Geometry

5.1 LINES

If we join any two points with a ruler and extend it on both sides, then a line is formed.
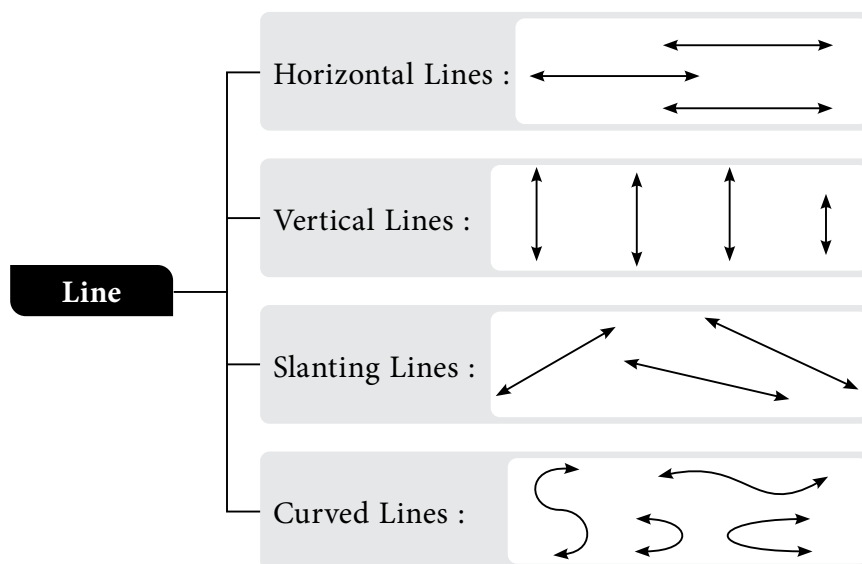
Line Segment

A line segment is a part of a line. It has a fixed length and two end points.

Ray

A ray is also a part of a line. It does not have a definite length. It has only one end point.

Intersecting Lines

When two or more lines cross over each other or meet at a point, then they are said to be intersecting lines.
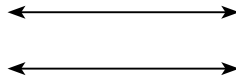
💡 *Olympiad Bite*

- A line is represented by the arrowheads on both the sides to indicate that the line can go on in both directions.
- A ray is represented by the arrowhead on one side to indicate that the line can go in one direction.
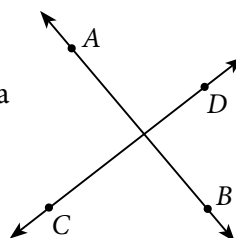
Parallel Lines

When two or more lines never meet, they are said to be parallel lines.
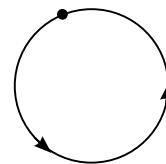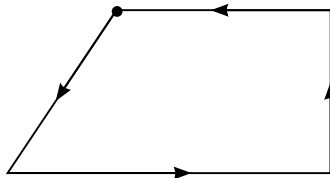
5.2 CLOSED AND OPEN FIGURES

Closed Figure

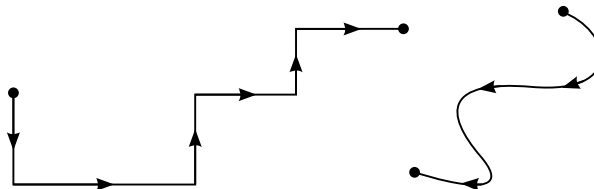A figure which has the same start point and end point is called closed figure.
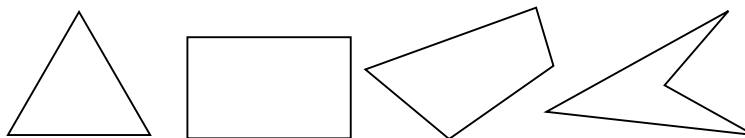
For example :

Open Figure

Figures which are not closed or in which start point and end point are not same are called open figures.

For example :

5.3 POLYGONS

Polygons are simple, closed shapes made up of three or more straight line segments.

Polygons

Triangles
It is a polygon with three sides only.

Quadrilaterals
It is a polygon with four sides only.

Scalene Triangle
A triangle in which all sides are of different lengths.

Square
A quadrilateral in which all sides are equal.

Rectangle
A quadrilateral in which only opposite sides are equal.

Equilateral Triangle
A triangle in which all sides are of equal length.

Isosceles Triangle
A triangle in which only two sides are of equal length.

1. Which of the following figures is open?

(A)

(B)

(C)

(D)

2. Find the number of horizontal lines in the given figure.

(A) 5 (B) 6
(C) 8 (D) 4

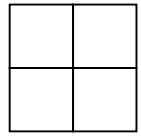**3.** Which of the following is not true for the given figure?
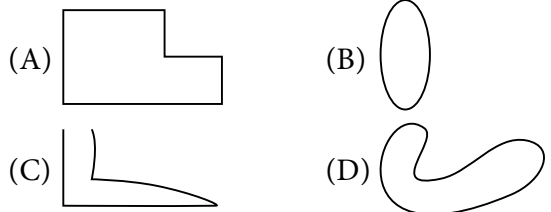
(A) $\overline{EF}$ and $\overline{GH}$ are parallel lines.

