10

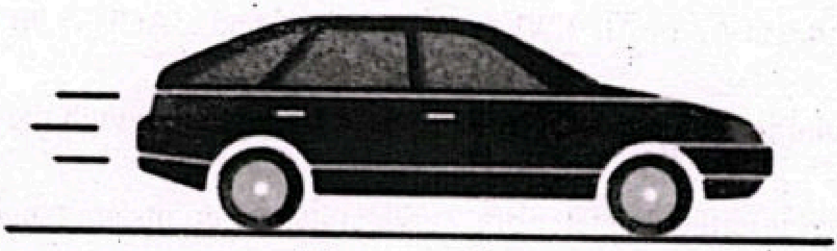
Tangents and Angles of a Circle

After studying this unit students will be able to:

- If a line is drawn perpendicular to a radial segment of a circle at its outer end point, it is tangent to the circle.
- The tangent to a circle and the radial segment joining the point of contact and the centre are perpendicular to each other.
- The two tangents drawn to a circle from a point outside the circle are equal in length.
- If two circles touch externally (internally), the distance between their centres is equal to the sum (difference) of their radii.
- The measure of a central angle of a minor arc of a circle, is double that of the angle subtended by the corresponding major arc.
- Any two angles in the same segment of a circle are equal.
- The angle in a semi-circle is a right angle.
- The angle in a segment greater than semi-circle is less than a right angle.
- The angle in a segment less than semi-circle is greater than a right angle.
- The opposite angles of any quadrilateral inscribed in a circle are supplementary.
- Apply concepts of tangents and angles to real life world problems such as architecture, monuments and pyramids etc.

Tangents have several important applications across various fields, particularly in mathematics, physics, engineering, and geometry. Some applications of tangents are:

- Tangents play an important role in the study of curves. They are lines that touch a curve at a single point, perpendicular to the curve's radius at that point. Tangents are used to define geometric properties such as the radius, diameter, chord, and arc length of circles.
- Tangents are used to design curves in buildings, such as arches and domes.
- Tangents are used to design curves in roads, bridges, and other structures. By using tangents, engineers can create curves that are safe and efficient for travel.
- Tangents are used to analyse the motion of objects. For example, when a car or bike travels down a road, the road becomes tangent at each location where the wheels roll.



Tangent Line

Tangent to a Circle

Tangent Line

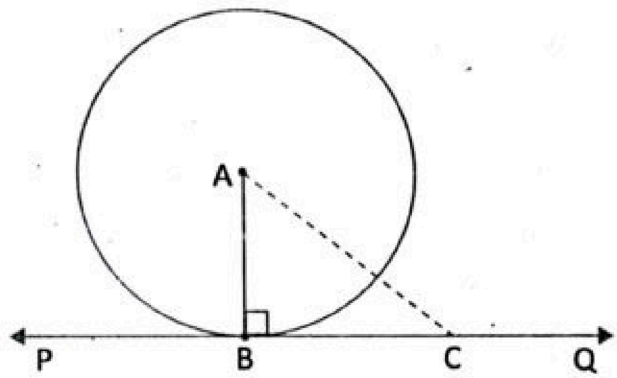
A line which touches the circle at only one point is called tangent line. A tangent line is perpendicular to the radial segment. More over the distance of tangent line from the centre is equal to radius of the circle.

Theorem 10.1

Statement:

If a line is drawn perpendicular to a radial segment of a circle at its outer end point, it is tangent to the circle.

Class Activity:



(i) Draw a radial segment AB ($\overline{AB}$) of a circle as shown in the adjoining figure.

(ii) Draw a perpendicular line PQ ($\overleftrightarrow{PQ}$) at the outer end of AB.

(iii) Check whether $\overleftrightarrow{PQ}$ touches the circle at only one point or not.
Is $\overleftrightarrow{PQ}$ tangent line?

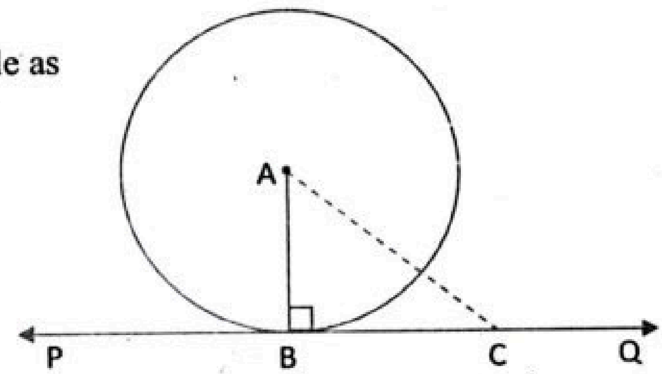
(iv) Take any point C on $\overleftrightarrow{PQ}$ and join C to A.
Why $\overline{AC}$ is not the radial segment?

Theorem 10.2

Statement:

The tangent to a circle and the radial segment joining the point of contact and the centre are perpendicular to each other.

Class Activity:



(i) Draw a radial segment AB ($\overline{AB}$) of a circle as shown in the adjoining figure.

(ii) Draw a tangent $\overleftrightarrow{PQ}$ at point B.

(iii) Measure the angel between $\overline{AB}$ and tangent $\overleftrightarrow{PQ}$. i.e. $\angle ABC$
What is the measure of $\angle ABC$?

(v) Take any point C on $\overleftrightarrow{PQ}$ and join C to A. Which is shortest $\overline{AB}$ or $\overline{AC}$? Why $\angle ABQ = 90^\circ$ and $\angle ACB \neq 90^\circ$?

