CHAPTER 12

VII-MATHEMATICS-NCERT-2023-24

12. Symmetry(Notes)

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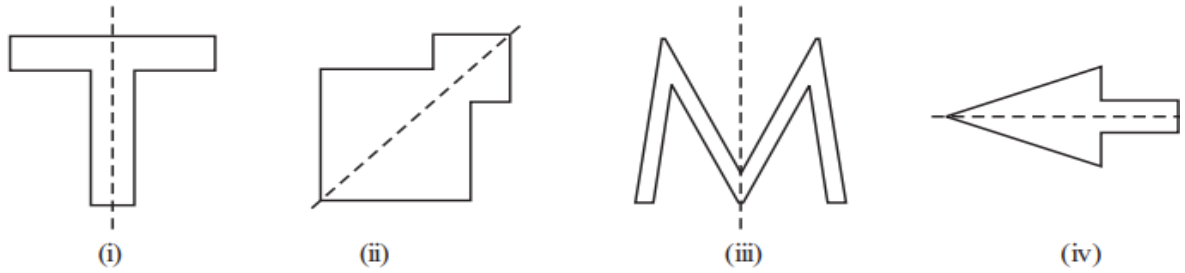
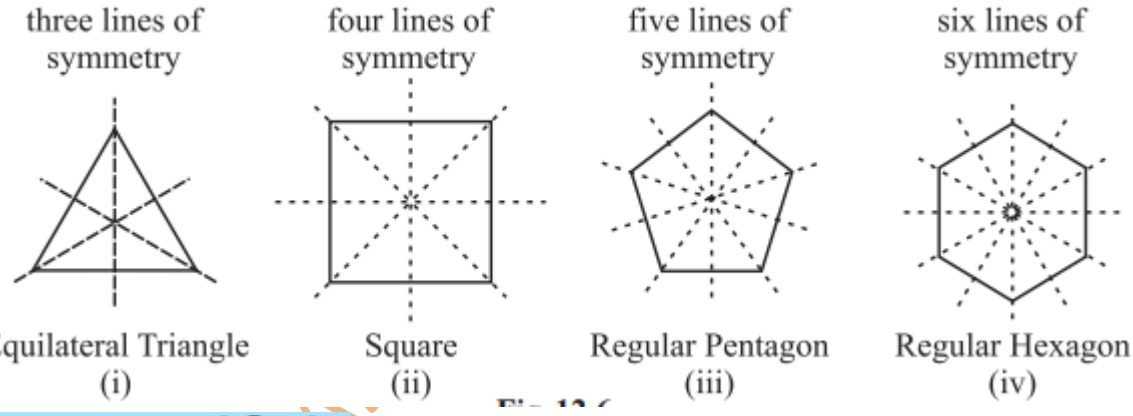
1. If a line divides the given figure into two coincidental parts, then the figure is said to be 'symmetrical' and the line is called the 'axis of symmetry' or 'line of symmetry'.
2. A figure can have one or more than one lines of symmetry or axes of symmetry.



