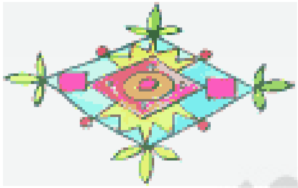
CHAPTER - 4

Basic Geometrical Ideas

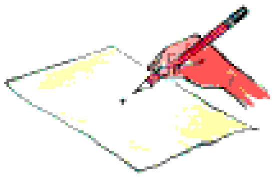
4.1 Introduction



We see a variety of things around us. There are buildings, utensils, furniture, pictures and lot more. You must have seen rangoli or mehendi designs. Have you ever made these? How do you make these designs? We use various geometrical shapes in them.

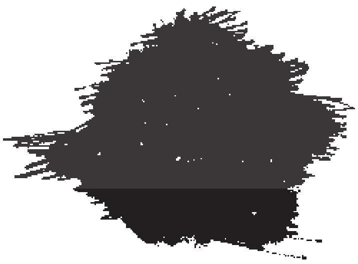
Observe some objects around you and identify what shapes you can see in them. For eg., screen of TV is in rectangle shape. Similarly, a fridge, pencil box, book etc. are also in rectangular shape. But what about a glass, bindi, flower etc? We have learnt about some geometric shapes in earlier classes. In this chapter, we will learn more about such geometric shapes.

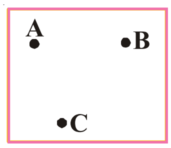
4.2 Point



Take a sharpened pencil and mark a dot on the paper. As you take even more sharper pencil, the dot will become smaller. Observe the almost invisible tiny dot. It will give you an idea of a point. A point determines a location. Think of some examples which look like points .

The distant stars also give us an idea of point. We use a point to locate Hyderabad in Andhra Pradesh map. Think more examples where you use a point to locate some specific thing in a picture, diagram or map.



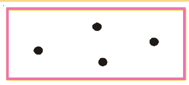


A point is denoted by a capital letter. In the adjucent figure A, B and C are three points.

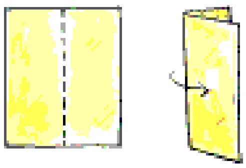
They are read as point A, point B and point C.

Do This

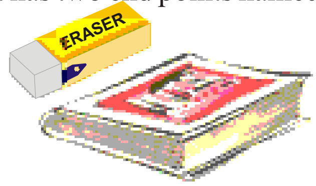
1. Four points are marked in the given rectangle. Name them.



4.3 A Line segment



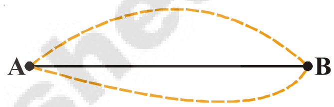
Take a thick paper and fold it as shown in figure. Look at the folded edge of this paper. It gives us an idea, of what a line segment is. The crease left on the sheet represents a line segment. It has two end points named A and B. A line segment has negligible thickness.



Take your note book or a pencil box and draw a line along its edge with a pencil on a sheet of paper.

What you have drawn is a representation of a line segment. It has two ends. Name them.

Take a thread. Stretch it. In this position it gives an idea of a line segment where the ends of the thread are the end points of the line segment.



Mark any two points A and B on a sheet of paper. Join them in as many ways as you like. What is the smallest distance from A to B. This is a line segment AB and is denoted by $\overline{AB}$ or $\overline{BA}$.

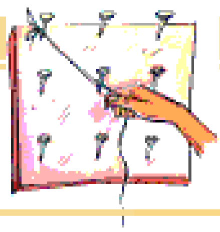
4.4 A Line

Imagine that the line segment from A to B (i.e. $\overline{AB}$) is extended beyond A in one direction and beyond B in the other direction without any end.

You now get a representation of a line.

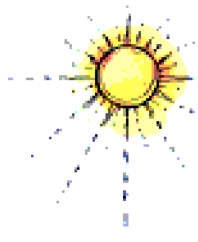
Since we cannot draw an indefinitely long line, we mark arrow notations on both sides to show that it will go on. This line is denoted by $\overleftrightarrow{AB}$. It is also denoted by small letters such as *l*, *m*, *n* etc. This is also called as straight line .