Corollaries:

(i) The line perpendicular to the tangent at point of contact passes through the centre of circle.

(ii) The lines perpendicular to the diameter of a circle at its end points are tangents to the circle.

(iii) The line perpendicular to the tangent of circle from centre passes through point of contact.

(iv) The tangents at end points of diameter of a circle are parallel.

Theorem 10.3

Statement:

The two tangents drawn to a circle from a point outside the circle are equal in length.

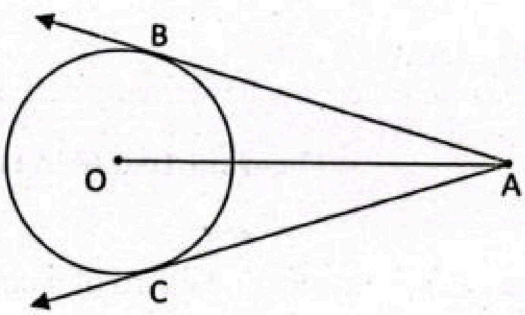
Class Activity:

(i) Draw a circle with centre O.

(ii) Take a point A outside the circle and join with O.

(iii) Draw two tangents $\overrightarrow{AB}$ and $\overrightarrow{AC}$. where B and C are points on the circle.

(iv) Measure $\overline{AB}$ and $\overline{AC}$. Are they equal?



Corollary:

The two tangents drawn to a circle from an outer point make equal angles with the line segment joining the centre and outer point.

Theorem 10.4

Statement:

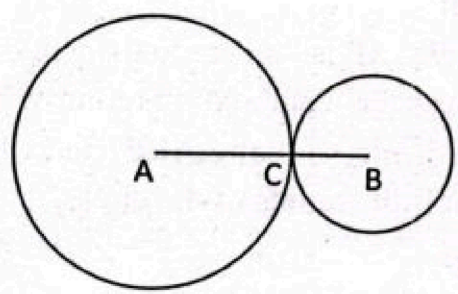
If two circles touch externally, the distance between their centres is equal to the sum of their radii.

Class Activity:

(i) Draw two circles of radii 2 cm and 1 cm with centres A and B respectively such that the circles touch externally as shown in the figure.

(ii) Join the centres of both circles by drawing AB.

(iii) Measure AB. It will be 3 cm.



Is 3 cm equal to the sum of radii of both the circles? Can we write AB = AC + BC ?

Corollary:

If two congruent circles touch externally, the distance between their centres is equal to diameter of each circle.

Theorem 10.5

Statement:

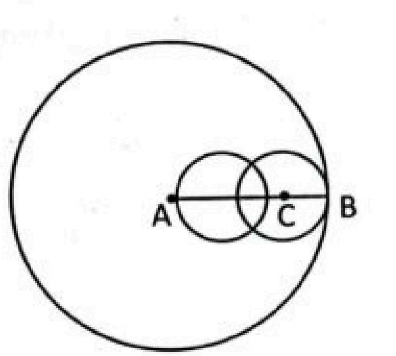
If two circles touch internally, the distance between their centres is equal to the difference of their radii.

Class Activity:

(i) Draw two circles of radii 3.5 cm and 1 cm with centres A and B respectively such that the circles touch internally as shown in the figure.

(ii) Draw AB.

(iii) Measure AC. It will be 2.5 cm.



Is 2.5 cm equal to the difference of radii of both the circles?

Can we write AC = AB – BC ?

where AB and BC are radii of both circles.

Corollary:

If two congruent circles touch intarnally, the distance between their centres is equal to zero.

Theorem 10.6 (Alternate Segment Theorem)

Statement:

An angle between a tangent and chord of a circle through the point of contact is equal to the angle in the alternate segment.

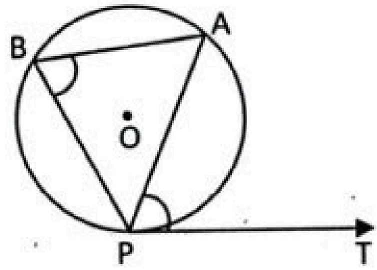
Class Activity:

(i) Draw a tangent $\overrightarrow{PT}$ and a chord $\overline{PA}$ at the point of contact T of a circle centered at O.

(ii) Measure $\angle APT$ and note it.

(iii) Draw angle $\angle ABP$ in the alternate segment and measure it.

You will see that $\angle APT = \angle ABP$



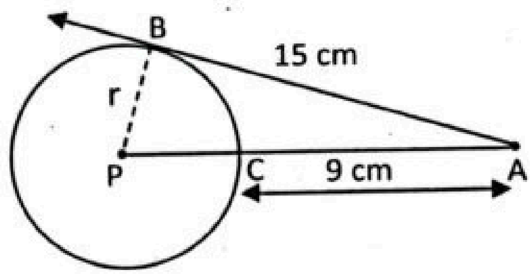
Example:

In the figure, $\overrightarrow{AB}$ is tangent to the circle of centre P.

(i) Express the length AP in terms of r.

(ii) What is measure of $\angle ABP$? and why?

(iii) What is the radius of the circle?



Solution:

(i) $AP = AC + PC = (9 + r)$ cm

(ii) $\angle ABP = 90^\circ$ because tangent line and radial segment are perpendicular to each other.

