



- Experimental verification of the following properties.
- The perpendicular from the centre of a circle to a chord bisects the chord and its inverse.
- Equal chords of a circle subtend equal angles at the center and its inverse.
- Cyclic quadrilateral, Cyclic point, Angle opposite the cyclic quadrilateral.
- The sum of opposite angles of a cyclic quadrilateral is 180° .

OR

The opposite angles of a cyclic quadrilateral are supplementary.

13.1 Introduction

In the previous classes, we have got the concept of circle as well as its related terminology such as radius, diameter arc, chord, radius segment, arc of a circle, and chord of the circle or relationship between the points of the circle and the different angles formed on its centre by arc. In order to expand the knowledge related to the circle, we will study in specific of the circle.

We will study in this unit the specific and interesting relation between the chord of the circle and the distance between the centre and also study the relationships between the quadrilaterals and the opposite angles formed by combining the four points of the circle.

13.2 The perpendicular from the centre of a circle to a chord bisects the chord :

Do these, think and conclude

Draw the circle of three different radius, take the point O as centre of each. In the first circle, draw a chord AB. Now with the help of set square draw the perpendicular OM to AB. Measure AM and BM. Find the value of AM – BM.

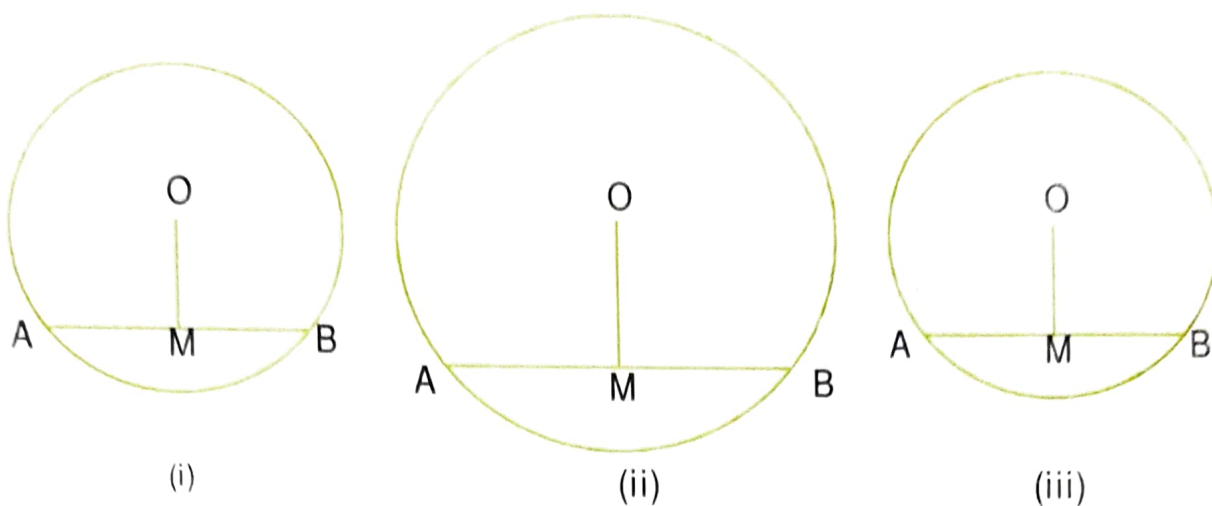


Fig. 13.1

Repeat this process itself for the other two circles and tabulate the results obtained on your exercise book as follows :

Serial of Circle	AM	BM	AM – BM
(i)			
(ii)			
(iii)			

From the table we find in every situation that the value of $AM - BM$ is 0 or the value of $AM - BM$ is so low that it can be considered negligible. In this way we can say that $AM = BM$ in every situations.

Do these, reason and make conclusions :

Draw a circle with centre 'O' on a tracing paper. Cut the circle and separate it.

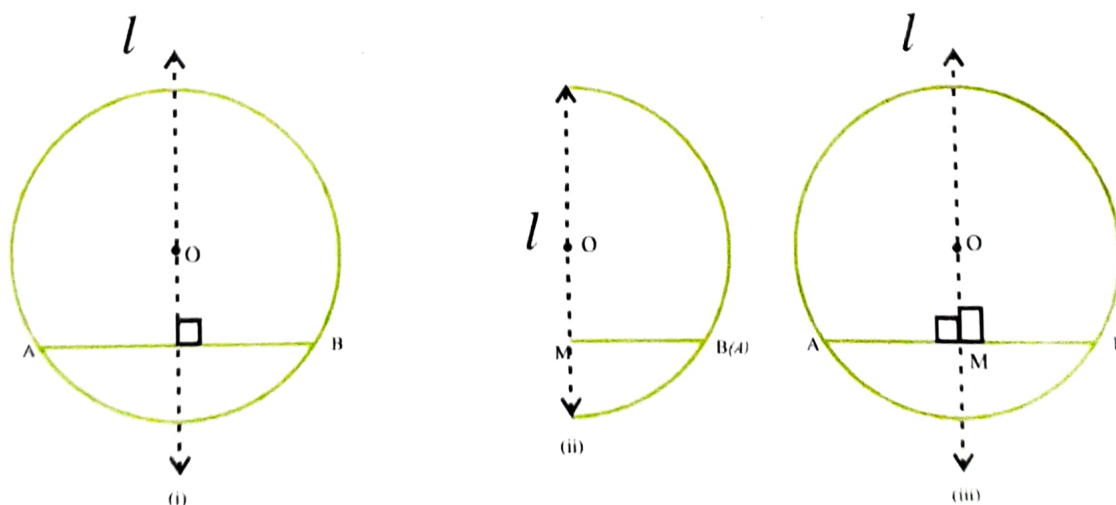


Fig. 13.2

Draw a chord AB of the circle, with the help of set square draw a perpendicular line l on AB which pass through the centre of the circle O. Turn the circle about the line l such that point A meets at point B and the line of turning is in the direction of line l . Now open the paper and the point M where turn marks cuts AB.

Thus, we find that AM is completely covering the BM and OM is perpendicular to AB.

So we come to the conclusion that :

The perpendicular from the centre of a circle to a chord bisects the chord.

13.2.1 The line joining the centre of a circle to the mid-point is perpendicular to the chord.

Think of them, do and conclude

Draw circle of three different radii on your exercise book, each of which has the centre O. In the first circle, draw a chord AB and take M as its middle point. Find out the angle $\angle OMA$ and the value of $90 - \angle OMA$.