Do This

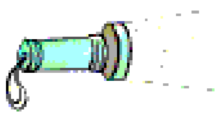


Take a geo-board. Select any two nails and tie tightly a thread from one end to the other. The thread you have fixed is a line which can extend in both directions and only in these two directions.

4.5 A Ray



Sun rays, light rays, rays from a torch are some examples of the Geometrical idea of a 'ray'.



A ray is a part of a line. It begins at a point (initial point) and goes on endlessly in a specified direction.

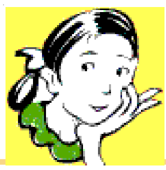
Thus a ray has only one end point.

Let A be a point on a line. B and C are two points on the same line on either side of A.

Then $\overrightarrow{AB}$ and $\overrightarrow{AC}$ are two rays.

Think, Discuss and Write

Here is a ray $\overrightarrow{OA}$. It starts at O and passes through the point A. It also passes through the point B.



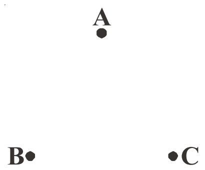
Can you name it as $\overrightarrow{OB}$? Why?

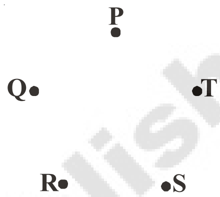
Can you write the ray $\overrightarrow{OA}$ as $\overrightarrow{AO}$? Why? Why not?

Give reasons.

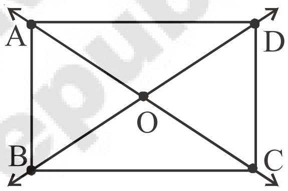
Exercise - 4.1

1. Join the points given below. Name the line segments so formed in the figure.

   i. 

   ii. 

2. Name the following from the figure.



   i. Any five points
   ii. Any five line segments
   iii. Any Three rays
   iv. Any two lines.

3. How many lines can be drawn through

   i. One point   ii. Two distinct points

   Make a rough figure for your answer.

4. Which of the following has a definite length?

   i. Line   ii. Point   iii. Line segment   iv. Ray

5. How many end points do the following have?

   i. Line segment   ii. Ray   iii. Line

6. Write 'True' or 'False'.

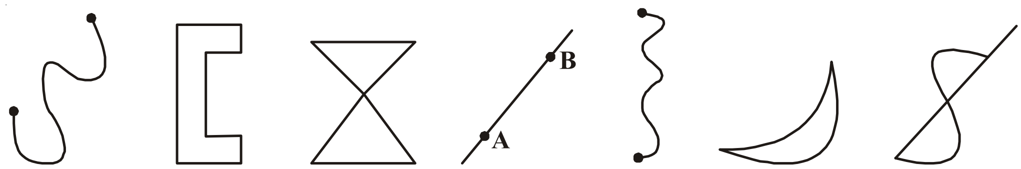
   i. A line has no end points. (   )
   ii. Ray is a part of a line. (   )
   iii. A line segment has no definite length. (   )
   iv. A line segment has only one end point. (   )
   v. We can draw many lines through a point. (   )

7. Draw and name:

   i. Line containing point P.
   ii. Line passing through R.

4.6 Curve

Have you seen drawings of kids? Here are some examples.



(i) (ii) (iii) (iv) (v) (vi) (vii)

These are all examples of curves.

Observe figure (i) and (ii) what is the difference between them?

Figure (ii) is called a closed curve and figure (i) is called an open curve.

Also observe that the curves (iii) and (vii) cross themselves, where as (i), (ii), (iv), (v) (vi) do not cross. If a curve does not cross itself, then it is a simple curve.

In every day language, curve usually does not refer to a straight line. But in mathematics a straight line is also curve.