(iii) ABP is right angled triangle, therefore using Pythagoras theorem, we have:

$$(AP)^2 = (AB)^2 + (BP)^2$$

$\Rightarrow \quad (9 + r)^2 = (15)^2 + r^2 \qquad \Rightarrow \quad 81 + r^2 + 18r = 225 + r^2$

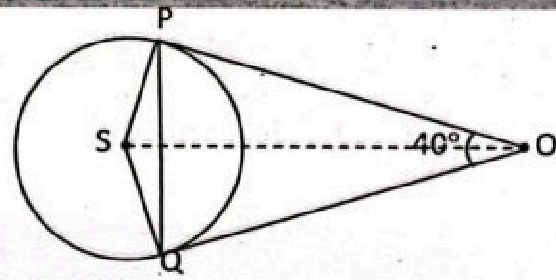
$\Rightarrow \quad 18r = 225 - 81 = 144 \qquad \Rightarrow \quad r = 144 \div 18 = 8$

$\therefore \quad$ Radius of the circle = 8 cm

Example:

In the figure, $\overline{OP}$ and $\overline{OQ}$ are tangents to a circle centered at S. If $\angle POQ = 40^\circ$, then find:

(i) $\angle PSQ$ (ii) $\angle SPQ$ (iii) $\angle OPQ$



Solution:

(i) Join O and S.

As OPS is right angled triangle, therfore:

$\angle OPS = 90^\circ$

Also $\angle POS = 20^\circ$ (Half of 40°. $\overline{OS}$ is angle bisector of $\angle POQ$.)

$\therefore\ \angle PSO = 90^\circ - 20^\circ = 70^\circ$

Hence, $\angle PSQ = \angle PSO + \angle QSO = 70^\circ + 70^\circ = 140^\circ$ ($\angle PSO = \angle QSO$)

(ii) In ΔPQS, $PS = QS$ (Radii of same circle)

$\therefore\ \angle SPQ = \angle SQP$ (Opposite angles of congruent sides of triangle)

Let $\angle SPQ = \angle SQP = x$

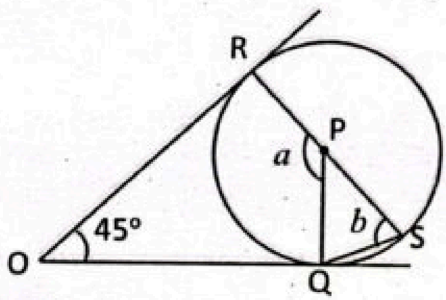
Then, $x + x + \angle PSQ = 180^\circ \quad \Rightarrow \quad 2x + 140^\circ = 180^\circ$

$\Rightarrow \quad 2x = 180^\circ - 140^\circ = 40^\circ \quad \Rightarrow \quad x = 20^\circ$

Hence, $\angle SPQ = \angle SQP = 20^\circ$

(iii) $\angle OPQ = \angle SPO - \angle SPQ = 90^\circ - 20^\circ = 70^\circ$

Example: Find the measures of angles a and b in the adjoining figure.



Solution:

As $\overline{OQ}$ and $\overline{OR}$ are tangents, therefore:

$\angle ORP = \angle OQP = 90^\circ$

Now OQPR is a kite.

$\therefore \quad 45^\circ + 90^\circ + a + 90^\circ = 360^\circ$

$\Rightarrow \quad a = 360^\circ - 90^\circ - 90^\circ - 45^\circ = 135^\circ$

As $\overline{RS}$ is a straight line and P lies on it.

$\therefore \quad a + \angle QPS = 180^\circ \quad \Rightarrow \quad 135^\circ + \angle QPS = 180^\circ$

$\Rightarrow \quad \angle QPS = 180^\circ - 135^\circ = 45^\circ$

In ΔPQS, $PQ = PS$ (Radii of same circle)

$\therefore\ \angle PQS = \angle PSQ$ (Opposite angles of congruent sides of triangle)

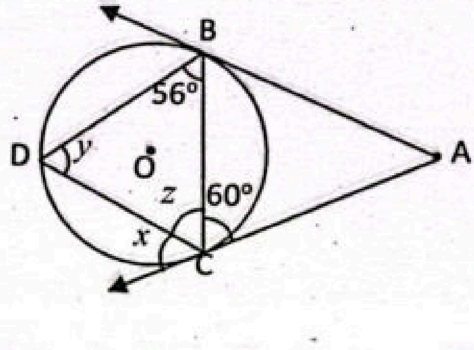
Then, $b + b + 45^\circ = 180^\circ \quad \Rightarrow \quad 2b + 45^\circ = 180^\circ$

$\Rightarrow \quad 2b = 180^\circ - 45^\circ = 135^\circ \quad \Rightarrow \quad b = 67.5^\circ$

Check Point:

The distance of a point P from the centre O of a circle of radius 6 cm, is 10 cm. Find the length of tangents to the circle from P.

Example: Find the measures of angles x, y and z in the adjoining figure.



Solution:

We know that:

$\angle BDC = \angle BCA$ (Theorem 10.6)

$\therefore \quad y = 60^\circ$

In triangle BCD:

$56^\circ + y + z = 180^\circ$

$\Rightarrow \quad 56^\circ + 60^\circ + z = 180^\circ$

$\Rightarrow \quad z = 180^\circ - 56^\circ - 60^\circ = 64^\circ$

Now,

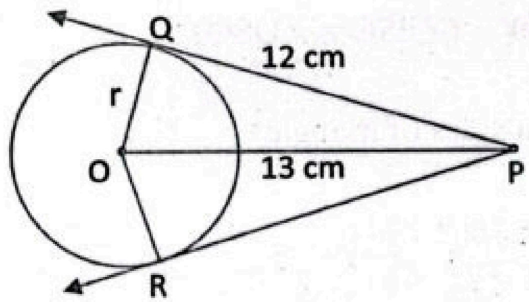
$\because x = \angle CBD$ (Theorem 10.6)