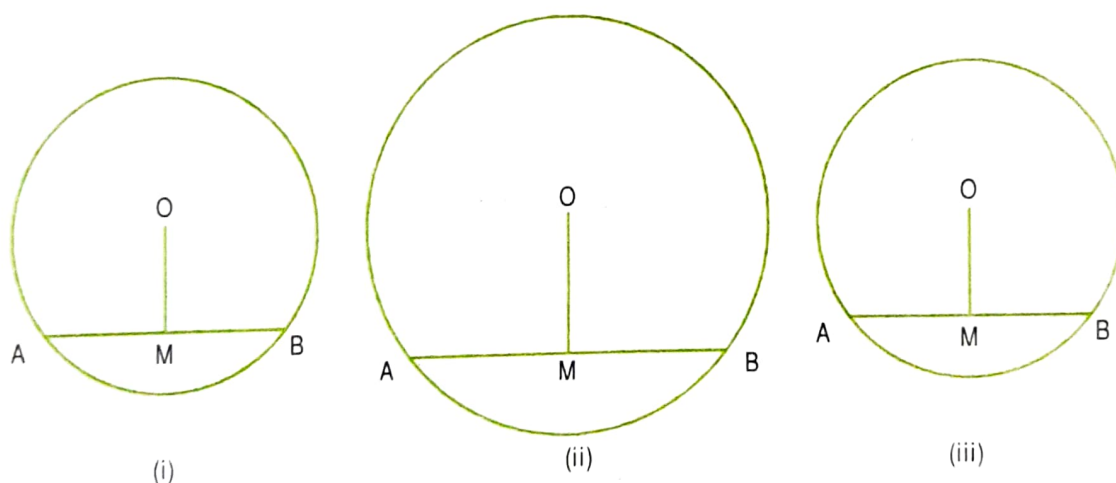


Fig. 13.3

The same process has also been repeated for the other two circles and tabulate the results as follows :

Serial No. of circle	$\angle OMA$	$90^\circ - \angle OMA$
(i)		
(ii)		
(iii)		

You will find that in every situation the value of $90^\circ - \angle OMA$ is zero or almost zero. In this way we can say $\angle OMA = 90^\circ$, i.e. OM is perpendicular to the chord AB.

Do this, argue and conclude

Draw a circle on a tracing paper, whose centre is O. Draw a chord AB on it and let the mid point of chord AB be M. Join point M and O together so that we get the line MO. Fold the paper along MO such that point A meets at point B.

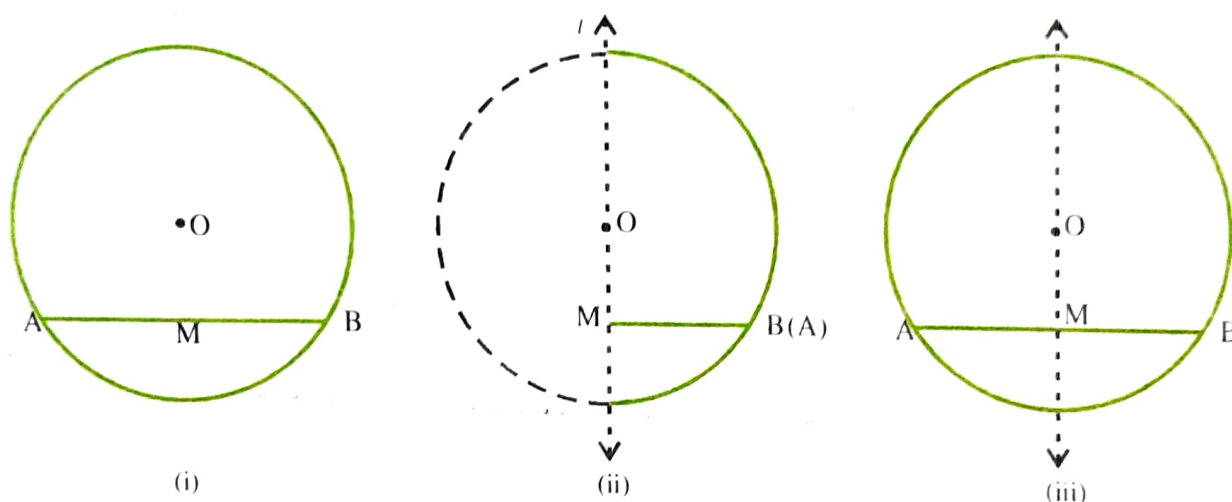


Fig. 13.4

Now open the paper. Does $\angle OMA$ covers $\angle OMB$ completely? You will find that $\angle OMA$ covers the $\angle OMB$ completely. In this way $\angle OMA = \angle OMB = 90^\circ$.

Therefore OM is perpendicular to AB.

A line segment joining the centre of any circle to the mid-point of a chord is perpendicular to that chord.

We can write both the above results below.

The perpendicular from the centre of a circle to a chord bisects the chord conversely the line segment which joins the mid-point of chord is perpendicular to the chord.

Example 1. In adjacent fig. 13.5, O is the centre of a circle whose one chord is AB, OP is perpendicular to the chord AB. If AB = 6 cm, find the length of AP.

Solution : We know that the perpendicular from the centre of a circle to a chord bisects the chord.

Thus, the centre of the circle is O and P is the mid point of AB.

$$\begin{aligned}\text{Therefore } AP &= \frac{1}{2} AB \\ &= \frac{1}{2} \times 6 \text{ cm.} \\ &= 3 \text{ cm}\end{aligned}$$

Thus length of AP is 3 cm.

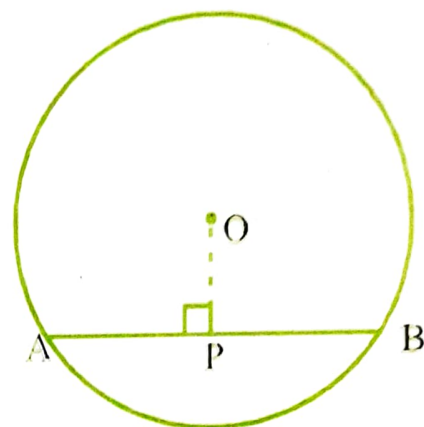


Fig. 13.5

Example 2. Find the length of a chord which is at a distance of 8 cm from the centre of a circle of radius 10 cm.

Solution : Let us suppose “O” is the centre of the circle whose radius is 10 cm. There is a chord AB in this circle and $OM \perp AB$ as shown in the adjacent figure.

We know that $AM = BM$

$$\{\because OM \perp AB\}$$

In $\triangle OMA$ $\angle M = 90^\circ$, $OM = 8 \text{ cm}$.

and $OA = 10 \text{ cm}$.

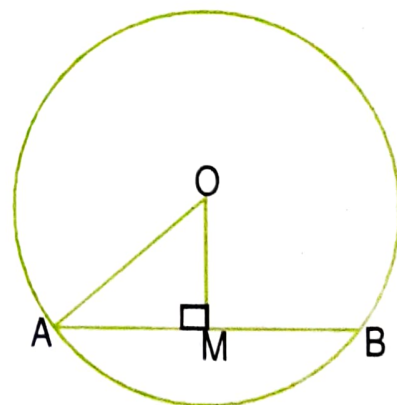


Fig. 13.6

From the Pythagoras theorem in the right angled triangle $\triangle OMA$

$$OM^2 + AM^2 = OA^2$$

$$\begin{aligned}\text{or } AM^2 &= OA^2 - OM^2 \\ &= 10^2 - 8^2 \\ &= 100 - 64 \\ &= 36 \\ \therefore AM &= \sqrt{36} \\ &= 6 \\ &= AB = 2 \times 6 \text{ cm.} = 12 \text{ cm.}\end{aligned}$$

Therefore length of chord = 12 cm.

Exercise 13(a)

1. In the adjacent fig. 13.7 O is the centre of the circle. The radius of the circle is 5 cm, AB is the chord of the circle whose length is 6 cm. If $OM \perp AB$ then find the length of OM.

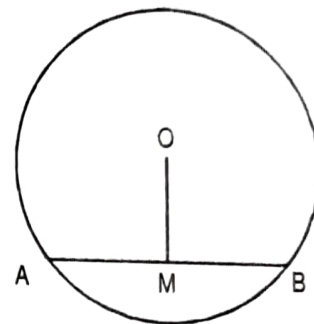


Fig. 13.7

2. In the adjacent fig. 13.8, O is centre of the circle find the length of a chord which is at a distance 5 cm from the centre of a circle of radius 13 cm.