(B) P is the intersection point of line $\overline{AB}$ and $\overline{CD}$

(C) $\overline{AB}$ is parallel to $\overline{EF}$.

(D) $\overline{CD}$ and $\overline{GH}$ are intersecting lines.
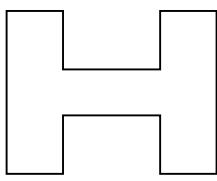
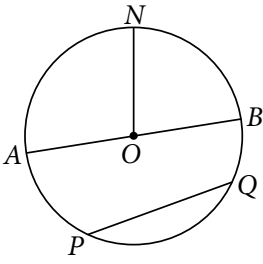**4.** How many squares are there in the given figure?

(A) 4 (B) 5
(C) 3 (D) 6
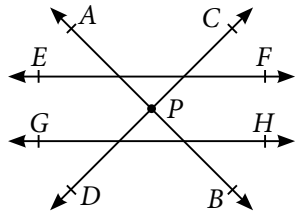
5. Number of slanting lines in the given figure is _____.
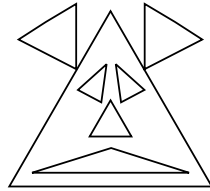
(A) 12 (B) 18
(C) 15 (D) 16

5.4 CIRCLES

Circle is a simple closed curve in which all points on it are at the same distance from a fixed point.

Centre of a Circle

The fixed point from which the distance of all points on a circle is same is called centre of the circle. Here, *O* is the centre of the circle.

Radius of a Circle

The distance between the centre and any point on the circle is called radius of the circle. Here, *ON*, *OB*, *OA* are radius of circle.

Chord of a Circle

A line segment obtained by joining any two points on a circle is called chord of the circle. Here, *PQ* and *AB* are chords of circle.
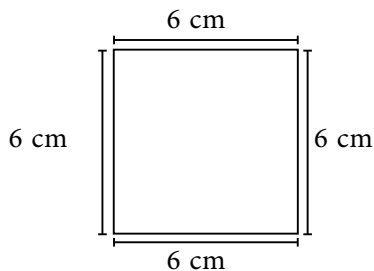
Diameter

A chord of a circle which passes through the centre of the circle is called diameter of the circle. Here, *AB* is the diameter of circle.
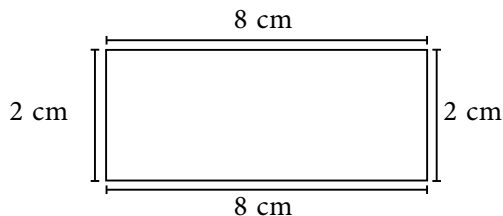
5.5 PERIMETER

The distance around a two-dimensional shape is called perimeter. Perimeter of any polygon is same as sum of all of its sides.
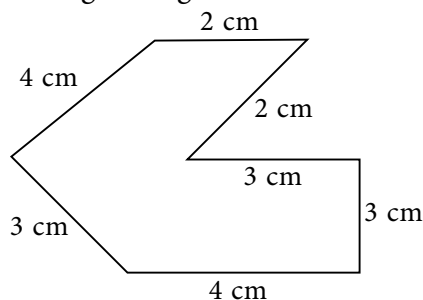
Square

Perimeter = 6 cm + 6 cm + 6 cm + 6 cm = 24 cm

Rectangle

Perimeter = 8 cm + 2 cm + 8 cm + 2 cm = 20 cm

For example : Find the perimeter of the given figure.

Perimeter = 2 cm + 2 cm + 3 cm + 3 cm + 4 cm + 3 cm + 4 cm = 21 cm

5.6 NET OF GEOMETRICAL SHAPES

Net of a geometrical shape is a 2-dimensional shape that can be folded to form a 3-dimensional shape. There are different types of net of a solid, depending upon how you fold it.

Net of Cube

Net of a cube has 6 faces and all are squares.

Net of Cuboid

Net of cuboid has 6 faces, in which pair of opposite faces are same.

Net of Cylinder

Net of cylinder has 3 faces, of which one is rectangle and two are identical circles.

Net of Cone

Net of cone has 2 faces, of which one is triangle and other is circle.

5.7 SYMMETRY

An object is said to be symmetrical when one half of it is the mirror image of the other half. The line which divides an object or shape into two halves to obtain symmetry is called line of symmetry.

For example :

Line of symmetry   Line of symmetry

SELF TEST - 2

1. Find the number of lines of symmetry of the given figure.

(A) 0   (B) 1
(C) 2   (D) 3

2. Which of the following is a net of the given solid?

(A)   (B)

(C)   (D)

3. Diameter of a circle is _____ the radius of the same circle.
(A) One-third   (B) Less than
(C) Equal to   (D) Twice

4. A _____ is a simple closed figure in which all points on it are at the same distance from a fixed point.
(A) Triangle   (B) Circle
(C) Rectangle   (D) Quadrilateral

5. If the perimeter of a square is 16 cm, then find the side of square.
(A) 5 cm   (B) 4 cm
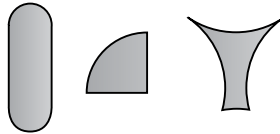(C) 8 cm   (D) 2 cm