$\Rightarrow \quad x = 56^\circ$

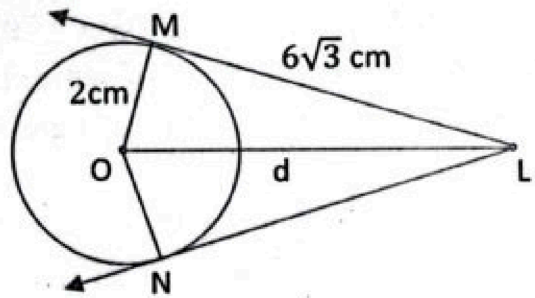
Exercise 10.1

1. Find the values of unknown in the following figures.

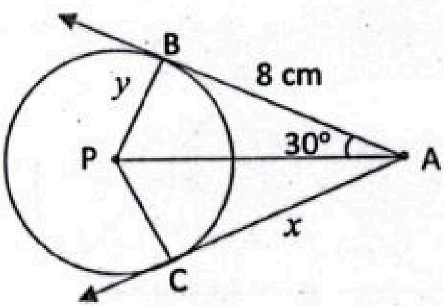
(i)



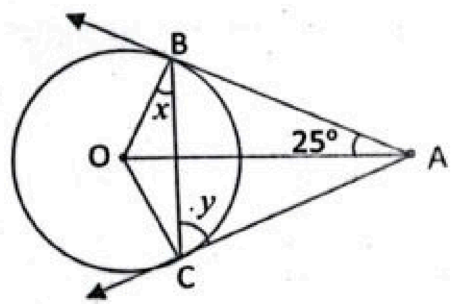
(ii)



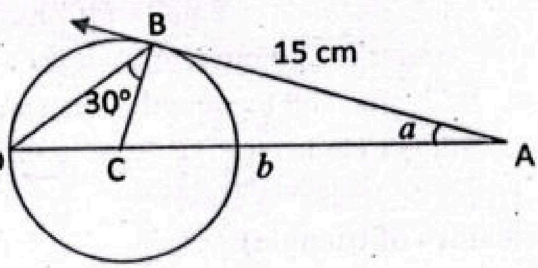
(iii)



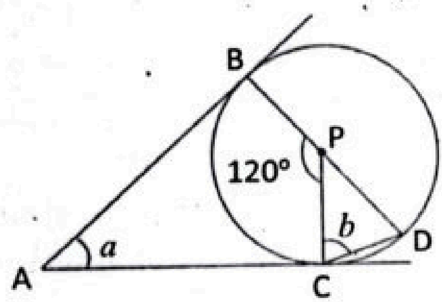
(iv)



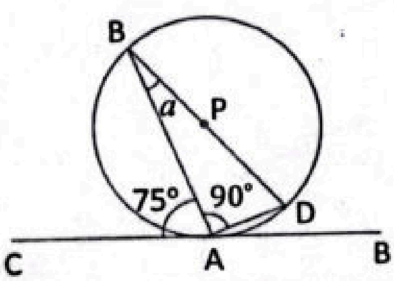
(v)



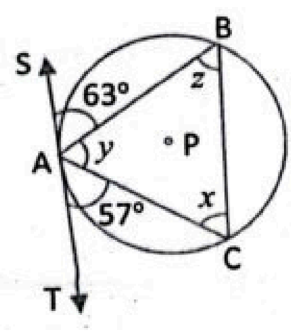
(vi)



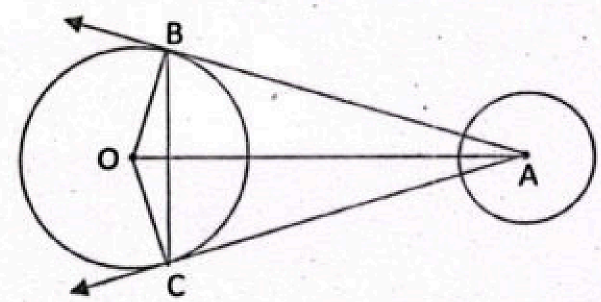
(vii)



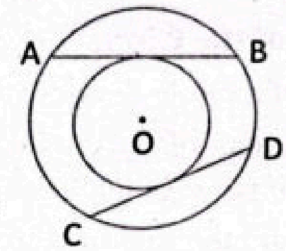
(viii)



2. In the figure AB and AC are two tangents of a circle with centre O at point B and C respectively. If $\angle BOC = 120^\circ$, then find:
   (i) $\angle OBA$ (ii) $\angle OCB$
   (iii) $\angle BAC$ (iv) $\angle ABC$

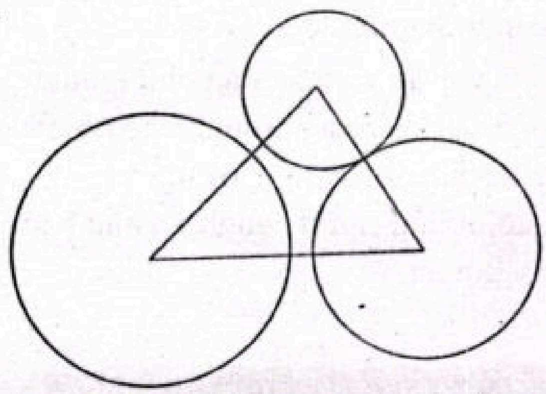


3. O is centre of two concentric circles. AB and CD are chords of outer circle tangent to inner circle. Prove that AB = CD.