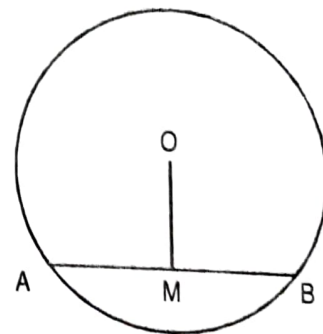


Fig. 13.8

3. A 10 cm long chord is drawn in a circle whose distance is 12 cm from the centre of the circle, find the radius of the circle.
4. A chord of length 8 cm drawn whose distance is 3 cm from the centre. Find the length of another chord drawn in the circle, which is 4 cm away from the centre.

Choose the correct options of question 5 and 6.

5. In the adjacent fig. 13.9 “O” is the centre of the circle whose one chord $AB = 30$ mm and diameter $AC = 34$ mm the distance OD from the centre of the chord AB is—

- (i) 34 mm (ii) 17 mm
(iii) 15 mm (iv) 8 mm

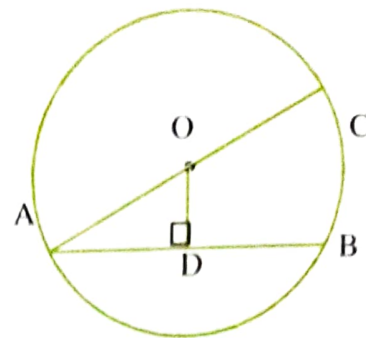


Fig. 13.9

6. In the adjacent fig. 13.10, O is the centre of the circle. The radius $OA = 5$ cm and length of chord $AB = 8$ cm. Perpendicular radius OD is drawn on the chord from the centre O. Line segment CD will be of length—

- (i) 1.1 cm (ii) 1.5 cm
(iii) 2.0 cm (iv) 3.0 cm

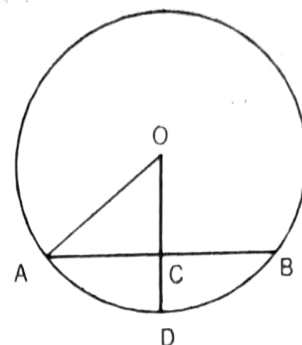


Fig. 13.10

7. In the adjacent fig. 13.11 “O” is the centre of the circle. If $OC \perp AB$. So choose true and false statement in the following statements.

- (i) $AC = CB$
(ii) $AB = \frac{1}{2} AC$
(iii) $AB = 2AC$
(iv) $OC = \sqrt{OA^2 - AC^2}$
(v) $AC = \sqrt{OA^2 + OC^2}$

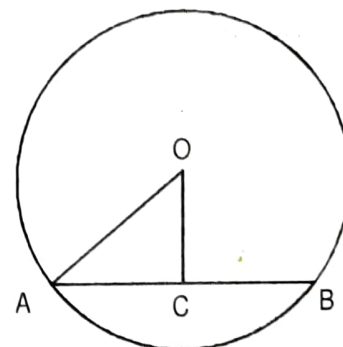


Fig. 13.11

Central Angle

The angle whose vertex is at the centre of any circle is called the central angle of that circle. Each arm of the central angle cuts the circle at different points. Joining these points we get a chord of the circle.

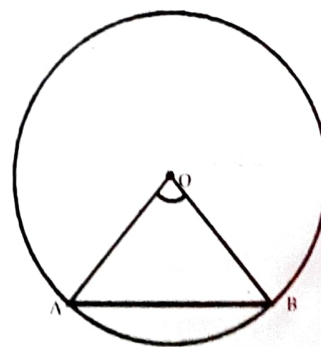


Fig. 13.12

In adjacent fig. 13.12 is a circle having centre at O. Centre of the circle O is the vertex of the $\angle AOB$. The rays of $\angle AOB$ cut the circle at points A and B and AB is the chord of the circle. In the way $\angle AOB$ is a central angle.

13.2.2 Equal chords of a circle subtend equal angles at the centre

Do these, think and conclude :

Draw three circles according to the picture on your exercise book, whose radii are different. Take "O" as the centre of each. In the first circle, drawn two chords AB and CD in such a way that $AB = CD$.

Draw the line segment OA, OB, OC and OD. Measure the angle $\angle AOB$ and $\angle COD$ in this way and find the value of $\angle AOB - \angle COD$.

Repeat the above procedure for the other two circles and tabulated the results obtained on your exercise manual as follows :

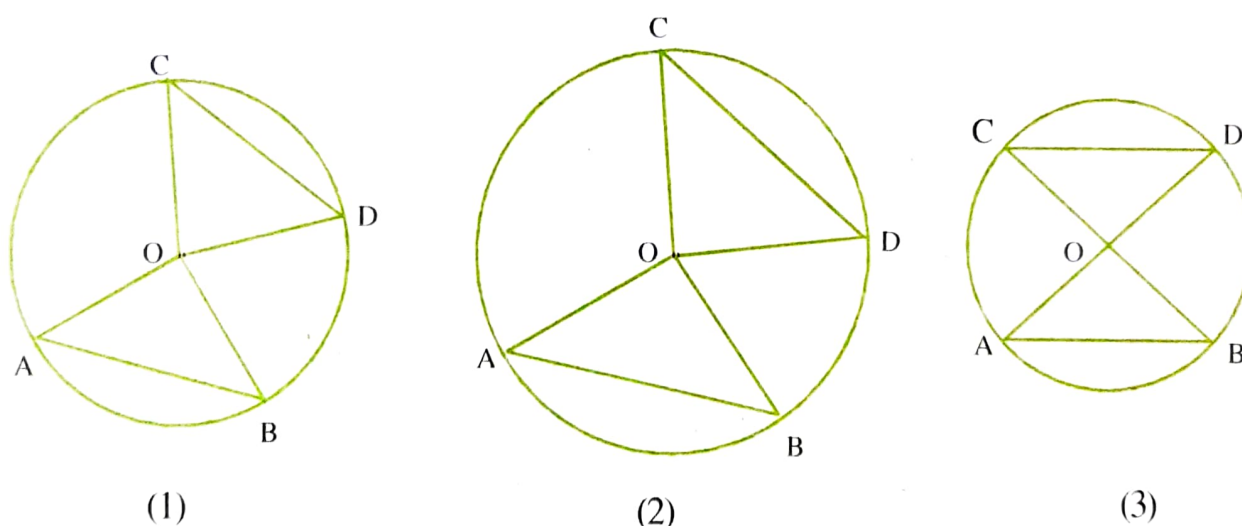


Fig. 13.13

Serial of Circle	$\angle AOB$	$\angle COD$	$\angle AOB - \angle COD$
1			
2			
3			

We will see that in each case the value of $\angle AOB - \angle COD$ is 0 or so low that it can be considered negligible. In this way, we can say that $\angle AOB = \angle COD$ in every situations.

So, we conclude that

Equal chords in any circle subtend equal angles at the centre.

Converse of the above result

Do, think and conclude :

According to figure, draw three circles of different radii on your exercise book. Take centre O of each circle. Make two angles $\angle AOB$ and $\angle COD$ at the centre of the first circle such that $\angle AOB = \angle COD$ where AB and CD are two chords of the circle.