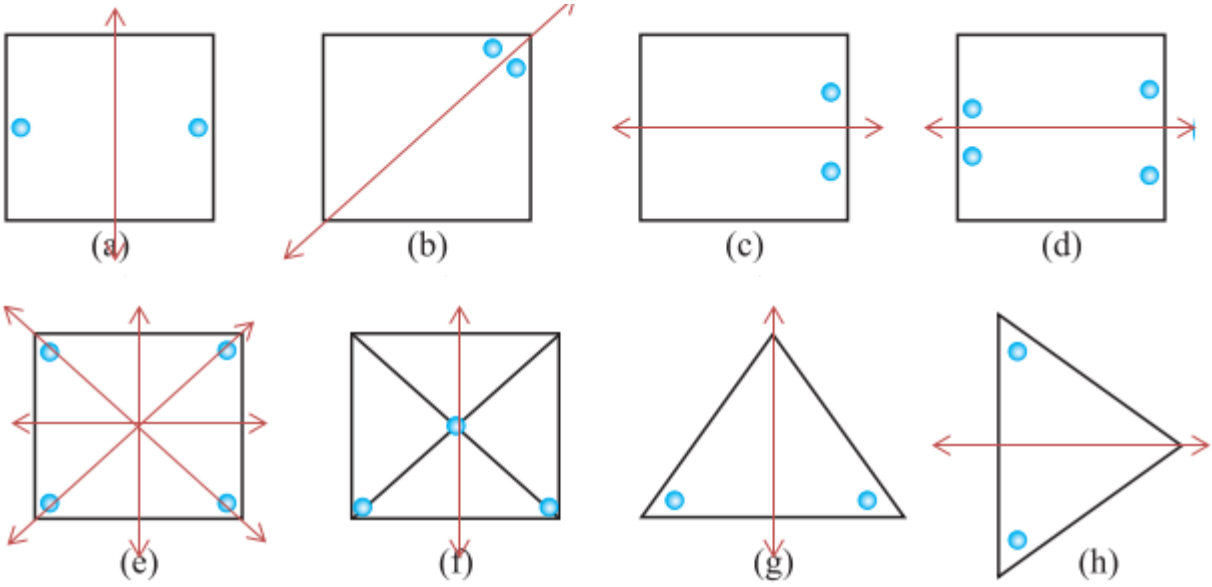
LINES OF SYMMETRY FOR REGULAR POLYGONS

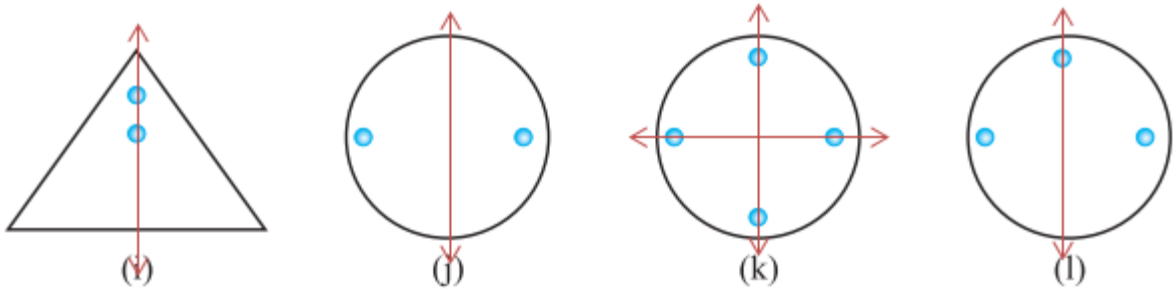
3. A polygon is said to be regular if all its sides are of equal length and all its angles are of equal measure,
4. An equilateral triangle is a regular polygon of three sides.
5. A square is a regular polygon of four sides.
6. Regular polygons have multiple (i.e., more than one) lines of symmetry.



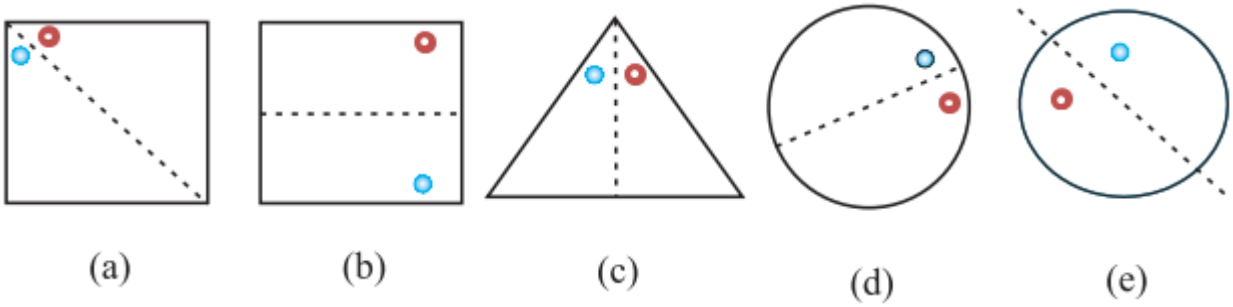
EXERCISE 12.1

1. **Copy the figures with punched holes and find the axes of symmetry for the following:**