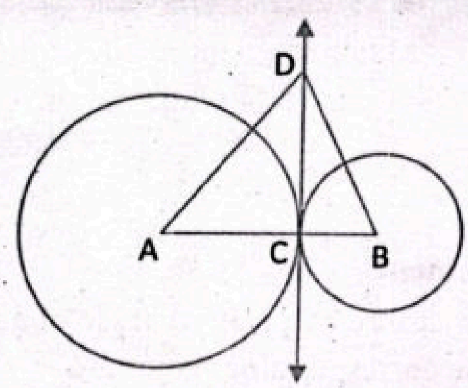


4. Ali is whirling a stone tied with a string of length 3 feet. All of a sudden string is broken and the stone moves along tangent direction of circular path and hits a point 5 feet away from Ali. Find the distance covered by the stone.

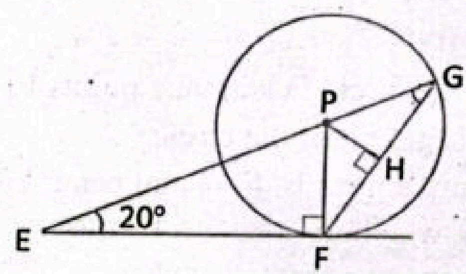
5. Three circles touch externally. The ratio of distances between centers is 2 : 3 : 4. The perimeter of triangle joining the centers is 36 cm. Find radius of each circle.



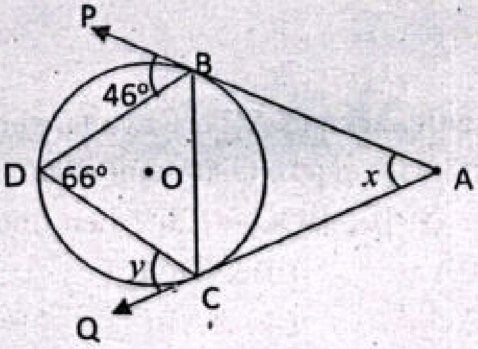
6. In the figure, AD = 5 cm, CD = 4 cm and BD = 4.5 cm. Find the distance between centres of circles.



7. In the adjoining figure, $\angle PEF = 20^\circ$. H is mid-point of $\overline{FG}$. Find $\angle PGH$.



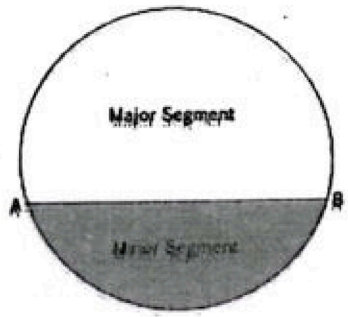
8. In the figure, triangle ABC, AB = AC.
Find the values of angles x and y.



Angle in a Segment of a Circle

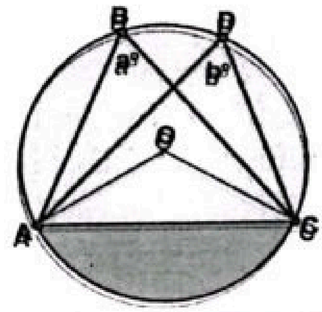
Segment of the Circle

A chord of a circle divides the circular region into two parts, called segment of the circle.
The region between chord and minor arc is called minor segment and the region between chord and major arc is called major segment. In the figure, the shaded region is minor segment and remaining region is major segment.



Angle in a Segment

An angle whose vertex is a point on the arc of a circle and whose arms pass through end points of chord, is known as inscribed angle of the arc.
In the adjoining figure, angles a and b are examples of angles in the segment.

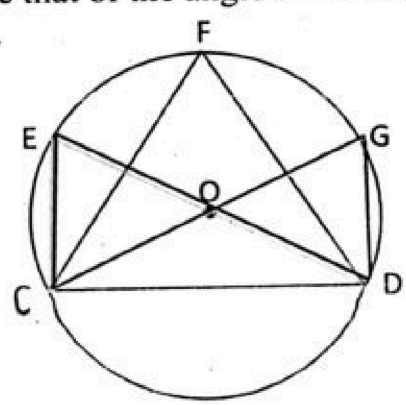


Key Fact:

Major segment is greater than semi-circular region and always contains the centre of the circle while minor segment is smaller than the semi-circular region.

Theorem 10.7

Statement:
The measure of a central angle of a minor arc of a circle, is double that of the angle subtended by the corresponding major arc.



Class Activity:
(i) Draw the circle O and take points E, F and G on the same segment of the circle.
(ii) Measure angles E, F, G and central angle COD.
(iii) Check whether:
$2\angle E = 2\angle F = 2\angle G = \angle COD$

Check Point:

Prove theorem 10.7 by taking central angle $\angle COD = 180^\circ$ and $\angle COD > 180^\circ$ (reflex angle).

Theorem 10.8

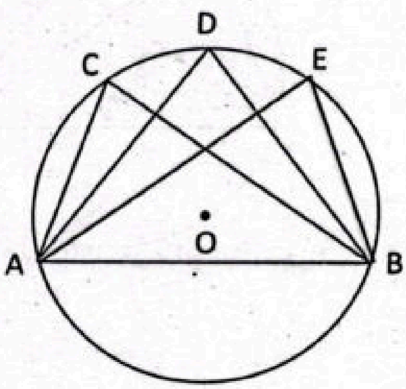
Statement: Any two angles in the same segment of a circle are equal.