EXERCISE

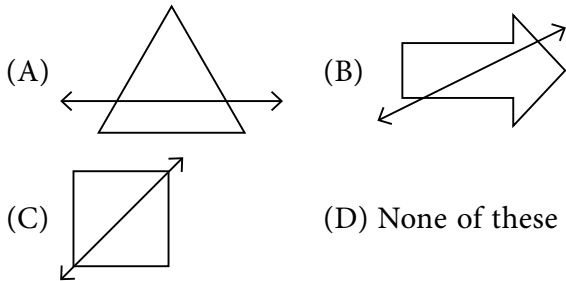**1.** Find the number of triangles in the given figure.
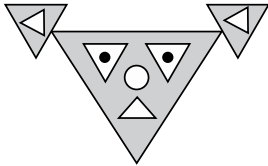
(A) 5 (B) 6
(C) 7 (D) 8

2. How many of the given figures are symmetric?

(A) 1 (B) 2
(C) 3 (D) 0

3. Which of the following figures correctly shows a line of symmetry?

(A)

(B)

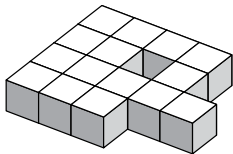(C)

(D) None of these

4. How many of the following are polygons?

(A) 5 (B) 3
(C) 4 (D) 2

5. If radius of a circle is 5 cm, then diameter of the circle is _____.
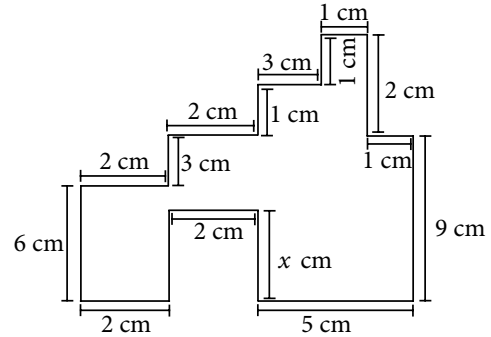
(A) 5 cm (B) 12 cm
(C) 10 cm (D) 6 cm

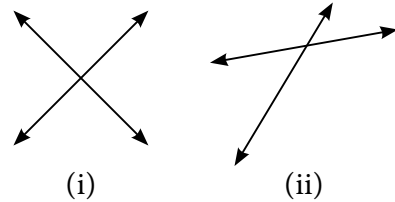**6.** Find the number of cubes in the given figure.

(A) 13 (B) 15
(C) 11 (D) 10

7. Find the value of x, if the perimeter of the given figure (not drawn to scale) is 50 cm.

(A) 10 (B) 5
(C) 15 (D) 6

8. Which of the following figures shows the pair of intersecting lines?
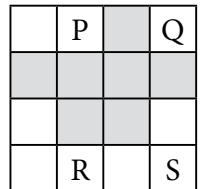
(i) (ii)

(A) Only (i) (B) Only (ii)
(C) Both (i) and (ii) (D) Neither (i) nor (ii)

9. Four small squares of side 5 cm are cut from each of the corners of a big square of side 20 cm. The perimeter of the remaining figure is _____.
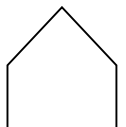
(A) 80 m (B) 8 m
(C) 80 cm (D) 8 cm

10. Which of the following squares must be shaded so that the given figure is symmetrical?
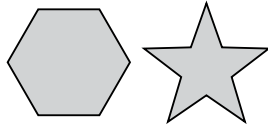
(A) P

(B) Q

(C) R

(D) S

11. In the given polygon, number of sides is _____ and number of vertices is _____.

(A) 7, 6

(B) 6, 6

(C) 5, 5

(D) 4, 7

12. The perimeter of the star (all sides are equal) is same as the perimeter of the hexagon (all sides are equal). If each side of the hexagon is 20 cm long, then each side of the star is _____.
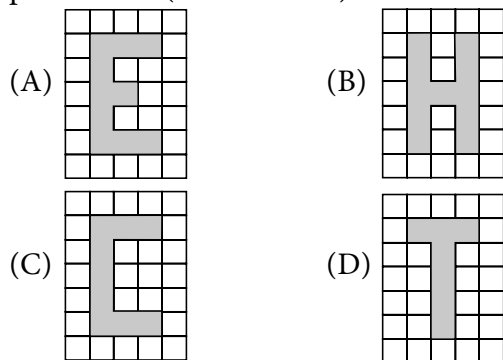
(A) 12 cm
(B) 10 cm
(C) 8 cm
(D) 9 cm

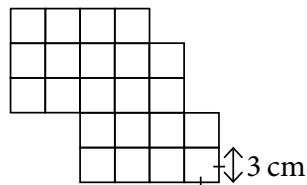**13.** How many of the following letters have parallel lines?

