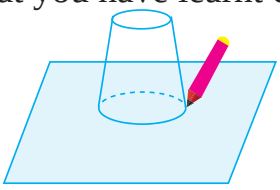
# 18 Circles

By studying this lesson you will be able to

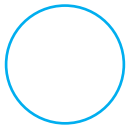
- draw circles by handling a pair of compasses accurately,
- identify what the centre, radius and diameter of a circle are, and
- create circle designs using a pair of compasses.

## 18.1 Drawing Circles

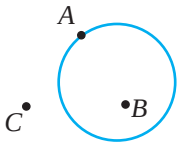
You are already capable of drawing circles and creating circle designs using different objects with circular shapes. Observe the figures given below to recall what you have learnt earlier on this subject.



A figure drawn using a tumbler is shown here. You have learnt that the entire curved line of the figure is called a circle.



In this figure, $A$ is a point on the circle, $B$ is a point inside the circle and $C$ is a point outside the circle.




When circles are drawn using various objects, the size of each circle drawn depends on the size of the circular shape of the object used to draw the circle. Therefore the above method is not suitable to draw a circle of the size of your choice. Let us investigate other methods of drawing circles without using objects with circular shapes. Let us do Activity 1.

## Activity 1

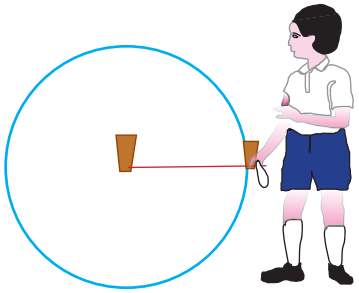
Get two sticks and a thread.

**Step 1 -** Fix one stick in the middle of a flat sandy land and tie a thread of a particular length to the stick as shown in the figure.

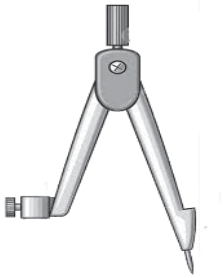
**Step 2 -** Tie the other end of the thread to another stick.

**Step 3 -** Mark a curved line on the sand by keeping one end of the second stick in contact with the sandy land while moving right around the stick fixed in the middle of the flat land, ensuring that the thread is tightly stretched at all times.

**Step 4 -** Repeat the above activity several times using threads of different lengths.



You will realize that the size of the circle depends on the length of the thread that is used.



There is a tool called "**a pair of compasses**" in the mathematical instruments box which can be used instead of the two sticks and the piece of thread, to do the above activity. Different lengths can be obtained using a pair of compasses, as was achieved above by using pieces of thread of different lengths.

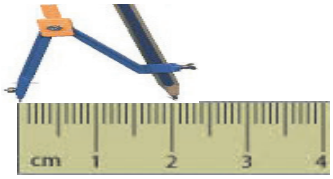
Now let us do the above activity using the pair of compasses. When you are preparing the pair of compasses, it is convenient to use a short pencil. The pencil should be fixed such that the point of the pencil and the point of the pair of compasses are at the same level when the pair of compasses is fully compressed.

## Activity 2

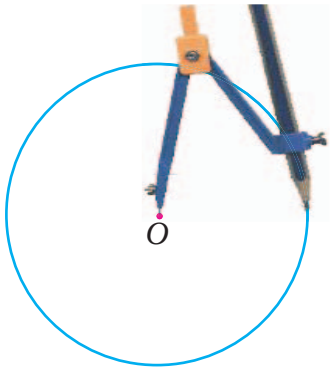
Get a pair of compasses with a correctly fixed pencil, a ruler and a white paper.

**Step 1 -** Mark a point called *O* towards the centre of the white paper.

**Step 2 -** Adjust the pair of compasses such that the distance between the pencil point and the point of the pair of compasses is 2 cm.




**Step 3 -** Keep the point of the pair of compasses fixed at *O* and draw a curved line on the piece of paper by moving the pencil point one whole round about the point *O*, while ensuring that the distance between the pencil point and the point of the pair of compasses remains unchanged. You will see that a circle is drawn around point *O*.




**Step 4 -** Construct several other circles by changing the distance between the point of the pair of compasses and the pencil point.

## Exercise 18.1

(1) Draw a circle by keeping a distance of 4 cm between the point of the pair of compasses and the pencil point.

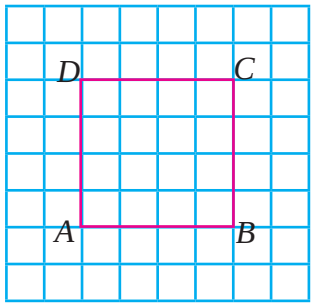
(2) Mark a point *O* on a clean sheet of paper. Keep the point of the pair of compasses on point *O* and draw 3 circles by changing the distance between the point of the pair of compasses and the pencil point.