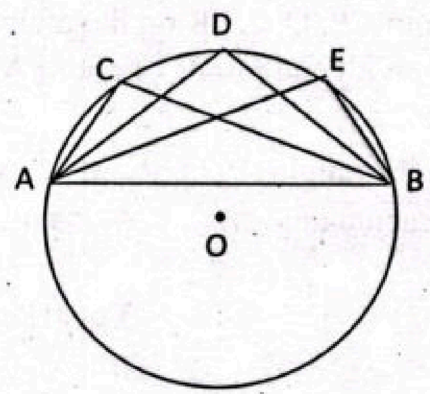
Class Activity:

(i) Draw two circles of different radii.

(ii) Draw a chord AB in both the circles.

(iii) Take three points C, D and E on the same segment and join them with end points of chord AB.





(iv) Complete the following table.

S. No	$\angle C$	$\angle D$	$\angle E$	Result
1.				
2.				

Are $\angle C = \angle D = \angle E$?

Result:

Any number of angles in the same segment of a circle are equal.

Theorem 10.9

Statement:

The angle in a semi-circle is a right angle.

Class Activity:

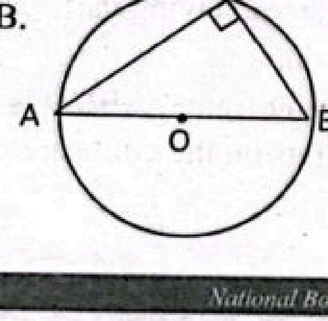
(i) Draw a semicircle O.

(ii) Take a point P on the semi-circle and draw AP and PB.

(iii) Measure angle APB.

What do you notice?

You will see that angle APB is equal to 90°.



Corrolary:

If an arc of a circle subtends a right angle at any point of the remaining part of the circle, then the arc is a semi-circle.

Theorem 10.10

Statement:

The angle in a segment greater than semi-circle is less than a right angle.

Class Activity:

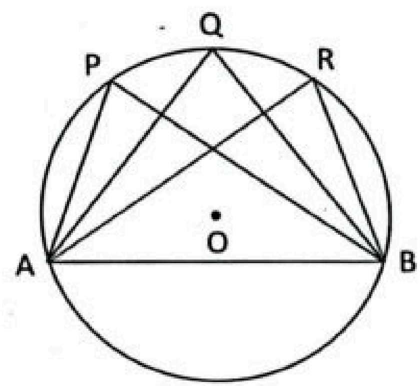
(i) Draw a circle O.

(ii) Draw a chord AB such that the centre lies in the major segment.

(iii) Take three points P, Q and R on the major segment and join them with end points of chord AB.

(iv) Measure $\angle P = \angle Q = \angle R$

You will see that angles P, Q, R are less than right angles (acute angles).



Theorem 10.11

Statement:

The angle in a segment less than semi-circle is greater than a right angle.

Class Activity:

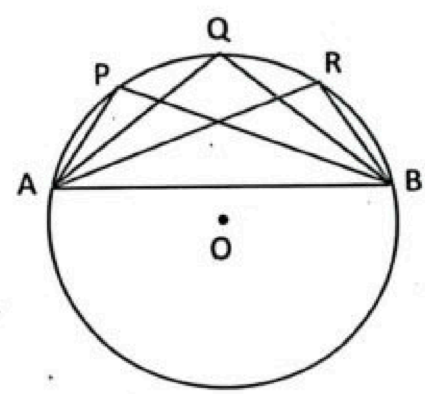
(i) Draw a circle O.

(ii) Draw a chord AB such that the centre lies in the major segment.

(iii) Take three points P, Q and R on the minor segment and join them with end points of chord AB.

(iv) Measure $\angle P = \angle Q = \angle R$

You will see that the angles P, Q, R are greater than right angle (obtuse angle)

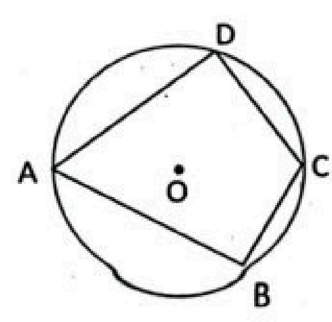


Cyclic Quadrilateral

A quadrilateral inscribed in a circle is called cyclic quadrilateral. Or a quadrilateral having vartices on the circle is called a cyclic quadrilateral.

In the adjoining figure, ABCD is cyclic quadrilateral.

The four points on the circle are called concyclic.



Theorem 10.12

Statement:

The opposite angles of any quadrilateral inscribed in a circle are supplementary. Or
The sum of opposite angles in a cyclic quadrilateral is 180°.

Class Activity:

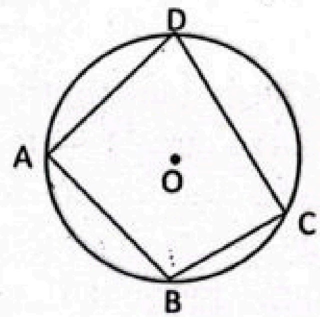
(i) Draw a circle O and inscribe a quadrilateral ABCD in the circle as shown in the adjoining figure.

(ii) Measure interior angles A, B, C and D of quadrilateral.

(iii) Add $\angle A$ and $\angle C$.
What is the sum of these angles? Yes! it is 180°.

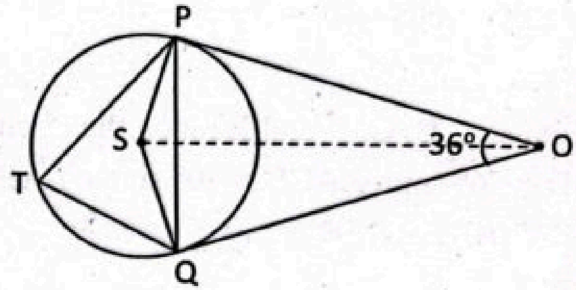
(iv) Again add $\angle B$ and $\angle D$.
What is the sum of these angles? Yes! it is 180°.