TRICK

(A) 1
(B) 2
(C) 3
(D) 4

14. Which of the following figures has the smallest perimeter? (1⊢⊣ = 1 unit)
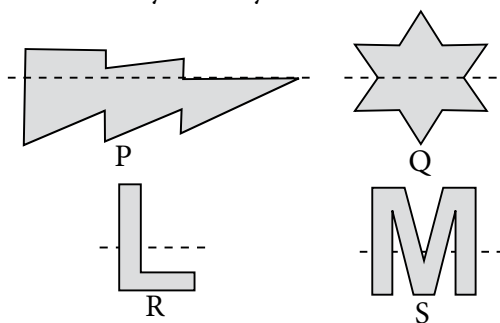
(A)
(B)
(C)
(D)

15. Find the perimeter of the given figure.

(A) 66 cm
(B) 60 cm
(C) 80 cm
(D) 56 cm

3 cm

16. In which of the following figures dotted line shows a line of symmetry?
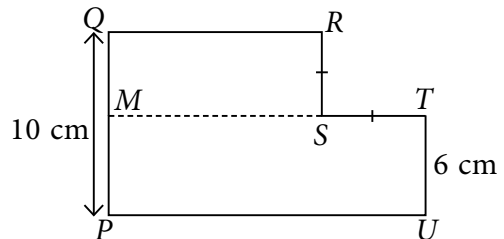
P

Q

R

S

(A) P
(B) Q
(C) R
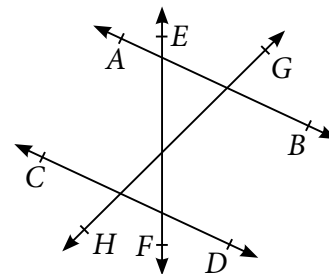(D) S

17. Which of the following options is INCORRECT?

(A) Polygon with least number of sides is a triangle.
(B) Equilateral triangle is not a polygon.
(C) Every quadrilateral is a polygon.
(D) None of these

18. Given figure is made up of two rectangles. Find the length of RS.
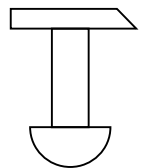
10 cm

6 cm

(A) 3 cm
(B) 4 cm
(C) 8 cm
(D) 5 cm

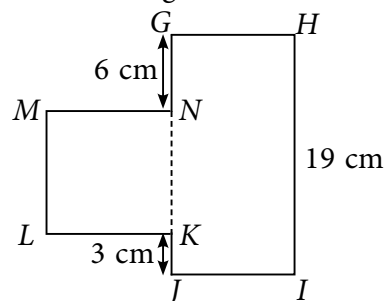**19.** Which of the following is parallel to $\overline{AB}$?

(A) $\overline{EF}$
(B) $\overline{GH}$
(C) $\overline{CD}$
(D) None of these

20. How many lines of symmetry does the given figure have?
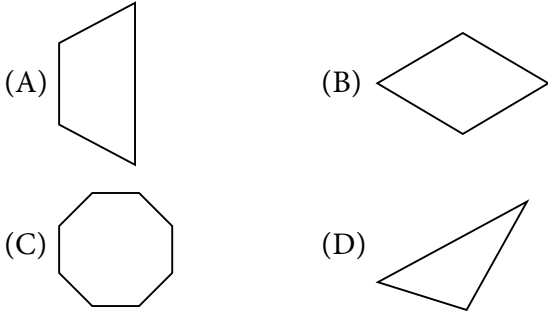
(A) 0
(B) 1
(C) 2
(D) 3

21. Given figure is made up of a square and a rectangle. Find the length of LK.
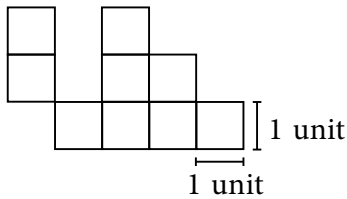
6 cm

19 cm

3 cm

(A) 8 cm
(B) 9 cm
(C) 7 cm
(D) 10 cm

22. Which of the following figures is not a symmetric figure?

(A)

(B)

(C)

(D)

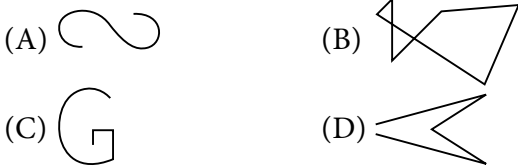**23.** Net of a cube has _____ faces and all are _____.

(A) 5, squares (B) 6, squares
(C) 5, rectangles (D) 6, rectangles

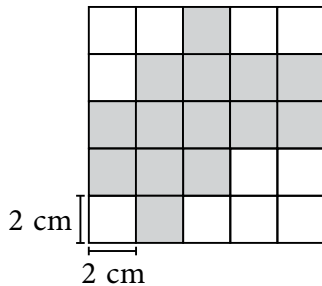**24.** How many more squares must be added to form the given figure a square of side 5 units?

(A) 12 (B) 17
(C) 18 (D) 16

25. Which of the following figures are closed?

(A)

(B)

(C)

(D)

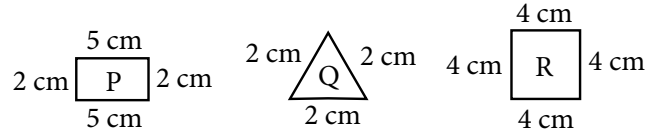**26.** Find the perimeter of the shaded figure.