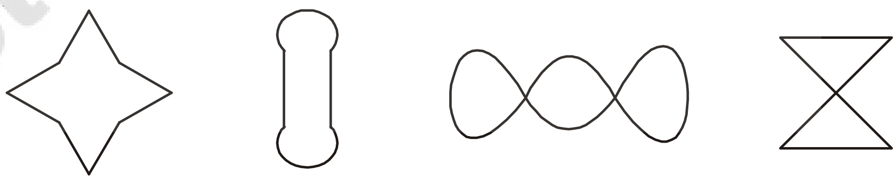
Think, Discuss and Write

1. Move your pencil along the following english letters and state which are open and which are closed.

2. Tell which letter is an example of simple curve.

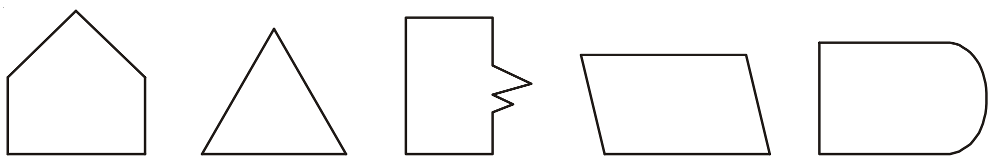
Try These

Identify which are simple curves and which are not?



POLYGONS

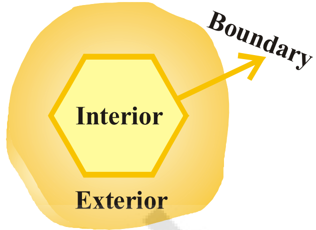
Look at these following figures:



(i) (ii) (iii) (iv) (v)

What can you say about them? Are they closed? How does each of them differ from one another? (i), (ii), (iii) and (iv) differ from (v), because they are made up of entirely of difinite number of line segments. They are called **Polygons**.

So a figure is a polygon if it is a simple closed figure made up of definite number of line segments. Draw ten polygons of different shapes.



Boundary wall of a park divides the plane into three parts i.e. inside the park, the park boundary wall and outside the park. You can't enter the park without crossing the boundary.

Likewise, a closed figure separates the plane into three parts.

i. Interior (inside) of the Figure

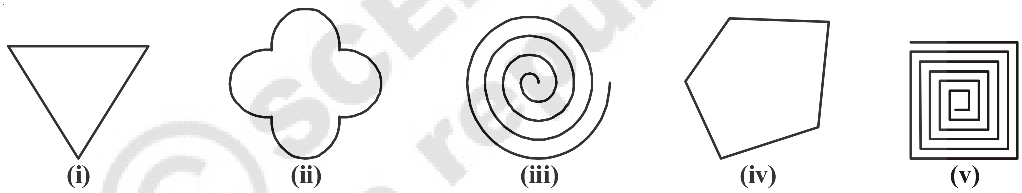
ii. Boundary of the Figure

iii. Exterior (out side) of the Figure

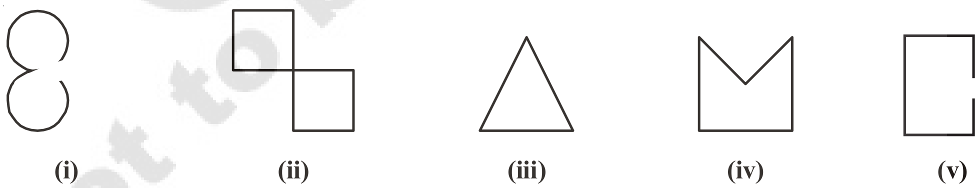
The interior of the Figure together with its boundary is called its **region**.

Exercise - 4.2

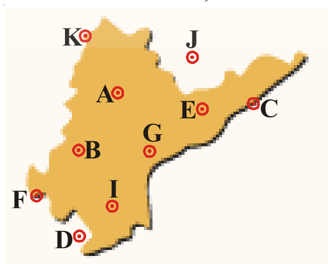
1. Tick these figures which are simple curves.



2. State which curves are open and which are closed



3. Name the points that lie in the interior, on the boundary and in the exterior of the figure.



4. Draw three simple closed figures:

   i. by straight lines only

   ii. by straight lines and curved lines both

4.7 Angle

Observe the picture

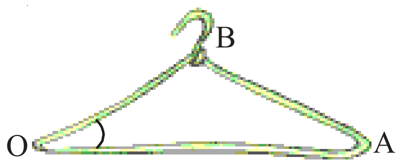


Figure - 1

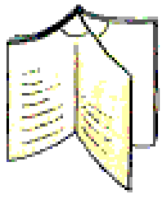


Figure - 2

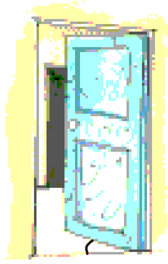


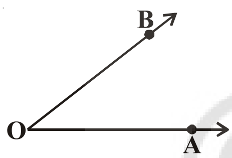
Figure - 3

Angles are made when corners are formed. In the figure - 1 imagine two rays say $\overrightarrow{OA}$ and $\overrightarrow{OB}$. These two rays have a common end point at O. The two rays here are said to form an angle.