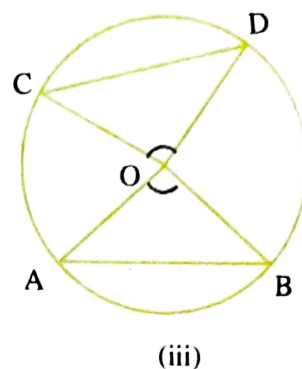
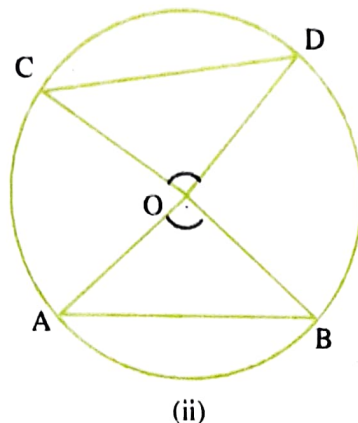
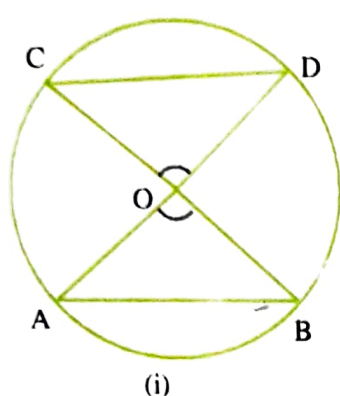


Fig. 13.14

Measure AB and CD. Find the value of $AB - CD$.

This process repeats for the other two circles and tabulated the results obtained on your exercise manual as follows :

Serial of Circle	AB	CD	AB - CD
(i)			
(ii)			
(iii)			

We will see that in each situation the value of $AB - CD$ is 0 or approximate zero in this way, we can say that $AB = CD$ in every situations.

In any circle if the angles subtended by two chords at the centre of a circle are equal then the chords are of equal length.

The above two results are to each other. In brief we write as follows :

Equal chords of a circle subtend equal angles at the centre and conversely if the angles subtended by two chord at the centre of a circle are equal then the chords are equal.

Example 3. An equilateral triangle $\triangle ABC$ is formed inside the circle whose centre is O . Find the measure of $\angle BOC$.

Solution : In adjacent fig.

- $\therefore \triangle ABC$ is an equilateral triangle.
- $\therefore AB = BC = CA$
- $\therefore$ These three sides are equal chords of a circle.
- $\therefore$ Each cord will have the same angle of the centre.

$$\text{i.e., } \angle BOC = \angle COA = \angle AOB$$

But the sum of the above three angles is 360°

$$\therefore \angle BOC = \angle COA = \angle AOB = \frac{360^\circ}{3} = 120^\circ$$

Therefore $\angle BOC = 120^\circ$

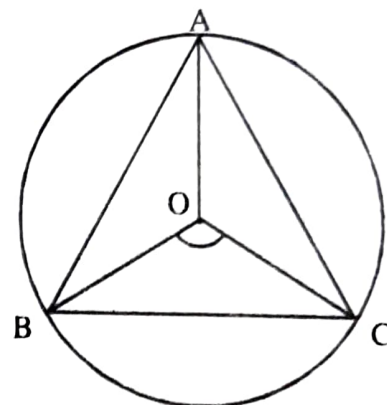


Fig. 13.15

Exercise 13(b)

- In the adjacent fig. 13.16 "O" is the centre of the circle. The three chords AB, PQ and CD of this circle have been drawn in such a way that $AB = PQ = CD$

If $\angle AOB = 65^\circ$ then find the value of $\angle POQ$ and $\angle COD$.

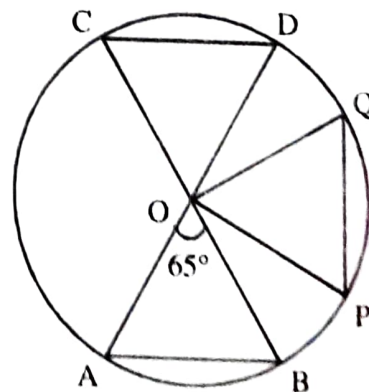


Fig. 13.16

2. In the adjacent fig. 13.17 "O" is the centre of the circle of $\angle AOB = \angle COD$ and chord $AB = 2.5$ cm, then find the length of the chord CD.

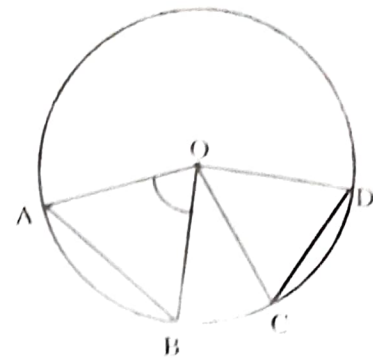


Fig. 13.17

3. "O" is the centre of a circle. A square ABCD is inscribed in the circle. How many degree angle is subtended by the side of the square at the centre of the circle ?
4. A polygon is inscribed in a circle. If each side of the polygon subtends an angle of 60° at the centre of the circle then how many sides are there in the polygon ?

13.2.2 Cyclic quadrilateral, cyclic point and angle of cyclic quadrilateral :

(i) Cyclic Quadrilateral

In fig. 13.18, combining the four points A, B, C and D of the circle, a quadrilateral ABCD is formed. This type of quadrilateral ABCD is called a cyclic quadrilateral.

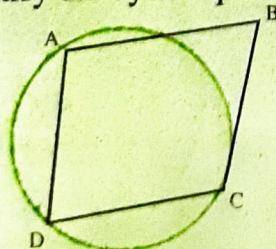
In other words, if all the four vertices of a quadrilateral lie on one circle, then it is called a cyclic quadrilateral.

Therefore

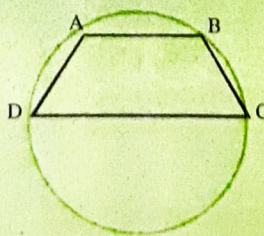
If all the four vertices of a quadrilateral lies on a circle, then it is called a cyclic quadrilateral.

Try

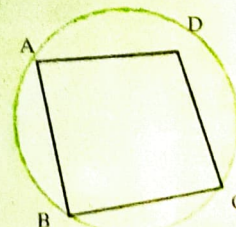
Identify the cyclic quadrilateral in the following shapes :



(i)



(ii)



(iii)

Fig. 13.19

Cyclic Point :

All the points that are situated on the same circle are called concyclic point or cocyclic point.

In the adjacent fig. O is the centre of the circle. Points A, B, C, D and E lies on the circle. Therefore points A, B, C, D and E are concyclic points.

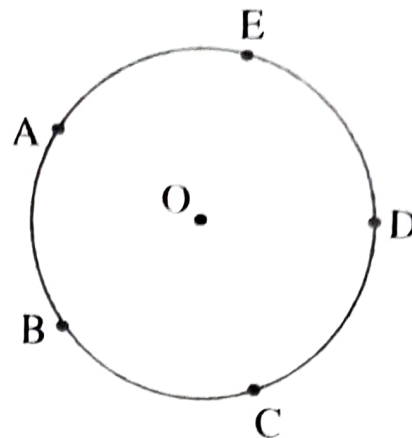


Fig. 13.20

Therefore

The points situated on the same circle are called concyclic points or cocyclic points.

Try :

Identify the cyclic points in the following circle

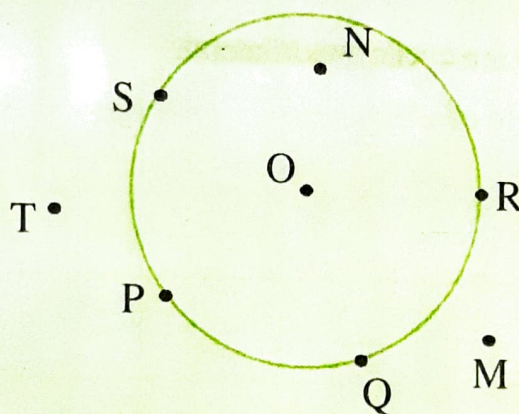


Fig. 13.21

Opposite angle of the cyclic quadrilateral

Think and write

In the adjacent fig. 13.22, in the cyclic quadrilateral ABCD, write the angle opposite to $\angle A$ and angle opposite to the $\angle B$.