(A) 28 cm (B) 20 cm
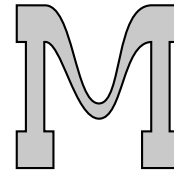(C) 38 cm (D) 40 cm

27. Select the CORRECT option.
(A) All diameters have same length in a circle.
(B) Radius is smaller than the diameter.
(C) Both (A) and (B)
(D) Neither (A) nor (B)

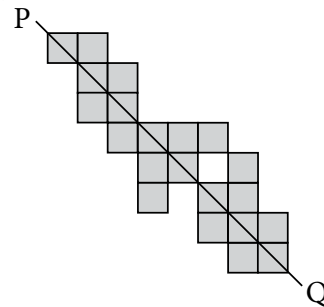**28.** Which of the given figures has the least perimeter?

(A) P (B) Q
(C) R (D) Can't be determined

29. How many slanting lines are there in the following letter ?
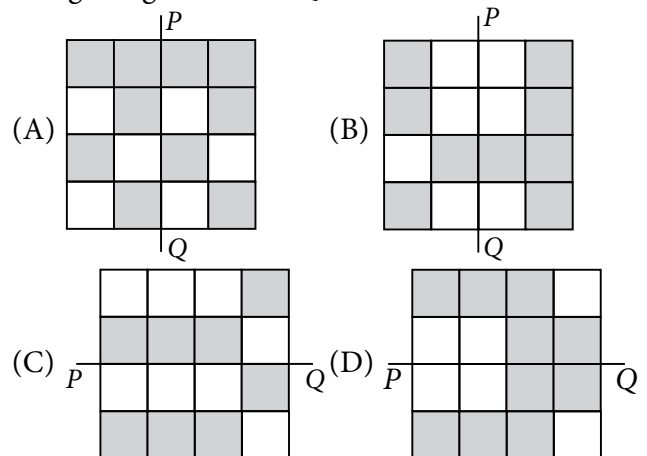

(A) 6 (B) 8
(C) 0 (D) 4

30. What is the minimum number of squares that must be added so that the line PQ becomes a line of symmetry?
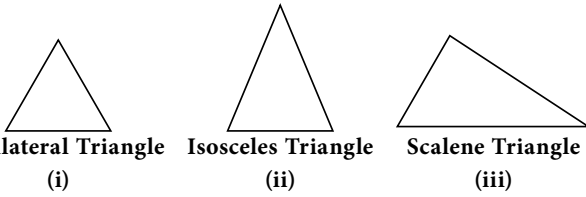

(A) 1 (B) 2
(C) 3 (D) 4

Achievers Section (HOTS)

31. Which of the following figures is symmetric along the given line *PQ*?

(A)

(B)

(C)

(D)

32. Consider the following figures and select the CORRECT option.

Equilateral Triangle **(i)**   Isosceles Triangle **(ii)**   Scalene Triangle **(iii)**

(A) All figures are not polygons with 3 sides.

(B) All sides of figure (ii) are equal.

(C) Figure (iii) does not have a line of symmetry.

(D) Figure (i) has two lines of symmetry.

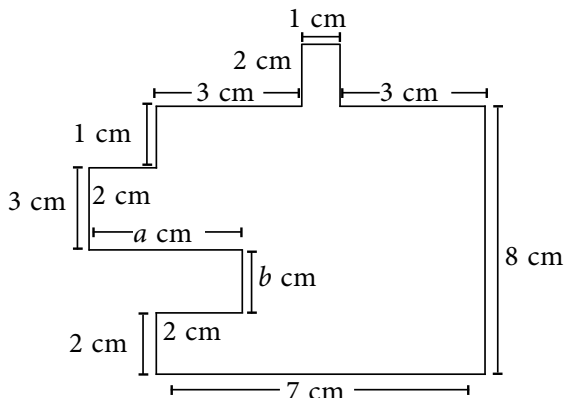**33.** Which of the following statements are true?

P : Polygons are closed figures with atleast two straight lines.

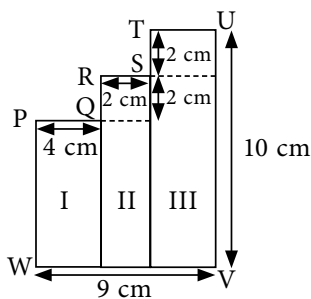**Q :** Square is a polygon which has only one line of symmetry.

(A) Only P   (B) Only Q

(C) Both P and Q   (D) Neither P nor Q

34. Find the value of $a + b$, if the perimeter of the given figure (not drawn to scale) is 50 cm.

(A) 13   (B) 14

(C) 16   (D) 15

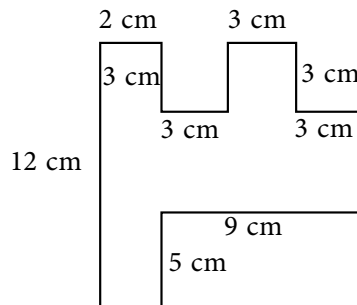**35.** Consider the given figure made up of 3 rectangles I, II and III and select the INCORRECT statement.

(A) Perimeter of rectangle II is 20 cm.

(B) Perimeter of rectangle III is 26 cm.

(C) Sum of perimeters of rectangles II and III is 56 cm.