What is sum of opposite interior angles of cyclic quadrilateral?



Example:

In the figure, $\overline{OP}$ and $\overline{OQ}$ are tangents to a circle centered at S. If $\angle POQ = 36^\circ$, then find:
(i) $\angle PSQ$ (ii) $\angle SQP$ (iii) $\angle PTQ$



Solution:

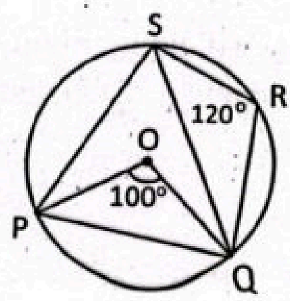
(i) Join O and S.
As OPS is right angled triangle, therfore:
$\angle OPS = 90^\circ$
Also $\angle POS = 18^\circ$ (Half of 36°. $\overline{OS}$ is angle bisector of $\angle POQ$.)
$\therefore\ \angle PSO = 90^\circ - 18^\circ = 72^\circ$
Hence, $\angle PSQ = \angle PSO + \angle QSO = 72^\circ + 72^\circ = 144^\circ$ ($\angle PSO = \angle QSO$)

(ii) In ΔPQS, $PS = QS$ (Radii of same circle)
$\therefore\ \angle SPQ = \angle SQP$ (Opposite angles of congruent sides of triangles)
Let $\angle SPQ = \angle SQP = x$
Then, $x + x + \angle PSQ = 180^\circ \quad \Rightarrow \quad 2x + 144^\circ = 180^\circ$
$\Rightarrow \quad 2x = 180^\circ - 144^\circ = 36^\circ \quad \Rightarrow \quad x = 18^\circ$
Hence, $\angle SPQ = \angle SQP = 18^\circ$

(iii) As, the measure of a central angle of a minor arc of a circle, is double that of the angle subtended by the corresponding major arc.
$\therefore \angle PTQ = \frac{1}{2}(\angle PSQ) = \frac{1}{2} \times 144^\circ = 72^\circ$

Example:

In the figure, A, B, C and D are points on a circle.
If $\angle POQ = 100^\circ$, $\angle QRS = 120^\circ$, then find:
(i) $\angle PSQ$ (ii) $\angle OPQ$ (iii) $\angle SPO$



Solution:

(i) $\angle POQ = 100^\circ$ (Central angle)

As, $2\angle PSQ$ is angle subtended by the corresponding major arc.

$\therefore\ 2\angle PSQ = \angle POQ = 100^\circ$

$\Rightarrow \angle PSQ = 50^\circ$

(ii) ΔPQS is isosceles with OP = OQ = radii. Therefore:

$\angle OPQ + \angle OQP + \angle POQ = 180^\circ$

$\Rightarrow\ 2\angle OPQ + 100^\circ = 180^\circ \qquad (\angle OPQ = \angle OQP)$

$\Rightarrow\ 2\angle OPQ = 180^\circ - 100^\circ = 80^\circ$

$\Rightarrow\ \angle OPQ = 80^\circ \div 2 = 40^\circ$

(iii) PQRS is a cyclic quadrilateral. Therefore:

$\angle SPQ + \angle SRQ = 180^\circ$ (Opposite angles in cyclic quadrilateral PQRS.)

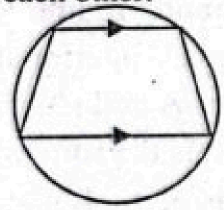
$\Rightarrow \angle SPQ + 120^\circ = 180^\circ \qquad \Rightarrow\ \angle SPQ = 180^\circ - 120^\circ = 60^\circ$

Now, $\angle SPO + \angle OPQ = \angle SPQ \ \Rightarrow\ \angle SPO + 40^\circ = 60^\circ$

$\Rightarrow \angle SPO = 60^\circ - 40^\circ = 20^\circ$

Key Fact:

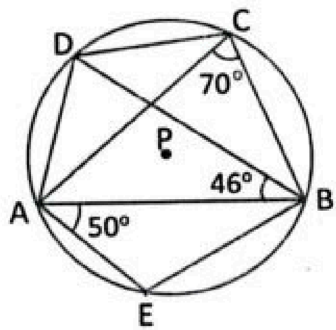
A cyclic trapezium is isosceles and its diagonal bisect each other.



Example:

In the figure, A, B, C, D and E lie on the circumference of a circle. If $\angle ABD = 46^\circ$ and $\angle ACB = 70^\circ$ and $\angle EAB = 50^\circ$, then find:

(i) $\angle DCA$ (ii) $\angle AEB$



Solution:

(i) $\angle ADB = \angle ACB = 70^\circ$ (angles in same segments are equal.)

In ΔABD:

$\angle ABD + \angle ADB + \angle BAD = 180^\circ$

$\Rightarrow 46^\circ + 70^\circ + \angle BAD = 180^\circ \quad \Rightarrow \angle BAD = 180^\circ - 46^\circ - 70^\circ = 64^\circ$

$\angle BAD + \angle BCD = 180^\circ$ (Opposite angles in cyclic quadrilateral ABCD.)