Look at the door. When it is closed it does not seem to make any angle with the threshold. As we start opening it there is an angle between the door and the threshold. It also changes as the position of the door changes. Here two rays can be imagined in the direction of the door and the threshold.

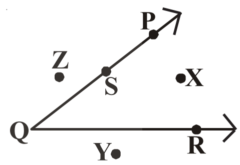
Observe how angles are formed between two hands of a clock at different time.

The two rays forming an angle are called the arms or sides of the angle. The common end point is called the vertex of the angle.



Here the two rays $\overrightarrow{OA}$ and $\overrightarrow{OB}$ are two **arms** or sides of the angle and O is the **vertex** of the angle. As the angle is formed at 'O', we read it as angle AOB or angle BOA and it is denoted by ∠AOB or ∠BOA (sometimes $A\hat{O}B$ or $B\hat{O}A$) or simply ∠O.

In the figure point X is in the interior of the angle. Z is not in the interior, it is in the exterior part of the angle. Point S is on the arms of the angle ∠PQR.



So angle divides the plane into three parts, interior (bounded by the two sides), angle and the exterior (which is outside the angle).

Now think about point Y. Where does it lie?

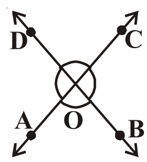
If you extend the rays $\overrightarrow{QP}$ and $\overrightarrow{QR}$, will point Y fall in the interior of the angle?

Is it possible to mark point M fall in the interior of the angle by extending the rays?

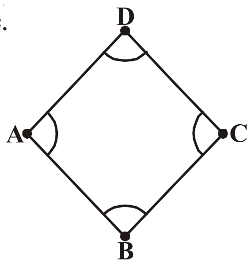
Exercise - 4.3

1. Name the angles, vertex and arms of the angles from the figure.

	i	ii	iii	iv	v
Angle	∠AOB				
Vertex	O				
Arms	$\overrightarrow{OA}$, $\overrightarrow{OB}$				



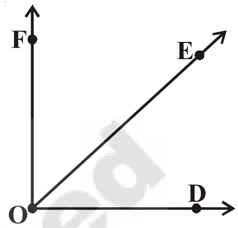
2. Name the angles formed in the figure.



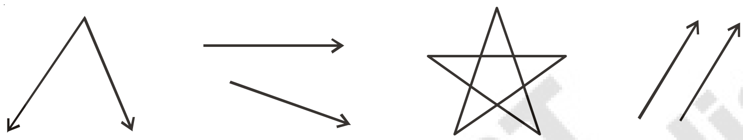
3. Mark the points in the figure which satisfy all the three conditions.

(i) A, B in the interior of ∠DOF

(ii) A, C in the exterior of ∠EOF (iii) B on ∠DOE



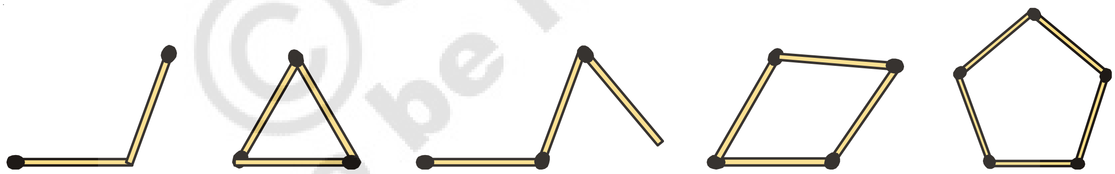
4. Mark the angles formed in the figure.



4.8 Triangle

Do This

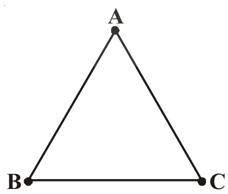
Take some match sticks and try to make simple closed figures.