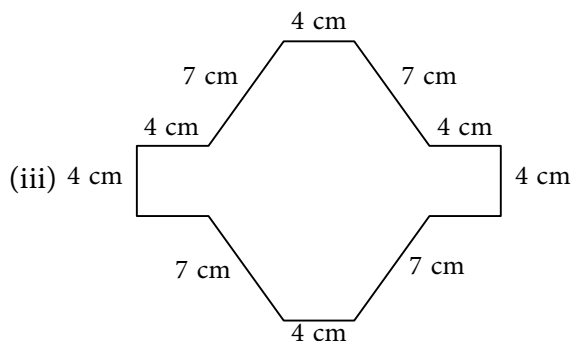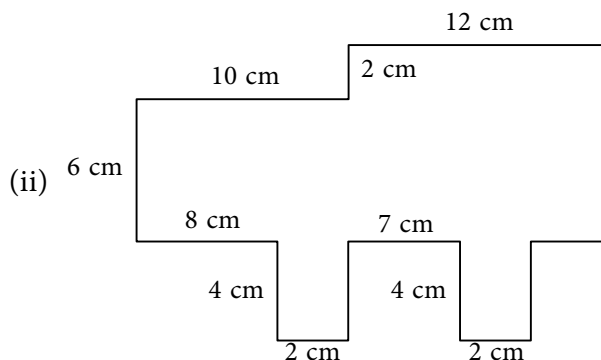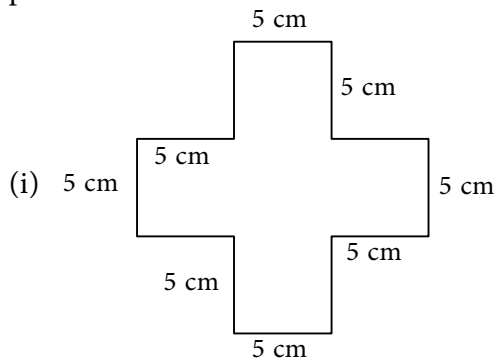(D) Difference between perimeters of rectangles I and III is 6 cm.

SOF IMO 2019 QUESTIONS

1. Find the perimeter of the given figure.

(A) 56 cm   (B) 50 cm

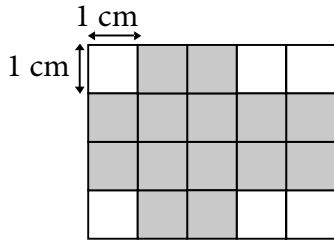(C) 48 cm   (D) 52 cm   *(Level-1)*

2. Which of the following figures have same perimeter?

(A) (i) and (ii) only   (B) (i) and (iii) only

(C) (ii) and (iii) only   (D) (i), (ii) and (iii)

(Level-1)

3. Find the perimeter of the shaded part of the given figure.
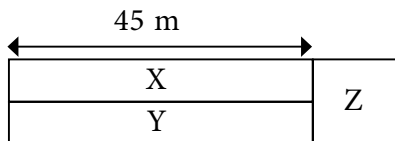

(A) 12 cm   (B) 14 cm

(C) 16 cm   (D) 18 cm   *(Level-1)*

4. Sahil has a field in the shape of a rectangle. The length of the field is twice its breadth. The breadth is 80 m. Find the perimeter of the field.

(A) 360 m   (B) 480 m

(C) 460 m   (D) 520 m   *(Level-1)*

5. The given figure is made up of two rectangles and a square. The length of rectangle X is thrice that of square Z. Find the perimeter of
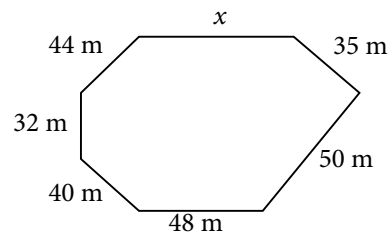
(i) square Z

(ii) the whole figure.

      (i)   **(ii)**

(A) 60 m   150 m

(B) 75 m   450 m

(C) 15 m   90 m

(D) 60 m   125 m   *(Level-1)*

6. How many letters in the given word have at least one line of symmetry?
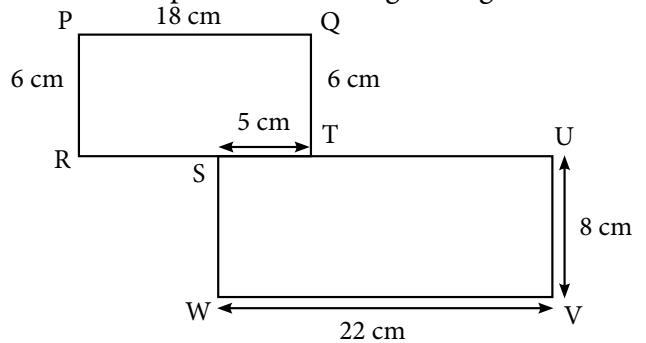
THOUSAND

(A) 4   (B) 6

(C) 5   (D) None of these

(Level-2)

7. If the perimeter of the given figure is 301 m, hen find the value of x.

(A) 51 m   (B) 50 m

(C) 52 m   (D) 54 m   *(Level-2)*

8. Find the perimeter of the given figure.

(A) 98 cm   (B) 96 cm

(C) 102 cm   (D) 108 cm   *(Level-2)*

9. Which of the following statements is CORRECT?

(A) A triangle with only two sides of equal length is called an equilateral triangle.

(B) Diameter of a circle is greater than its radius.

(C) A rectangle has four lines of symmetry.