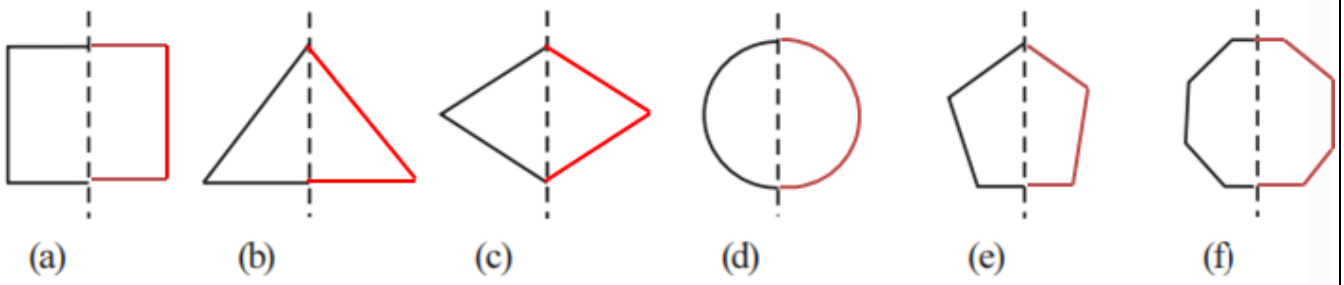




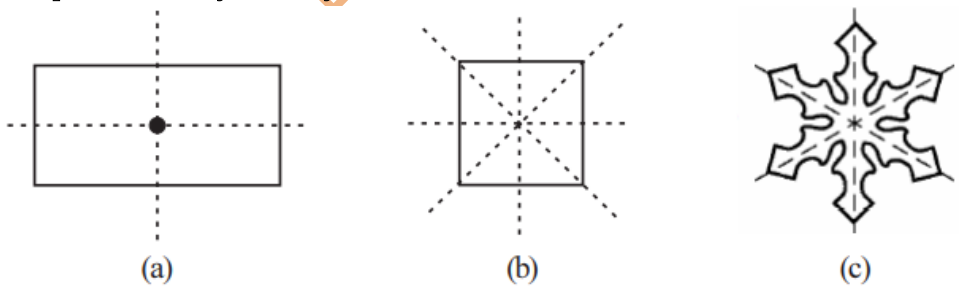
2. Given the line(s) of symmetry, find the other hole(s):



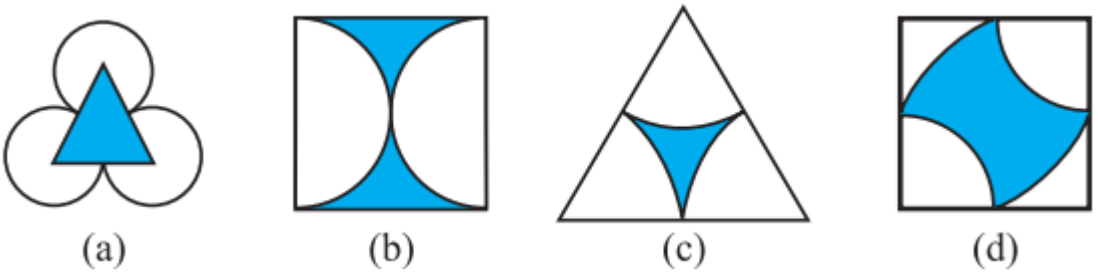
3. In the following figures, the mirror line (i.e., the line of symmetry) is given as a dotted line. Complete each figure performing reflection in the dotted (mirror) line. (You might perhaps place a mirror along the dotted line and look into the mirror for the image). Are you able to recall the name of the figure you complete?