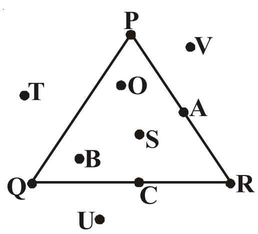


What is the least no. of sticks needed to form a closed figure? Obviously three. Can you explain why two match sticks can not make a closed figure.

The simple closed figure fromed by three line segments is a triangle. The line segments are called sides.

Look at the triangle formed by three line segments $\overline{AB}$, $\overline{BC}$ and $\overline{CA}$. Here A, B, C are called three vertices of the triangle ABC. You know that the angles ∠BAC, ∠ABC, ∠ACB are formed at the vertices. The triangle ABC is denoted simply as ΔABC.





Being a polygon, a triangle has an exterior and an interior region.

Observe the triangle and points marked in the figure.

O is in the interior of the triangle. What are the other points in the interior?

P is a point on the triangle. Name the other points lying on the boundary of the triangle.

T is in the exterior of the triangle. What are the other points in the exterior?

Therefore, a triangle divides a plane into three parts.

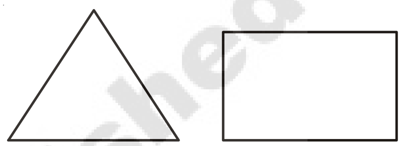
(i) Interior of the triangle; (ii) Boundary of the triangle; (iii) Exterior of the triangle.

The boundary and interior of the triangle together is called triangular region.

Do this

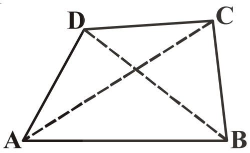
Take some straw pieces of different size. Pass thread into any 3 pieces and make different triangles. Draw figures for the triangles in your notebook.

4.9 Quadrilateral



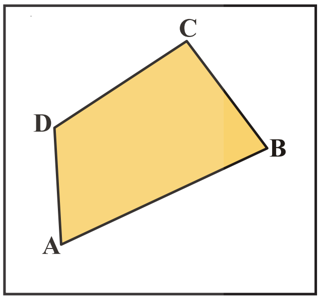
(i) (ii)

Observe the polygons in the adjacent figure. You know that a polygon with three sides as in Fig (i) is a triangle, similarly a simple closed polygon with four sides is called a quardrilateral. Fig. (ii) is an example for quadrilateral.



Here ABCD is a quadrilateral and the four line segments $\overline{AB}$, $\overline{BC}$, $\overline{CD}$ and $\overline{AD}$ are called its four sides, ∠A, ∠B, ∠C and ∠D are its four angles and the line segments joining opposite vertices A, C and B, D namely $\overline{AC}$ and $\overline{BD}$, are called its two diagonals.

As in a triangle, quadrilateral drawn on a plane, divides it into three parts known as interior, boundary and exterior of the quadrilateral.



The shaded part of the quadrilateral is its interior and the unshaded part is the exterior of the Quadrilateral.

The side opposite to $\overline{AB}$ is $\overline{DC}$.

What are the sides opposite to $\overline{BC}$, $\overline{CD}$ and $\overline{AD}$?

The side $\overline{AB}$ is adjacent to $\overline{BC}$ and $\overline{AD}$.

Name the adjacent sides of $\overline{BC}$, $\overline{CD}$ and $\overline{AD}$.

The opposite angles of ∠A is ∠C.

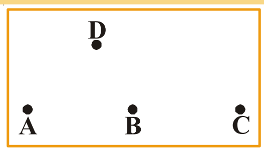
What is the other pair of opposite angles?

The adjacent angle of ∠A is ∠B and ∠D.

What are the other pairs of adjacent angles.

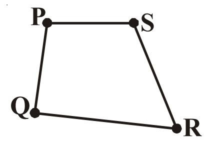
Think, Discuss and Write

Take four points A, B, C and D such that A, B, C lie on the same line and D is not on it. Can the four line segments $\overline{AB}$, $\overline{BC}$, $\overline{CD}$ and $\overline{AD}$ form a quadrilateral? Give reason.

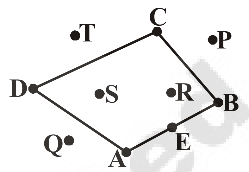


Exercise - 4.4

1. Mark any four points A, B, C and D. Join them to make a quadrilateral. Name it.
2. PQRS is a Quadrilateral. Answer the following.