(3) (i) Draw a straight line segment *AB* of length 3 cm.

(ii) Keep the point of the pair of compasses at point *A* and extend it until the pencil point reaches point *B*. Now draw the circle which goes around point *A*.

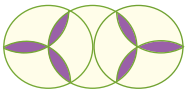
(iii) Keep the point of the pair of compasses on point *B* and extend it until the pencil point reaches point *A*. Now draw the circle which goes around point *B*.

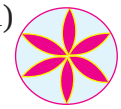
(4) (i) Draw a square *ABCD* in your square ruled exercise book by taking the length of 4 squares of your exercise book as the length of a side of the square.

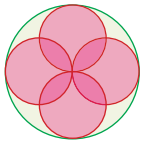


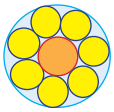

(ii) Take the distance between the point of the pair of compasses and the pencil point to be the length of 2 squares of your exercise book and draw 4 circles around the points *A*, *B*, *C* and *D*.

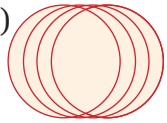
(5) Several circle designs created by using a pair of compasses and a pencil are shown below. Create these designs or some other circle designs using a pair of compasses and a pencil.

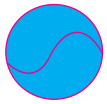
(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) 

(6) Create a design suitable for a wall hanging by drawing circles using a pair of compasses and a pencil.

## 18.2 Centre, radius and diameter of a circle

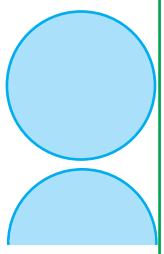
### • The centre of a circle

**Activity 3**

**Step 1** - Draw a circle on a piece of paper using a pair of compasses and a pencil.

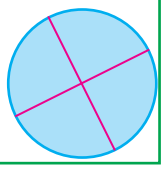
**Step 2** - Cut along the circle and separate out the circular lamina.

**Step 3** - Fold the circular lamina into two equal parts.

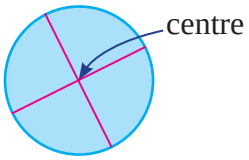


**Step 4 -** Open out the folded lamina and fold it again into two equal parts along another line.

**Step 5 -** Open out the folded lamina again and mark the fold lines in a dark colour using a ruler.



Observe how the two fold lines intersect each other. You will notice that the point of intersection of the fold lines and the point at which the point of the pair of compasses was kept while drawing the circle are the same. This point is called the **centre** of the circle.




## • The radius of a circle

### Activity 4

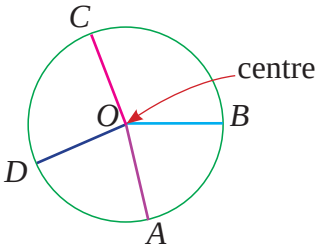
**Step 1** - Draw a circle on a piece of paper using a pair of compasses and a pencil.

**Step 2** - Mark the centre of the circle as *O*.

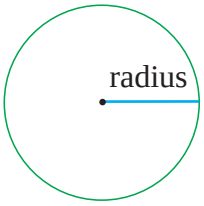
**Step 3** - Mark several points on the circle and name them as *A*, *B*, *C* and *D*.

**Step 4** - Join each of these points to the centre.

**Step 5** - Using a ruler, measure the lengths of the straight line segments that were obtained in step 4.




You will notice that the lengths of these straight line segments are all equal to each other and identical to the distance between the points of the pair of compasses and the pencil that was used to draw the circle. Accordingly, the distance from the center of a circle to any point on the circle is the same constant value.



The straight line segment joining the center of a circle to a point on the circle is called **a radius** of the circle. The term 'radius' is also used for the length of the radius.

## • The diameter of a circle

### Activity 5

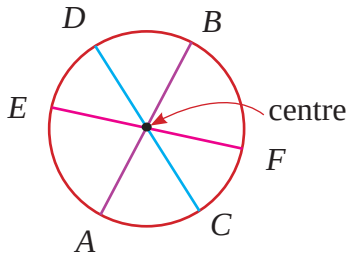
**Step 1 -** Draw a circle on a piece of paper using a pair of compasses and a pencil.