We see that $\angle C$ is opposite to $\angle A$ and $\angle D$ is opposite to $\angle B$.

Therefore $\angle A$ and $\angle C$, $\angle B$ and $\angle D$ are opposite angles.

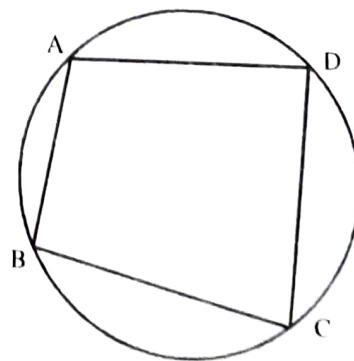


Fig. 13.22

Exercise 13(c)

1. In the adjacent fig. 'O' is the centre of the circle. Name the cyclic quadrilateral inscribed in the given circle.

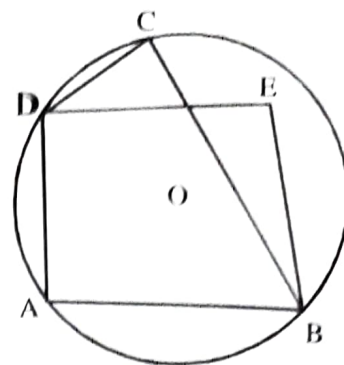


Fig. 13.23

2. In the adjacent fig. 'O' is the centre of the circle. Given point A, B, C, D, E and F. Which of the given points are concyclic ?

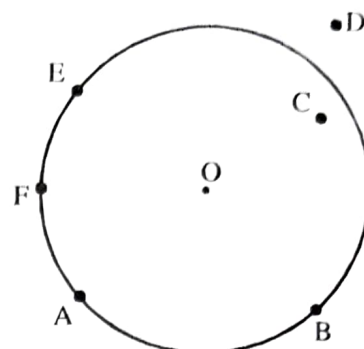


Fig. 13.23

3. In the adjacent fig. ABCD is a cyclic quadrilateral.
 - (i) Find the opposite angle of $\angle A$.
 - (ii) Find the opposite angle of $\angle B$.

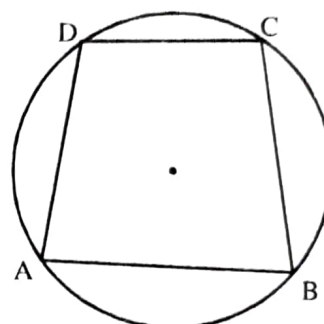


Fig. 13.25

4. See the adjacent fig. and tell the true/false statement in the following statements :
 - (i) Points A, B, C and D are concyclic points.
 - (ii) Points A, B, C, D and E are not concyclic points.
 - (iii) Points A, B, C, D, E and F are not concyclic points.
 - (iv) $\angle D$ is the opposite angle of $\angle ABC$.
 - (v) Quadrilateral BCDA is not a cyclic quadrilateral.
 - (vi) Quadrilateral ABCD is a cyclic quadrilateral.
 - (vii) $\angle C$ is the opposite angle of $\angle B$.

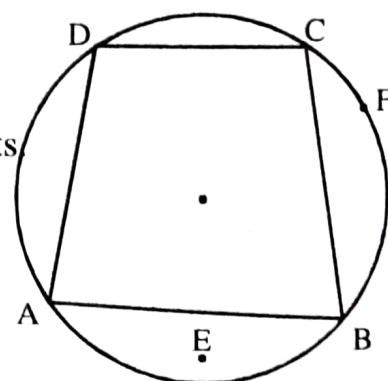
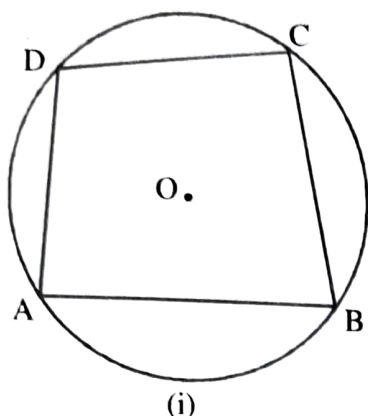


Fig. 13.26

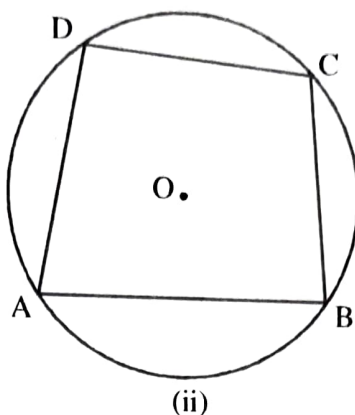
13.3 Sum of opposite angles of a cyclic quadrilateral

Do, think and conclude

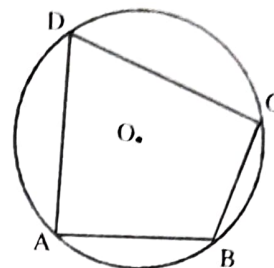
Draw a circle with centre O. Make a quadrilateral ABCD inscribed in this circle. Measure its angles and find $\angle A + \angle C$ and $\angle B + \angle D$.



(i)



(ii)



(iii)

Fig. 13.27

Repeat the same process with the angles of two other cyclic quadrilaterals and tabulate the results as follows :

Serial of Quadrilateral	$\angle A$	$\angle C$	$\angle A + \angle C$	$\angle B$	$\angle D$	$\angle B + \angle D$
(i)						
(ii)						
(iii)						

We will see that the $\angle A + \angle C$ is 180° , if it is more or less then we ignore it.

Similarly, we will see that at every time $\angle B + \angle D = 180^\circ$.

Therefore,

The sum of each pair of opposite angles of a cyclic quadrilateral is 180° . In the other words, the sum of a pair of opposite angles of a quadrilateral is 180° .

Do these, think and conclude :

Draw a circle with centre O and inscribe a quadrilateral ABCD in it. In this way ABCD become a cyclic quadrilateral. $\angle A$ and $\angle C$ are a pair of opposite angles of the quadrilateral, and $\angle B$ and $\angle D$ are another pair of opposite angles.

Now take a tracing paper and trace the quadrilateral ABCD. Take a point 'O' in the quadrilateral. Separate the four angles A, B, C and D by cutting along the dotted lines as shown in fig. 13.29(i)

Now draw a line l as shown in the fig. 13.29(ii). Take point P and Q on this line. So

Keep $\angle A$ and $\angle C$ at point P, so that the points A and C are at point P and the line segment AE is along the ray PQ and the line segment CF is opposite to ray PQ. In this way we see that line AH and CG will lie on each other. We will see that $\angle A$ and $\angle C$ will make linear pairs or $\angle A + \angle C = 180^\circ$.