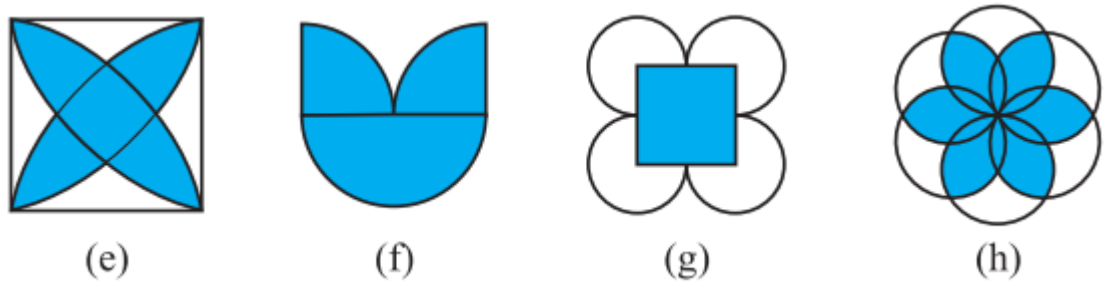


4. The following figures have more than one line of symmetry. Such figures are said to have multiple lines of symmetry.

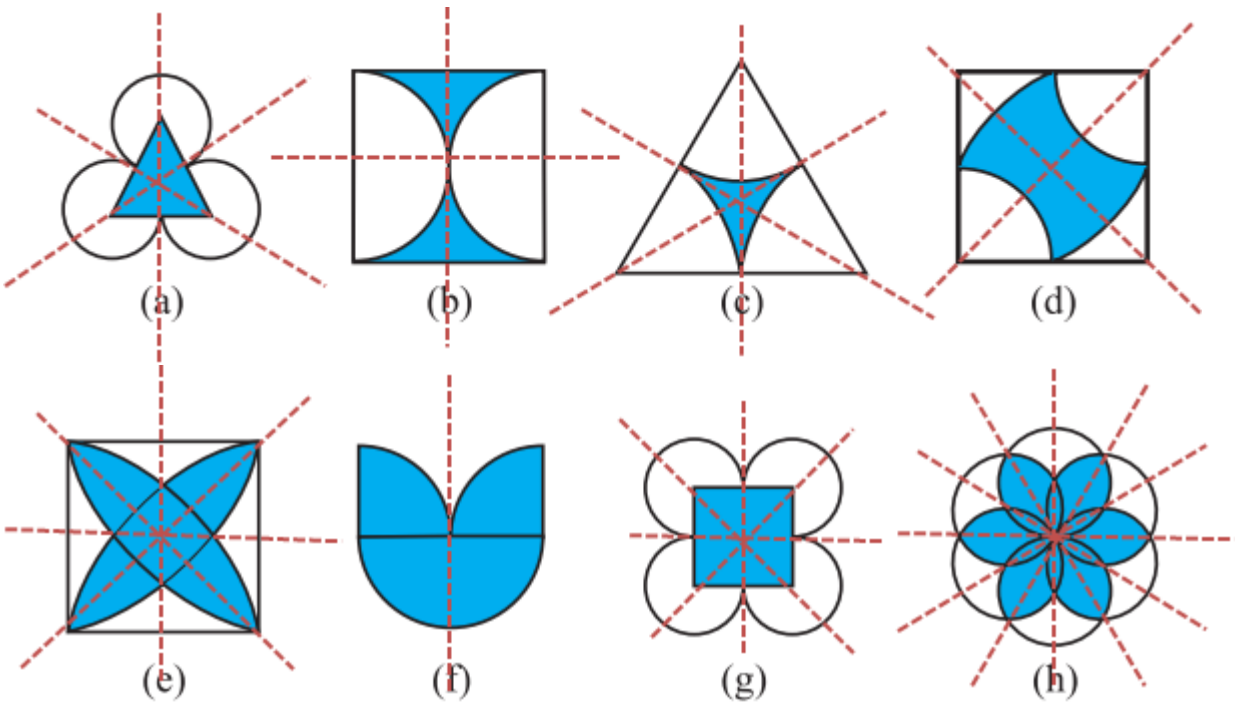


Identify multiple lines of symmetry, if any, in each of the following figures:

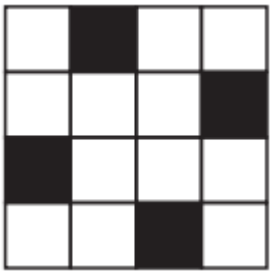




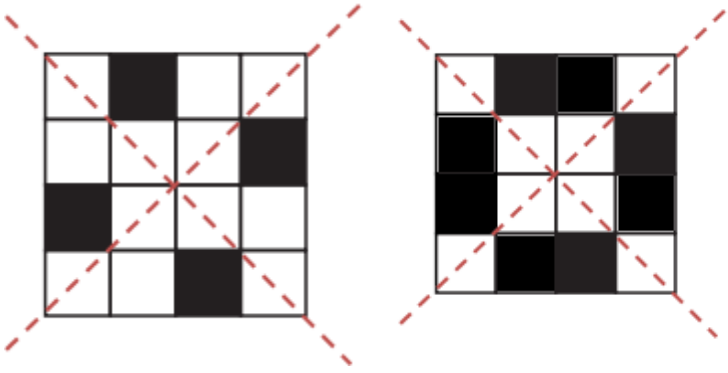
Sol:



5. Copy the figure given here.
Take any one diagonal as a line of symmetry and shade a few more squares to make the figure symmetric about a diagonal. Is there more than one way to do that? Will the figure be symmetric about both the diagonals?

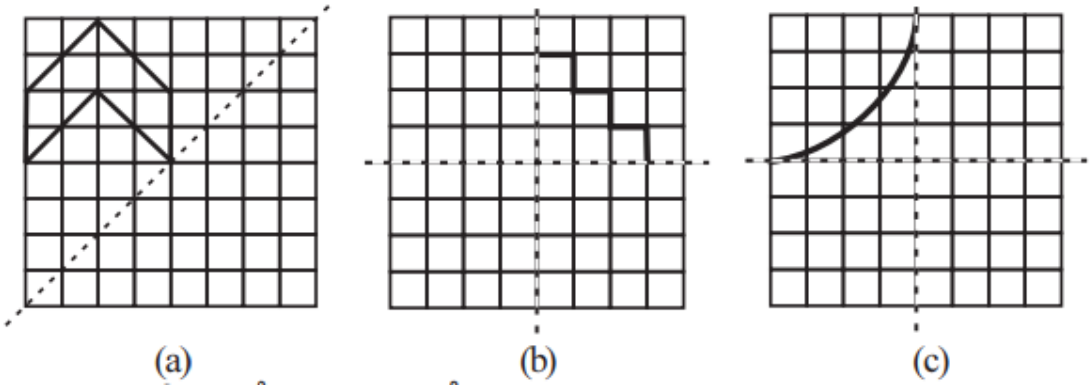


Sol: Yes, the figure is symmetric about the diagonals.

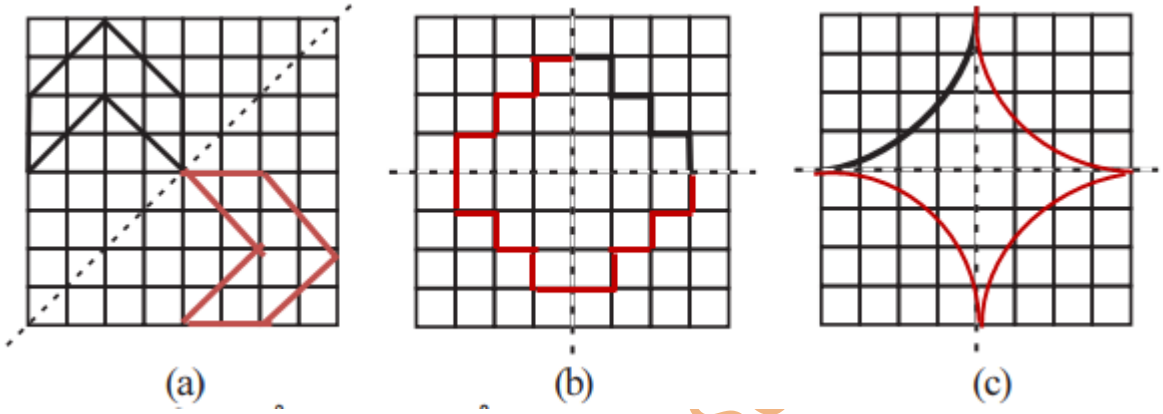


There is more than one way so as to make the figure symmetric about a diagonal as we can choose any of its 2 diagonals.