**Step 2 -** Mark the centre of the circle as *O*.

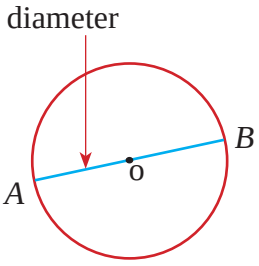
**Step 3 -** Draw a straight line segment through the point *O* using the ruler, and name the intersecting points of the straight line segment and the circle as *A* and *B*.

**Step 4 -** Measure the length of the straight line segment *AB* using the ruler.

**Step 5 -** Draw several such straight line segments by changing the position of the ruler. Observe that the lengths of all these straight line segments are equal.




A straight line segment joining two points on a circle, which passes through the centre of the circle, is called **a diameter** of the circle. The term 'diameter' is also used for the length of a diameter.




According to this figure, *AB* is a diameter and *OA* and *OB* are radii of the circle.

$AB = OA + OB$

Further, $OA = OB$ (radii of the circle)

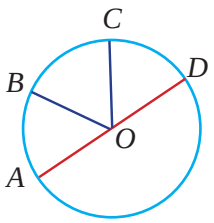
$AB = OA + OA$

That is, $AB = 2\,OA$

The diameter of a circle is twice its radius.

## Exercise 18.2

(1) Do the following for the circle shown in the figure.




(i) Name the centre of the circle.

(ii) Name the radii.

(iii) Name a diameter.

(2) (i) Draw a circle of radius 4 cm.

(ii) Name the centre of the circle as $O$ and a point on the circle as $X$.

(iii) Produce $XO$ until it meets the circle again at $Y$.

(iv) Write down the name used to define $XY$. Measure the length of $XY$ and write it down.

(3) Draw a straight line segment $AB$ such that $AB$ = 3 cm. Draw two circles of radius 3 cm each, taking the points $A$ and $B$ as the two centres.

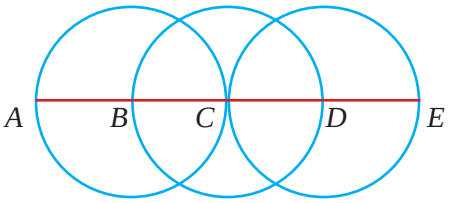
(i) Name the points of intersection of the two circles as $P$ and $Q$.

(ii) Measure the lengths of $AP$ and $BP$.

(iii) Join $PA$ and produce it until it meets the circle with centre $A$ again at $R$.

(iv) What name is used to define the straight line segment $PR$?

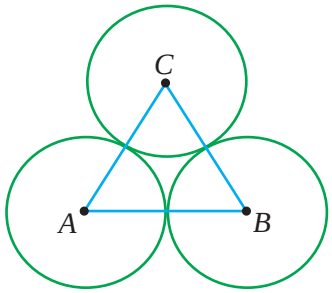
(4) $B$, $C$ and $D$ are the centres of the circles shown in the figure. The radii of all three circles are equal. Here $AE$ = 10 cm.




(i) Find the length of $AC$.

(ii) Find the radius of each circle.

(5) $ABC$ is an equilateral triangle. The perimeter of the triangle $ABC$ is 12 cm. Three circles of equal radii and centres $A$, $B$ and $C$ respectively have been drawn as shown in the figure.




(i) Calculate the length of the side $AC$.

(ii) Calculate the radius of the circle with centre $A$.

(iii) Calculate the diameter of the circle with centre $B$.

(6) (i) Draw a circle of radius 3 cm. Name its centre $O$.

(ii) Mark a point on the circle and name it $A$.

(iii) Draw a circle of radius 3 cm with $A$ as its centre. Mark one of the intersecting points of this circle and the first circle as $B$.

(iv) Draw a circle of radius 3 cm with $B$ as the centre.

(v) Similarly, draw another 4 circles such that the centres of these circles all lie on the first circle and the radius of each circle is 3 cm.

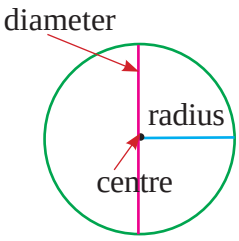
(vi) Do all the circles with centres that lie on the first circle pass through $O$?

(7) (i) Draw a straight line segment $AB$ of length 4 cm. Draw a circle such that $AB$ is a diameter.

(ii) Draw two circles having $A$ and $B$ as their centres and $AB$ the radius of each circle.

## Summary

- A straight line segment joining the centre of a circle to a point on the circle is called a radius of the circle.
- A straight line segment joining two points on a circle, which passes through the centre of the circle, is called a diameter of the circle.
- The diameter of a circle is twice its radius.




## Ponder

(1) Get a rectangular piece of paper and draw the largest possible circle that can be drawn on that piece of paper using a pair of compasses.