanation of A
- b) Both A and R are true but R is not the correct explanation of A
- c) A is true but R is false
- d) A is false but R is true

**ANSWER KEY -****Multiple Choice questions:**

1. (a) 1
2. (b) 2
3. (d) 4
4. (c) 3
5. (a) 1
6. (d) no line of symmetry
7. (d) Countless.
8. (a) 0
9. (b) 2
10. (d) 6
11. (a) C
12. (d) E.
13. (c) D
14. (d) T.
15. (d) M.

**Match The Following:**

	Column I		Column II
1.	Taj Mahal	B.	Symmetric Monument
2.	Scissor	D.	One line of symmetry
3.	Letter 'l'	A.	Horizontal & Vertical
4.	Scalene triangle	C.	No line of symmetry

**Fill in the blanks:**

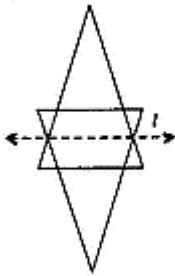
1. The geometrical figure **Rectangle or Rhombus** has 2 lines of symmetry.
2. The alphabet 'A' has **Vertical-One** line of symmetry.
3. The circle has **Infinite** line of symmetry.
4. The flower which has lines of symmetry is **Sunflower**.

**True /False:**

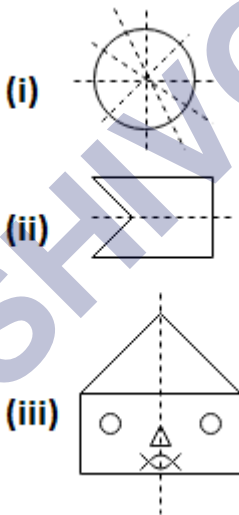
1. False
2. False
3. True
4. True

**Very Short Answer:**

1. Gram and moong
2. Another name of line of symmetry is axis of symmetry.
3. The letters O, M, H, T, V and X look the same after reflections because these letters have 1 vertical line of symmetry.
- 4.



5.



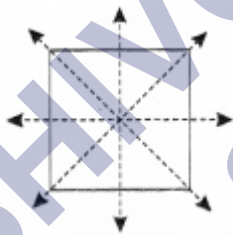
6. Yes, all the butterfly have the line of symmetry.  
Rough figure and axis of symmetry is as follows:



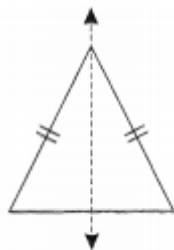
7. Symmetry refers to the exact match in shape and size between two halves of an object. It shows the proportional. There are three types of symmetry-
  - (i) Line of symmetry or axis of symmetry
  - (ii) Mirror symmetry
  - (iii) Rotational symmetry
8. The 4 English letters having no line of symmetry are: P, F, G and Z.
9. The required letters are:  
E, B, C, D, K
10. The required English letters are A, H, I, M

### Short Answer:

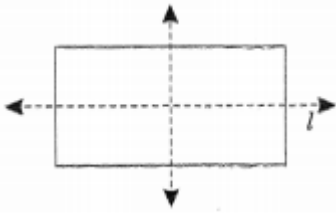
1. (a) The figure is a square. It has 4 lines of symmetry.



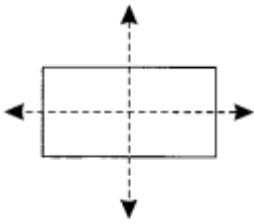
- (b) It is an isosceles triangle. It has one vertical line of symmetry.



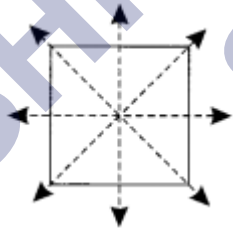
- (c) The given figure is a rectangle which has two lines of symmetry.