(D) None of these   *(Level-2)*

10. Arrange the given figures in ascending order of their perimeters.
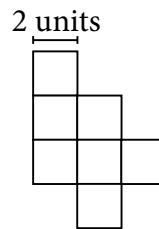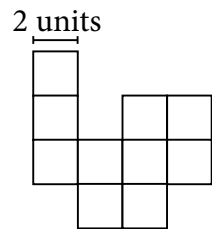
(A) S, Q, R, P   (B) S, P, R, Q

(C) P, R, Q, S   (D) R, P, Q, S   *(Level-2)*

HINTS & EXPLANATIONS

SELF TEST - 1

1. **(C)**

2. **(B):** Number of horizontal lines = 6

3. **(C):** As $\overline{AB}$ is intersecting to $\overline{EF}$.
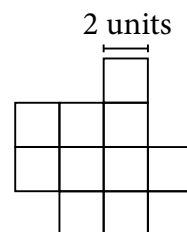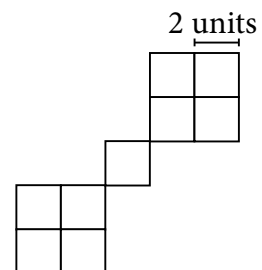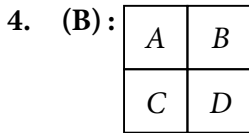
4. **(B):**

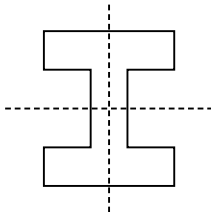| A	B
C	D

The squares formed are :
A, B, C, D and $ABCD$
So, number of squares formed = 5

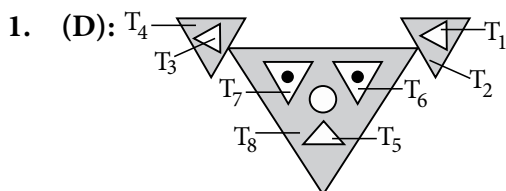5. **(D):** Number of slanting lines in the given figure = 16

SELF TEST - 2

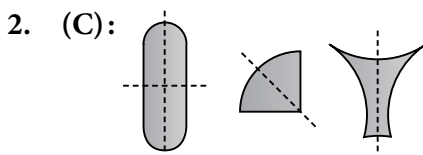1. **(C):**

∴ Number of lines of symmetry = 2

2. **(A)**   3. **(D)**   4. **(B)**

5. **(B):** Perimeter of square = 16 cm
$\Rightarrow$ 4 × side = 16 cm
$\Rightarrow$ Side = 4 cm

EXERCISE

1. **(D):**

So, triangles formed are T_1, T_2, T_3, T_4, T_5, T_6, T_7 and T_8.
∴ Number of triangles = 8

2. **(C):**

3. **(C)**

4. **(B):** Polygons are :

5. **(C):** Radius = 5 cm
So, diameter = 2 × radius
= (2 × 5) cm = 10 cm

6. **(B)**

7. **(B):** Perimeter of figure = 50 cm
$\Rightarrow$ 9 + 1 + 2 + 1 + 1 + 3 + 1 + 2 + 3 + 2 + 6 + 2 + x + 2 + x + 5 = 50
$\Rightarrow$ 40 + 2x = 50
$\Rightarrow$ 2x = 10 $\Rightarrow$ x = 5

8. **(C)**

9. **(C):**
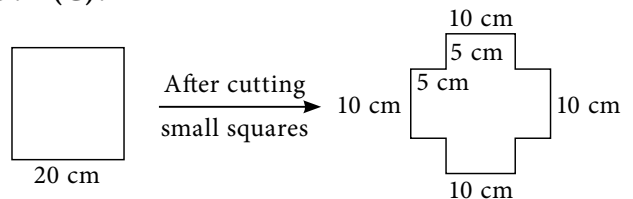
So, perimeter of the remaining figure = (10 + 5 + 5 + 10 + 5 + 5 + 10 + 5 + 5 + 10 + 5 + 5)cm = 80 cm

10. **(A):**

Line of symmetry

11. **(C)**
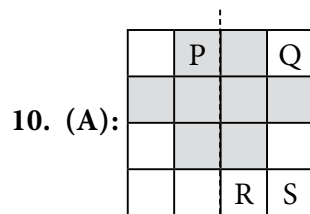
12. **(A):** Perimeter of hexagon = (6 × 20) cm
= 120 cm
So, perimeter of star = 120 cm
$\Rightarrow$ 10 × side = 120 cm
$\Rightarrow$ Side = 12 cm

13. **(D)**

14. **(D):** (A) Perimeter = (22 × 1) units = 22 units
(B) Perimeter = (24 × 1) units = 24 units
(C) Perimeter = (20 × 1) units = 20 units
(D) Perimeter = (16 × 1) units = 16 units

15. **(A):** Perimeter = 22 × length of each side
= (22 × 3) cm = 66 cm

16. **(B)**   17. **(B)**

18. **(B):** As *MTUP* is a rectangle.
So, $MP = TU = 6$ cm

So, $QM = QP - MP$
$= (10 - 6)$ cm $= 4$ cm
Also, $QRSM$ is a rectangle.
$\therefore$ $RS = QM = 4$ cm