6. Copy the diagram and complete each shape to be symmetric about the mirror line(s):



Sol:



7. State the number of lines of symmetry for the following figures:

(a) An equilateral triangle -3
(b) An isosceles triangle -1
(c) A scalene triangle -0
(d) A square -4
(e) A rectangle-2
(f) A rhombus -2
(g) A parallelogram -0
(h) A quadrilateral -0
(i) A regular hexagon -6
(j) A circle-Infinitely many

8. What letters of the English alphabet have reflectional symmetry (i.e., symmetry related to mirror reflection) about?

(a) a vertical mirror
Sol: A,H,I,M,O,T,U,V,W,X,Y
(b) a horizontal mirror
Sol: B,C,D,E,H,I,K,O,X
(c) both horizontal and vertical mirrors.
Sol: H,I,O,X

9. **Give three examples of shapes with no line of symmetry.**

Sol: (1) A Scalene triangle (2) A Quadrilateral (3) A Parallelogram.

10. What other name can you give to the line of symmetry of (a) an isosceles triangle? (b) a circle?

Sol: (a) Median or altitude.

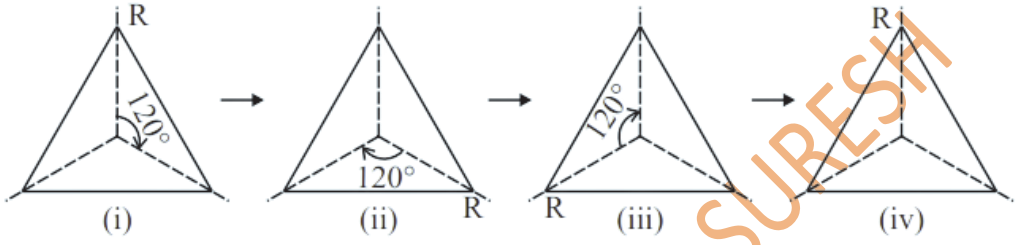
(b) Diameter.

12.3 Rotational Symmetry

(i) If, after a rotation, an object looks exactly the same, we say that it has a rotational symmetry.
(ii) The rotation turns an object about a fixed point. This fixed point is the centre of rotation.
(iii) The angle by which the object rotates is called the angle of rotation.
(iv) In a complete turn (of 360^0), the number of times an object looks exactly the same is called the order of rotational symmetry.
(v) A half-turn means rotation by 180°; a quarter-turn is rotation by 90°.
(vi) The order of symmetry of a square is 4 .
(vii) The order of symmetry of an equilateral triangle is 3.

Try These

1. (a) Can you now tell the order of the rotational symmetry for an equilateral triangle?



Sol: The order of the rotational symmetry for an equilateral triangle is 3

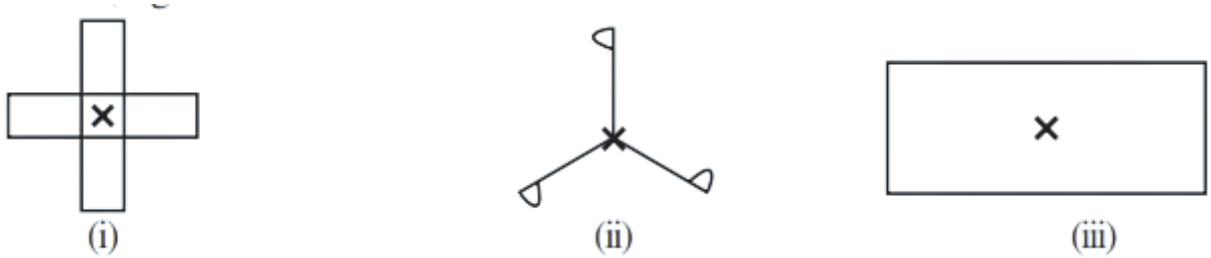
(b) How many positions are there at which the triangle looks exactly the same, when rotated about its centre by 120°?
Sol: 3