2. (a) The dotted line is a line of symmetry.  
 (b) The dotted line is a line of symmetry.  
 (c) The dotted line is not a line of symmetry.  
 (d) The dotted line is not a line of symmetry.  
 (e) The dotted line is a line of symmetry.  
 (f) The dotted line is a line of symmetry
3. (a) Rectangle has two lines of symmetry  
 (i) Horizontal  
 (ii) Vertical



- (b) Square has four lines of symmetry.  
 (i) 1 horizontal  
 (ii) 1 vertical  
 (iii) 2 diagonally



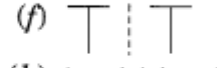
- (c) Parallelogram has no lines of symmetry



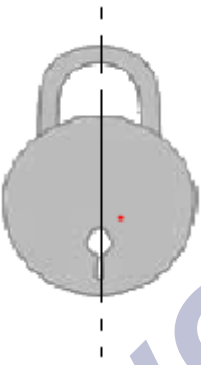
Right angled triangle has no line of symmetry.



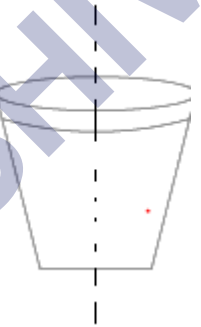
4.



5. (a) This is symmetrical

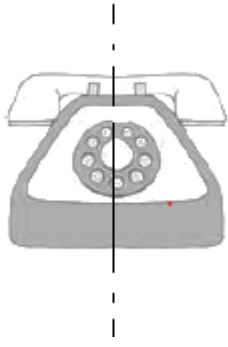


(b) This is symmetrical

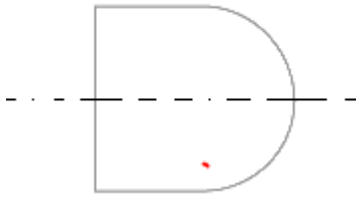


(c) This is not symmetrical

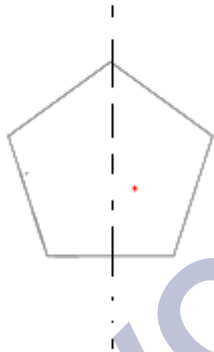
(d) This is symmetrical



(e) This is not symmetrical

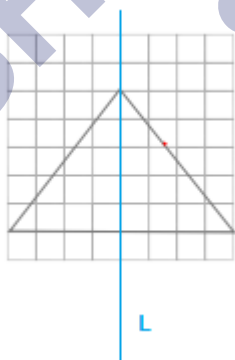


(f) This is symmetrical



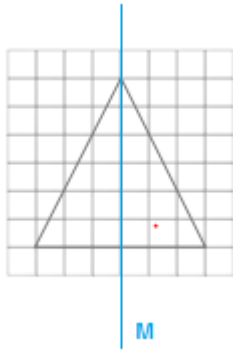
### Long Answer:

1. (a) This figure has line of symmetry as L

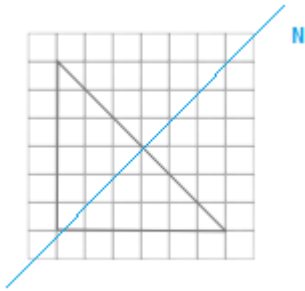


(b) This figure has line of symmetry as M





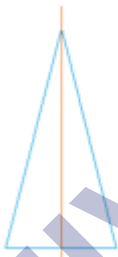
(c) This figure has line of symmetry as N



(d) There is no line of symmetry

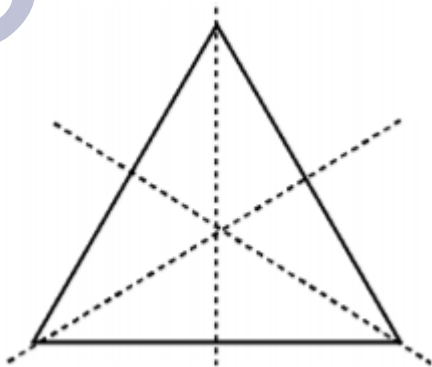
2. (a) Isosceles Triangle

Number of lines of Symmetry: 1



(b) It is not possible to draw which has two lines of symmetry

(c) Equilateral Triangle



(d) Scalene triangle where all sides are different



3. a) A,H,I,M,O,T,U,V,W,X,Y  
b) B,C,D,E,H,I,K,O,X  
c) F,G,J,L,N,P,Q,R,S,Z

### Assertion and Reason Answers:

- 1) a) Both A and R are true and R is the correct explanation of A  
2) a) Both A and R are true and R is the correct explanation of A

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