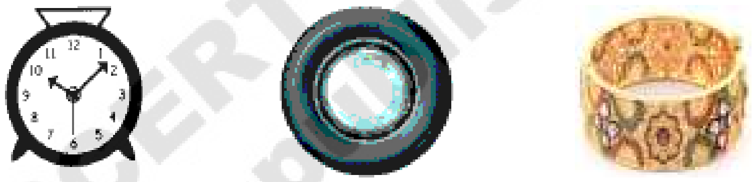
   i. The opposite side of QR is ____________.
   ii. The angle opposite to ∠P is ____________.
   iii. The adjacent sides of PQ are ____________.
   iv. The adjacent angles of ∠S are ____________.
3. Name the points marked in the figure



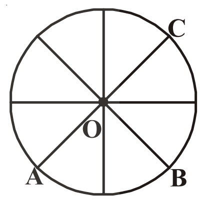
   i. The points in the interior of Quadrilateral.
   ii. The points on the boundary of Quadrilateral.
   iii. The points in the exterior of the Quadrilateral.

4.10 Circle

Look at the figures



Keep a bangle on a paper and draw along its boundary with pencil. You get a round shape. This will give you an idea of a circle. Such a round shaped figure is a circle. Can you think of some more examples from real life?

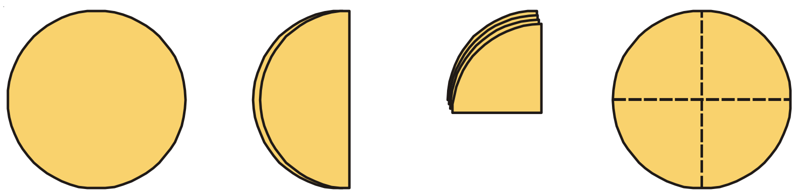


Observe a cycle wheel and measure the length of each spoke. You might conclude that the length of each spoke is same. The point in the middle is the **centre** and the length of curve edge is called circumference and the distance from the centre to any point on the circle is the **radius**. Observe the centre and the radius in each circle given in the figure.

Are all the radii same? O is the centre and $\overline{OA}$, $\overline{OB}$ and $\overline{OC}$ are radii of the circle.

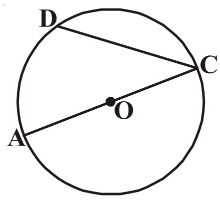
Do This

Draw a circle on a paper and cut it along its edge. Fold it into half and again fold it to one fourth to make folding marks as shown.



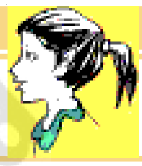
You will observe a point in the middle. Mark this O. This is the centre of the circle. You can also indicate its radius.How many radii can you draw in a circle?

$\overline{AC}$ is a line segment joining two points on the circle.



Is there any other such line segment which joins two points on the circumference? CD is one such line segment. A line segment joining two points on the circumference of the circle is called a **chord.** Thus both $\overline{CD}$ and $\overline{AC}$ are chords of the circle. The chord $\overline{AC}$ is a special chord as it passes through the centre 'O'. A chord which passes thorugh the centre of a circle is called it **diameter.**

Do This



Draw a circle and draw at least 5 chords in it. Make sure at least one of them passes through the centre. Name them and fill the table

S.No.	Chord	Length	Passes through the centre (Yes/No)
1.			
2.			
3.			
4.			
5.			

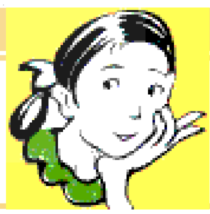
What do you notice?

You must have noticed that the chord passing through the centre is the longest. Let us go back to the figure, $\overline{AC}$ is a line segment whose mid-point is at O.

Also, we know that $\overline{OA}$ and $\overline{OC}$ are two radii of the circle. Thus, we can see that length of $\overline{OA}$ + length of $\overline{OC}$ = length of $\overline{AC}$.

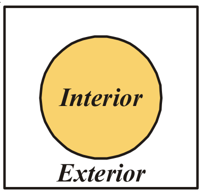
Diameter is infact twice the radius of the circle.