2. Which of the following shapes (Fig 12.15) have rotational symmetry about the marked point.

Sol: (i) 2 (ii) 4 (iii) 1 (iv) 5

Try These

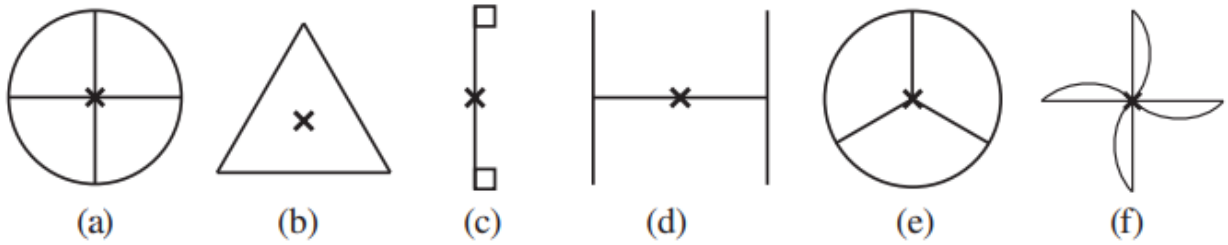
Give the order of the rotational symmetry of the given figures about the point marked (Fig 12.17).



Sol: (i) 4 (ii) 3 (iii) 2

EXERCISE 12.2

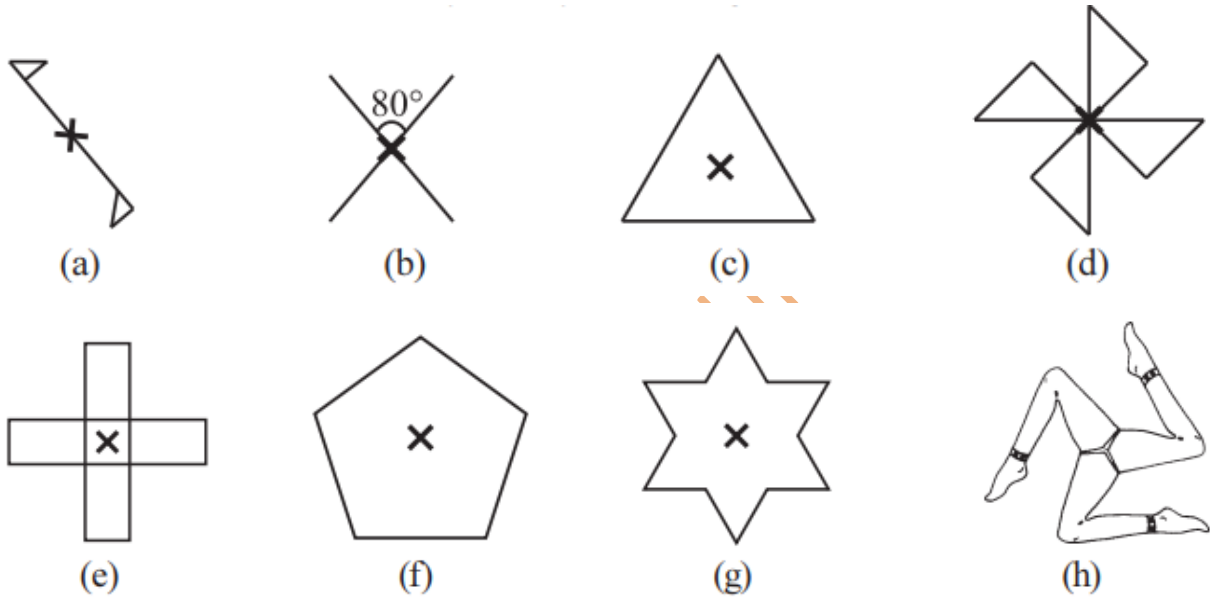
1. Which of the following figures have rotational symmetry of order more than 1:



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

Sol: Order of rotational symmetry for (a) 4, (b) 3, (c) 1, (d) 2,(e)3, (f)4.