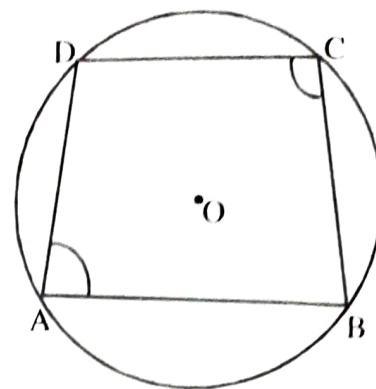


Fig. 13.28

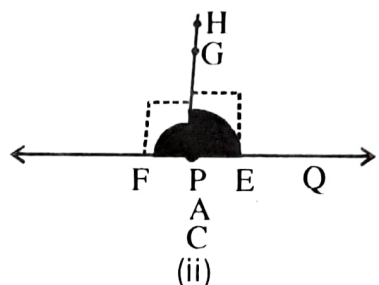
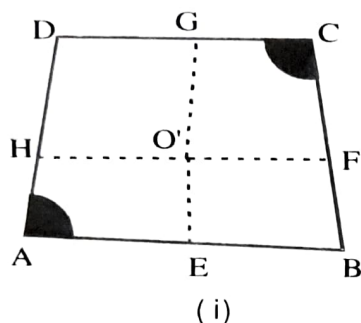


Fig. 13.29

Do this process for $\angle B$ and $\angle D$. We will see as mentioned above that $\angle B + \angle D = 180^\circ$. Thus we find that

**The opposite angles of a cyclic quadrilateral are supplementary
are sum of opposite angles or 180° .**

Example 4. Side AB of cyclic quadrilateral ABCD produced to E. If $\angle D = 110^\circ$, then find $\angle CBE$.

Solution : $\therefore \angle D$ and $\angle CBA$ are opposite angle of cyclic quadrilateral.

$$\therefore \angle D + \angle CBA = 180^\circ$$

$$\text{or } 110^\circ + \angle CBA = 180^\circ$$

$$\text{or } \angle CBA = 180^\circ - 110^\circ$$

$$\text{or } \angle CBA = 70^\circ$$

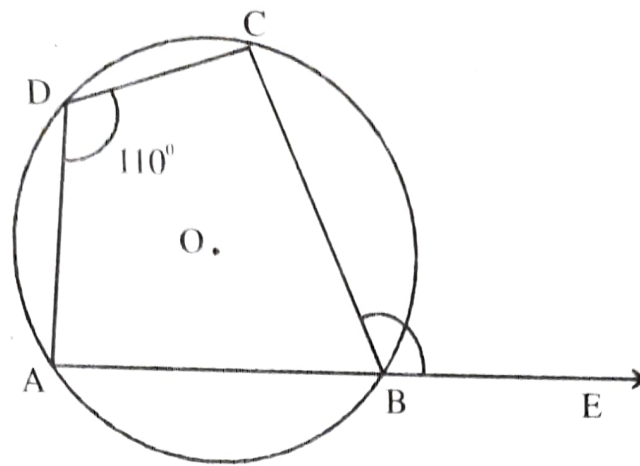


Fig. 13.30

$\therefore \angle CBA$ and $\angle CBE$ is a linear pair.
 $\therefore \angle CBA + \angle CBE = 180^\circ$
 or $70^\circ + \angle CBE = 180^\circ$
 or $\angle CBE = 180^\circ - 70^\circ$
 $\angle CBE = 110^\circ$
 Thus $\angle CBE = 110^\circ$

Example 5. In adjoining figure 13.31, ABCD is a cyclic quadrilateral in which $\angle A = 65^\circ$ and $\angle B = 70^\circ$. Find the measures of $\angle C$ and $\angle D$.

Solution : We know that the opposite angles of a cyclic quadrilateral are supplementary.

$$\angle A + \angle C = 180^\circ$$

$$\angle C = 180^\circ - \angle A$$

But $\angle A = 65^\circ$ (given)

$$\begin{aligned} \angle C &= 180^\circ - 65^\circ \\ &= 115^\circ \end{aligned}$$

and $\angle B + \angle D = 180^\circ$

$$\begin{aligned} \therefore \angle D &= 180^\circ - \angle B \\ &= 180^\circ - 70^\circ \\ &= 110^\circ \end{aligned}$$

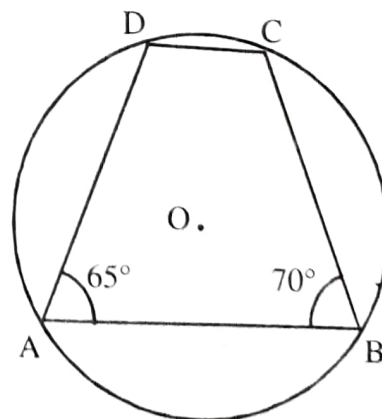


Fig. 13.31

Exercise 13(d)

1. In the adjoining fig. 13.32, side AB of cyclic quadrilateral ABCD is produced to point E. Find the value of exterior angle $\angle CBE$ is :

- (i) 115° (ii) 105°
(iii) 65° (iv) 75°

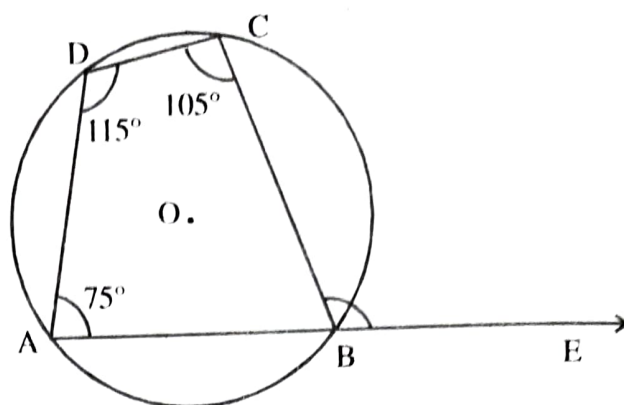


Fig. 13.32

2. In the adjoining fig. 13.33, ABCD is a cyclic quadrilateral in $AB \parallel CD$. Complete the following statements.

- (i) $\angle A + \angle D = 180^\circ$ because $AB \parallel DC$ and these are angle.
(ii) $\angle B + \angle D = 180^\circ$, because these angles are
(iii) $\angle A = \angle B$ because $\angle A + \angle D = \dots\dots\dots$

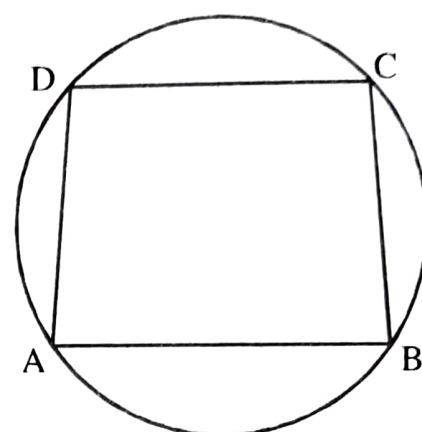


Fig. 13.33

3. In the adjoining fig. 13.34, O is the centre of the circle. If chord $AC =$ chord BC then, find the value of $\angle ABC$ and $\angle ACB + \angle APB$.

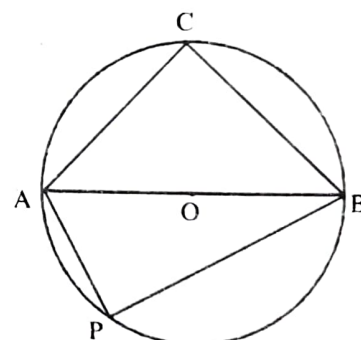


Fig. 13.34

4. In the adjoining fig. 13.35, 'O' is the centre of the circle and AOB is its diameter. The points C and D on the circle are such that $\angle CAB = 30^\circ$ and $\angle ABD = 40^\circ$. Find the value of $\angle CAD$ and $\angle CBD$.