Think and Discuss

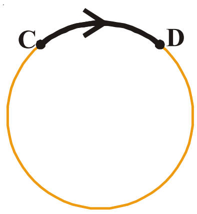


Is it possible to draw more than one diameter in a circle? Are all the diameters equal in length?

Discuss with your friends and find the answer.



Look at the figure again. The part of the circle between the points C and D is called an arc and denoted by $\overset{\frown}{CD}$.



Name the other arc in the figure.

As a circle is a simple closed figure, it divides the plane with its boundary as interior and exterior.

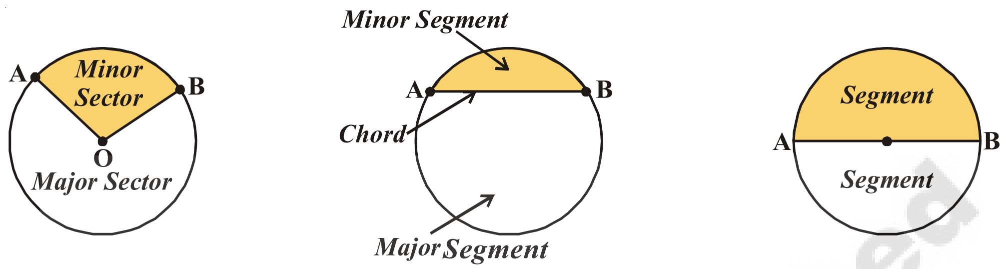
The region in the interior of a circle enclosed by the boundary is called **circular region**.

Some other parts of the circle

Region enclosed by an arc and two radii is called **sector** of the circle.

Region enclosed by an arc and a chord is called **segment** of a circle. Chord of a circle divides it into two segments.

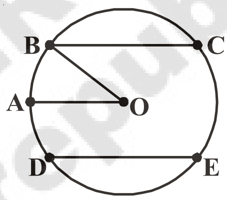
Region enclosed by an arc and a diameter is a **semi circular region**.



Exercise - 4.5

1. Draw a circle and name its centre, a radius, a diameter and arc.

2. Shade the regions in the circle
   - i. Sector with red
   - ii. Minor segment with yellow



3. Say 'True' or 'False'
   - i. We can locate only one centre in a circle ( )
   - ii. Diameter is twice the radius ( )
   - iii. An arc is a part of a circle ( )
   - iv. All chords are equal in length ( )
   - v. All radii are not equal in length ( )

4. Take a circular sheet of paper. Fold it into two halves. Press the fold and open it. Do you find the crease of a diameter ? Repeat the same activity by changing the fold. How many diameters do you observe? How many more diameters can be formed?

What have we discussed?

1. A point determines a location. It is usually denoted by a capital letter.
2. A line segment is formed by joining two points. It has a fixed length.
3. A line is obtained when a line segment extends on both sides indefinitely.
4. A ray is a portion of a line starting at a point and goes in one direction endlessly.
5. Any figure drawn without lifting a pencil may be called a curve. In this sense, a line is also a curve.
6. A simple curve is one that does not cross itself.

7. Curves are of 2 types- open and closed.
8. An angle is made up of two rays starting from a common end point. The common end point is called vertex and the two rays are arms of the angle.
9. Every angle divides the plane as interior, exterior and boundary of the angle.
10. A triangle is a simple closed figure bounded by three line segments.
11. A triangle has three vertices, three sides and three angles.
12. A triangle with its boundary and interior is called the triangular region.
13. A quadrilateral is a simple closed figure bounded by four line segments. It has four vertices, four sides, four angles and two diagonals.
14. A circle is simple closed curve, where each point on the boundary is at an equal distance from the centre. The fixed distance is the radius.
15. A part of a circle is an arc and the total length of the circle is called its circumference.
16. A chord of a circle is a line segment joining any two points on the circle. Diameter is also a chord.
17. A diameter of a circle is double the radius.
18. A circle with its boundary and interior together is a circular region.
19. The region in a circle bounded by two radii and the arc is called sector.
20. The region in a circle bounded by a chord and the arc is called a segment of the circle.
21. A semi circle is half of the circle. Each diameter divides a circle into two semicircles.

Euclid (Greece)
365 BC
He is a famous Greek philosopher and mathematician. He has introduced geometry in a logical order in the book, 'The Elements'. His geometry is known as Euclidean geometry.