2. Give the order of rotational symmetry for each figure:



(a) (b) (c) (d)

(e) (f) (g) (h)

Sol:

Figure	order of rotational symmetry
(a)	1
(b)	2
(c)	3
(d)	4
(e)	4
(f)	5
(g)	6
(h)	3

12.4 LINE SYMMETRY AND ROTATIONAL SYMMETRY

Some shapes have only line symmetry (Ex: **E**), some have only rotational symmetry (Ex: **S**) and some have both line symmetry and rotational symmetry (Ex: **H**)

DO THIS

Fill the blanks in the following table:

Alphabet Letters	Line Symmetry	Number of Lines of Symmetry	Rotational Symmetry	Order of Rotational Symmetry
Z	No	0	Yes	2
S	No	0	Yes	2
H	Yes	2	Yes	2
O	Yes	Infinite	Yes	Infinite
E	Yes	1	No	1
N	No	0	Yes	2
C	Yes	1	No	1

EXERCISE 12.3

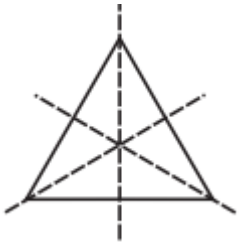
1. **Name any two figures that have both line symmetry and rotational symmetry.**

Sol: Square, Circle, Equilateral triangle,...

2. **Draw, wherever possible, a rough sketch of**

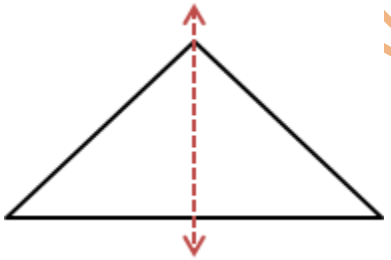
(i) **a triangle with both line and rotational symmetries of order more than 1.**

Sol: An equilateral triangle. (Order of line symmetry is 3 and order of rotational symmetry is 3)



(ii) a triangle with only line symmetry and no rotational symmetry of order more than 1.

Sol: Isosceles triangle (Order of line symmetry is 1 and order of rotational symmetry is 1)

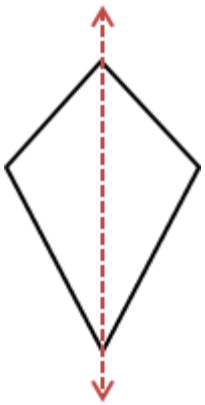


(iii) a quadrilateral with a rotational symmetry of order more than 1 but not a line symmetry.

Sol: Parallelogram (order of rotational symmetry is 2 but no line symmetry)

(iv) a quadrilateral with line symmetry but not a rotational symmetry of order more than 1.

Sol: A kite



3. If a figure has two or more lines of symmetry, should it have rotational symmetry of order more than 1?

Sol: Yes.

4. Fill in the blanks:

Shape	Centre of Rotation	Order of Rotation	Angle of Rotation
Square	Intersecting point of diagonals	4	90^0
Rectangle	Intersecting point of diagonals	2	180^0
Rhombus	Intersecting point of diagonals	2	180^0
Equilateral Triangle	Intersecting point of medians	3	120^0
Regular Hexagon	Intersecting point of diagonals	6	60^0
Circle	Centre of the circle	Infinite	At every point
Semi-circle	Centre of the circle	1	360^0

5. Name the quadrilaterals which have both line and rotational symmetry of order more than 1.

Sol: Square.

6. After rotating by 60° about a centre, a figure looks exactly the same as its original position. At what other angles will this happen for the figure?

Sol: $120^0, 180^0, 240^0, 300^0, 360^0$ (Multiples of 60^0)

7. Can we have a rotational symmetry of order more than 1 whose angle of rotation is (i) 45°? (ii) 17°?

Sol: (i)Yes (45^0 is a factor of 360^0)

(ii) No (17^0 is not a factor of 360^0)