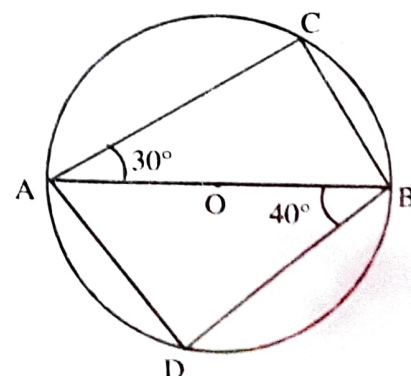


Fig. 13.35

5. In the adjoining fig. 13.36, a quadrilateral PQRS is inscribed in a circle. If $\angle R = 80^\circ$ and $\angle S = 85^\circ$ then, find the values of $\angle P$ and $\angle Q$.

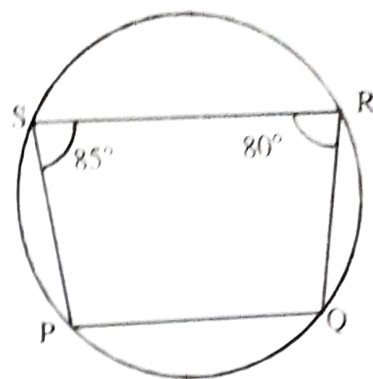


Fig. 13.36

6. In the adjoining fig. 13.37, two circles intersect each other at P and Q. The cyclic quadrilateral APQC and BPQD are such that APB and CQD are line segments. If $\angle A = 95^\circ$ and $\angle C = 80^\circ$, then find the value of $\angle B$, $\angle D$, $\angle APQ$ and $\angle PQD$.

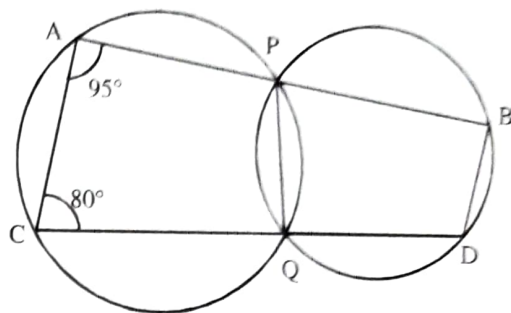


Fig. 13.37

7. In the adjoining fig. 13.38, ABCD is a cyclic quadrilateral. If $\angle C = x^\circ$ and $\angle A = 2x^\circ$. Find the value of x .

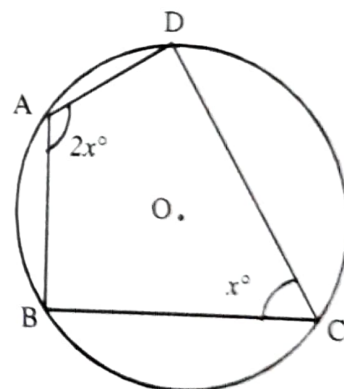


Fig. 13.38

Example 6. In the adjoining fig. 13.39, O is the centre of the circle and ABCD is a cyclic quadrilateral. If $\angle ADC = 140^\circ$. Find the value of $\angle BAC$.

Solution : $\therefore$ ABCD is a cyclic quadrilateral.
 $\therefore \angle ABC + \angle ADC = 180^\circ$
 or $\angle ABC + 140^\circ = 180^\circ$

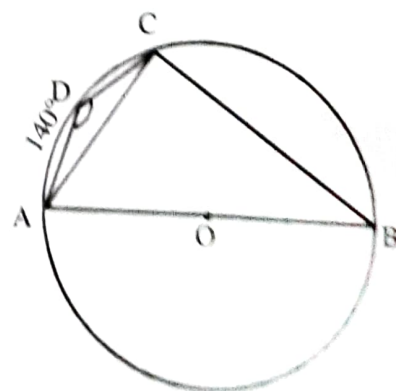


Fig. 13.39

$$\therefore \angle ABC = 180^\circ - 140^\circ = 40^\circ$$

$\therefore$ AB is the diameter of circle.

$$\therefore \angle ACB = 90^\circ$$

Now in right angle triangle.

$$\angle ABC + \angle BAC = 90^\circ$$

$$\begin{aligned}\therefore \angle BAC &= 90^\circ - \angle ABC \\ &= 90 - 40^\circ \\ &= 50^\circ\end{aligned}$$

Example 7. In adjacent fig. 13.40, 'O' is the centre of the circle. Two chords AB and CD are drawn in the circle whose mid points are M and N respectively. If OM = 8 cm, ON = 15 cm and chord AB = 30 cm, then, find the length of chord CD.

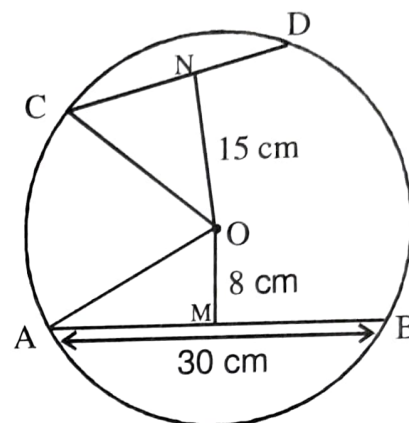


Fig. 13.40

Solution : $\therefore$ Point M is the mid-point of chord AB.

$$\therefore OM \perp AB$$

Again $\therefore AB = 30\text{cm}$ (given)

$$\therefore AM = \frac{1}{2} AB = \frac{1}{2} \times 30 \text{ cm} = 15 \text{ cm}$$

In right angle $\triangle OMA$

$$\begin{aligned}OA^2 &= OM^2 + AM^2 \\ &= 8^2 + 15^2 \\ &= 64 + 225 = 289\end{aligned}$$

$$\therefore OA = \sqrt{289} = 17 \text{ cm}$$

$\therefore$ OA and OC are radii

$$\therefore OC = OA = 17 \text{ cm.}$$

Again in right angle $\triangle ONC$

$$\begin{aligned}NC &= \sqrt{OC^2 - ON^2} \\ &= \sqrt{17^2 - 15^2} \\ &= \sqrt{64} = 8 \text{ cm.}\end{aligned}$$

$$\begin{aligned}
 \therefore \text{Chord } CD &= 2 \text{ NC} & (\because N, \text{ is the midpoint of chord } CD) \\
 &= 2 \times 8 \text{ cm.} \\
 &= 16 \text{ cm.}
 \end{aligned}$$

Efficiency Practice-13

Choose the correct answer from question 1 to 3.

1. In the adjoining fig. 'O' is the centre of the circle, and $OM \perp AB$. If $AB = 10$ cm. and $OM = 4$ cm, Find the radius OA of the circle.