19. (C)   20. (A)

21. (D): As, $GHIJ$ is a rectangle.
$\therefore$ $GJ = HI = 19$ cm
$\Rightarrow GN + NK + KJ = 19$ cm
$\Rightarrow 6$ cm $+ NK + 3$ cm $= 19$ cm
$\Rightarrow NK = 19$ cm $- 9$ cm $= 10$ cm
As, $KLMN$ is a square, so $LK = NK = 10$ cm

22. (D)   23. (B)

24. (D):

1	2	3	4	5
6	7	8	9	10
	11		12	13
	14			15
16				

Number of more squares that must be added = 16

25. (B)

26. (D): Required perimeter = 20 × side
$= (20 × 2)$ cm $= 40$ cm

27. (C)

28. (B): Perimeter of figure P $= (5 + 2 + 5 + 2)$ cm
$= 14$ cm
Perimeter of figure Q $= (2 + 2 + 2)$ cm $= 6$ cm
Perimeter of figure R $= (4 + 4 + 4 + 4)$ cm $= 16$ cm
So, figure Q has least perimeter.

29. (C)

30. (C):
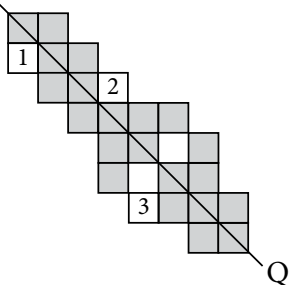
31. (D)

32. (C): (A) Incorrect, All the given figures are polygons with 3 sides.
(B) Incorrect, Only two sides of figure (ii) are equal.
(C) Correct
(D) Incorrect; Equilateral triangle has three lines of symmetry.

33. (D): P : False; Polygons are closed figures with atleast three straight lines.
Q : False, square is a polygon which has four lines of symmetry.

34. (B) : Since, perimeter of the given figure = 50 cm
So, $(1 + 2 + 3 + 8 + 7 + 2 + 2 + b + a + 3 + 2 + 1 + 3 + 2)$ cm $= 50$ cm
$(36 + a + b)$ cm $= 50$ cm
$\Rightarrow a + b = 50$ cm $- 36$ cm $= 14$ cm

35. (C): Perimeter of rectangle I = 6 + 4 + 6 + 4 = 20 cm.
Perimeter of rectangle II = 2 + 8 + 2 + 8 = 20 cm.
Perimeter of rectangle III = 3 + 10 + 3 + 10 = 26 cm.

SOF IMO 2019 QUESTIONS

1. (D): Perimeter $= (2 + 3 + 3 + 3 + 3 + 3 + 3 + 4 + 9 + 5 + 2 + 12)$ cm
$= 52$ cm

2. (B): (i) Perimeter $= (12 × 5)$ cm $= 60$ cm
(ii) Perimeter $= (12 + 8 + 3 + 4 + 2 + 4 + 7 + 4 + 2 + 4 + 8 + 6 + 10 + 2)$ cm $= 76$ cm
(iii) Perimeter $= (4 + 7 + 4 + 4 + 4 + 7 + 4 + 7 + 4 + 4 + 4 + 7)$ cm $= 60$ cm
So, Perimeter of figure (i) = Perimeter of figure (iii).
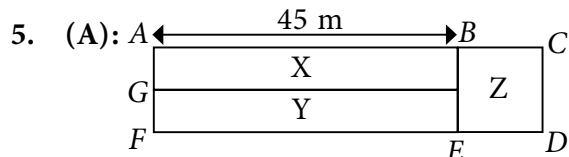
3. (D): Perimeter $= (18 × 1)$ cm $= 18$ cm

4. (B): Breadth of the field = 80 m
Length of the field = 2 × 80 = 160 m
$\therefore$ Perimeter of the field
$= 2$ (length + breadth)
$= 2(160 + 80)$ $= 2 × 240 = 480$ m

5. (A):

As, length of rectangle (AB) = 3 × length of square (BC)
So, $45 = 3\ BC$
$\Rightarrow BC = 45 ÷ 3 = 15$ m
(i) Perimeter of square Z = 4 × 15 m = 60 m
(ii) Perimeter of whole figure
$= AB + BC + CD + DE + EF + FA$
$= (45 + 15 + 15 + 15 + 45 + 15)$ m
$= 150$ m

6. **(B):** T H O U S A N D

7. **(C):** Perimeter of the given figure = 301 m
$\Rightarrow 44 + x + 35 + 50 + 48 + 40 + 32 = 301$
$\Rightarrow x + 249 = 301 \Rightarrow x = 52$ m

8. **(A):** Perimeter of figure = (18 + 6 + 17 + 8 + 22 + 8 + 13 + 6) cm = 98 cm

9. **(B):** (A) Incorrect : A triangle with only two sides of equal length is called an isosceles triangle.

(B) Correct

(C) Incorrect : A rectangle has two lines of symmetry.

10. **(C):** Perimeter of P = (14 × 2) units = 28 units

Perimeter of Q = (18 × 2) units = 36 units

Perimeter of R = (16 × 2) units = 32 units

Perimeter of S = (20 × 2) units = 40 units

Ascending order of figures according to their perimeters, is P, R, Q and S.