- (i) 5 cm
- (ii) 3 cm
- (iii) $\sqrt{41}$ cm
- (iv) $\sqrt{116}$ cm

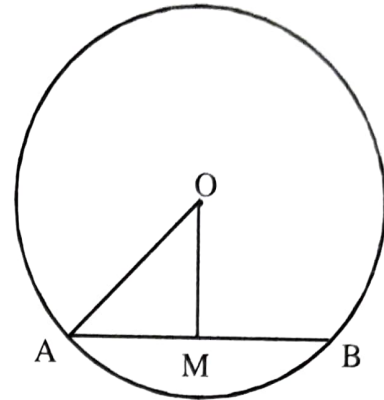


Fig. 13.41

2. In the adjoining fig. 13.42, if $\angle A = 80^\circ$ and $\angle B = 85^\circ$ then value of $\angle D$ is—

- (i) 145° (ii) 85°
- (iii) 80° (iv) 95°

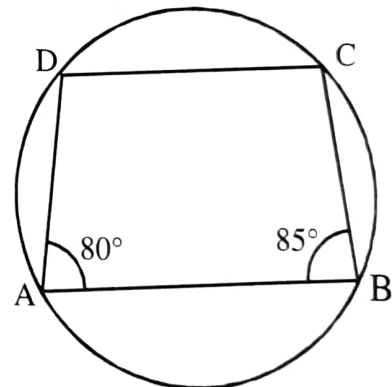


Fig. 13.42

3. In adjoining fig. 13.43 O is the centre of the circle. Chord $AB = \text{Chord } CD$ and $\angle AOB = 70^\circ$, find the value of $\angle COD$ is:

- (i) 35° (ii) 55°
- (iii) 70° (iv) 110°

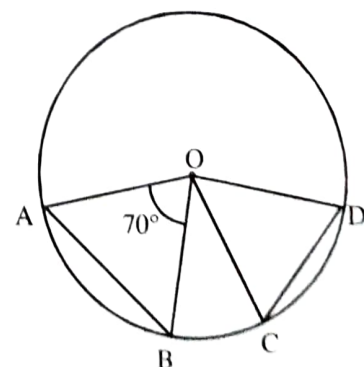


Fig. 13.43

4. In adjacent fig. 13.44, AB is a diameter of a circle with centre O and radius OD is perpendicular to AB. If C is any point on the circle then find the value of $\angle ABD$ and $\angle BCD$.

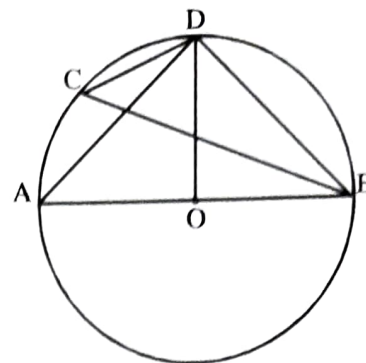


Fig. 13.44

5. In adjacent fig. 13.45, $\triangle ABC$ is an equilateral triangle. D and E are two points on the circle, find $\angle BEC$ and $\angle BDC$.

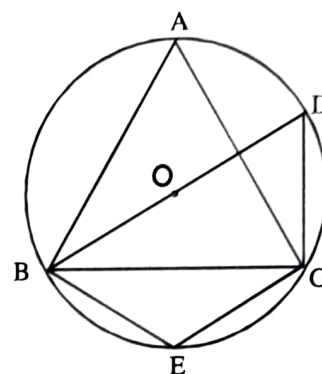


Fig. 13.45

6. In adjacent fig. 13.46, a cyclic quadrilateral ABCD inscribed in the circle with two diagonals AC and BD. If $\angle ACB = 55^\circ$ and $\angle BAC = 45^\circ$ then find the value of $\angle ADC$.

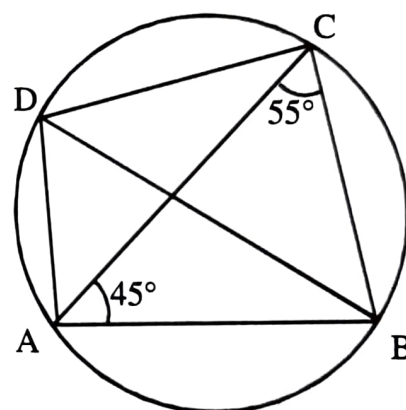


Fig. 13.46

7. Find the distance of the chord of length 16 cm from the centre of a circle of radius 10 cm.
8. The length of a chord in a circle is equal to its radius. Find the angle formed by the chord at the centre.
9. Draw a circle of radius 2.5 cm. Draw a chord at the distance of 0.7 cm from the centre of the circle. Measure the length of this chord and check the answer by calculation.
10. Draw a circle of radius 3 cm. Draw two equal chords of length 3 cm. Measure the angle subtended at the centre by each chord. Are the value of both angles equal ?

11. In adjoining fig. $\angle PQR = 100^\circ$ where P, Q and R lies on the circle with centre O. Find $\angle OPR$.

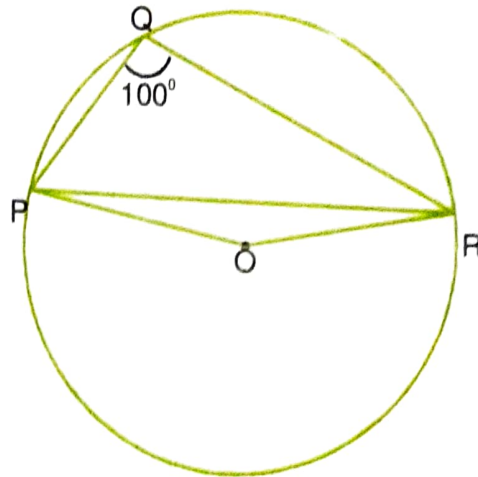


Fig. 13.47

We have learnt

1. The quadrilateral, which is formed by joining any four points on the circle, is called a cyclic quadrilateral.
2. All the points that are situated on the same circle are called concyclic point.
3. In a cyclic quadrilateral angles in front of each other are called opposite angles of cyclic quadrilateral.
4. The perpendicular from the mid-point of a circle to a chord bisects the chord.
5. The line joining the centre of the circle to the centre of the chord is perpendicular to the chord.
6. The angle whose vertex is at the centre of a circle is called the central angle of the circle.
7. Equal chords of a circle subtend equal angles at the centre.
8. In a circle the chords that substends equal angles at the centre of the circle are of equal lengths.
9. The sum of each pair of opposite angles of a cyclic quadrilateral is 180° .
10. The opposite angles of a cyclic quadrilateral are supplementary.

ANSWERS

Exercise 13(a)

1. 4 cm, 2. 24 cm, 3. 13 cm, 4. 6 cm, 5. (iv) 8 cm, 6. (iii) 2.0 cm, 7. (i) True, (ii) False, (iii) True, (iv) True, (v) False.

Exercise 13(b)

1. $\angle POQ = 65^\circ = \angle COD$ 2. 2.5 cm, 3. 90° , 4. 6

Exercise 13(c)

1. Cyclic quadrilateral ABCD, 2. Cyclic point A, B, E, F 3. (i) $\angle C$ (ii) $\angle D$, 4. (i) True, (ii) True, (iii) True, (iv) True, (v) False, (vi) True, (vii) False

Exercise 13(d)

1. (iii) 115° , 2. (i) Interior angle, (ii) Opposite angle of cyclic quadrilateral, (iii) $\angle B + \angle D$ 3. $\angle ABC = 45^\circ$, $\angle ACB + \angle APB = 180^\circ$, 4. $\angle CAD = 80^\circ$, $\angle CBD = 100^\circ$, 5. $\angle P = 100^\circ$, $\angle Q = 95^\circ$, 6. $\angle B = 85^\circ$, $\angle D = 100^\circ$, $\angle APQ = 100^\circ$, $\angle PQD = 95^\circ$, 7. $x^\circ = 60^\circ$

Efficiency Practice 13

1. (iii) $\sqrt{41}$ cm 2. (iv) 95° 3. (iii) 70° 4. $\angle ABD = 45^\circ = \angle BCD$ 5. $\angle BEC = 120^\circ$, $\angle BDC = 60^\circ$, 6. $\angle ADC = 100^\circ$, 7. 6 cm, 8. 60° , 9. 4.8 cm, 10. 60° , Yes 11. 10°