$64^\circ + \angle BCD = 180^\circ \Rightarrow 64^\circ + (70^\circ + \angle DCA) = 180^\circ$

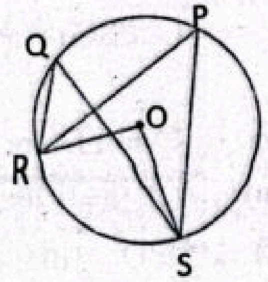
$\Rightarrow \angle DCA = 180^\circ - 64^\circ - 70^\circ = 46^\circ$

(ii) $\angle AEB + \angle ACB = 180^\circ$ (Opposite angles in cyclic quadrilateral AEBC.)

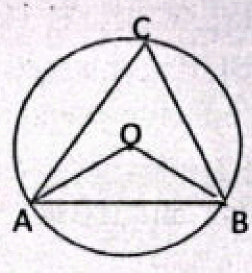
$\angle AEB + 70^\circ = 180^\circ \qquad \Rightarrow \angle AEB = 180^\circ - 70^\circ = 110^\circ$

Exercise 10.2

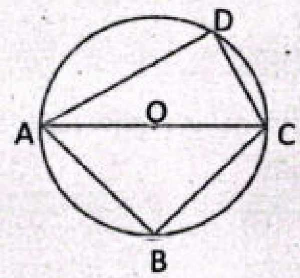
1. In the adjoining figure $\angle P = 30^\circ$.
Find values of $\angle Q$ and $\angle ROS$.



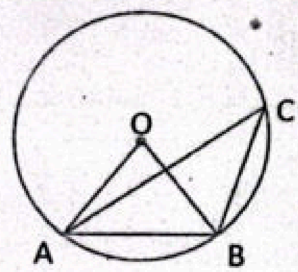
2. In the adjoining figure $\angle BAO = 30^\circ$.
Find $\angle ABO$, $\angle AOB$, $\angle ACB$.



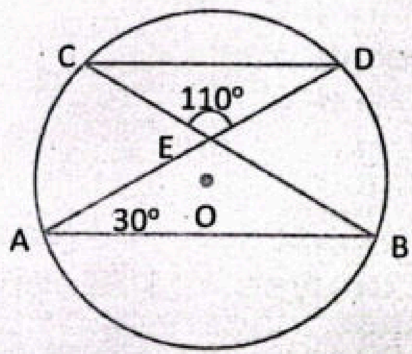
3. In the adjoining figure $\angle BAC = 40^\circ$ and $\angle ACD = 60^\circ$. Find $\angle ABC$, $\angle BCA$, $\angle CAD$.



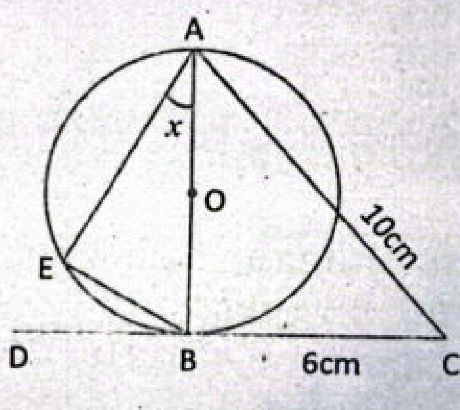
4. In the figure, AOB is equilateral triangle.
Find the measures of $\angle O$ and $\angle C$.



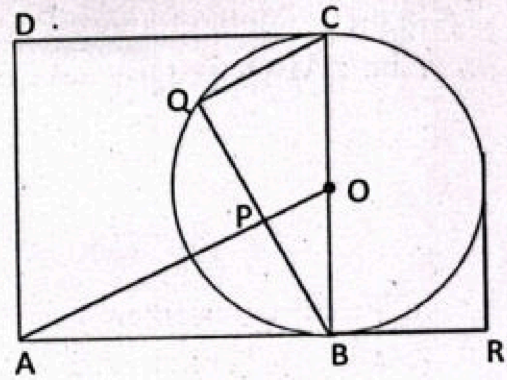
5. In the figure, $\overline{AB}$ is parallel to $\overline{CD}$.
Find the values of $\angle AEB$, $\angle B$, $\angle C$ and $\angle D$.



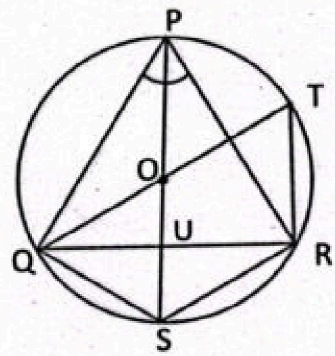
6. In the figure, $\overline{BC}$ is diameter and $\overline{CD}$ is tangent touching the circle at B. If $x = 30^\circ$, then find:
(i) radius of circle
(ii) $\angle ABE$
(iii) $\angle ABC$
(iv) $\angle EBD$



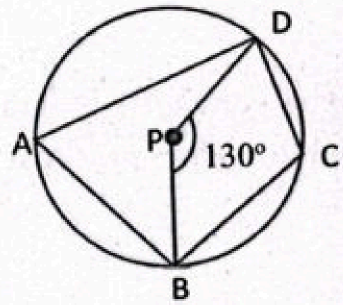
7. In the figure, ABCD is a square having side 10 cm. Triangle BOP is enlarged as triangle BCQ. Find:
   (i) Scale factor of enlargement if OP = 2 cm.
   (ii) CQ
   (iii) ∠BQC and ∠BPO
   (iv) AO
   (v) AR



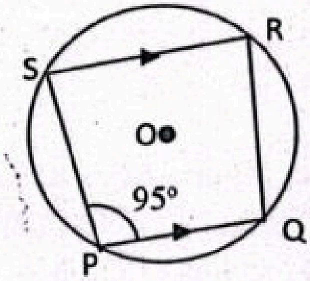
8. In the adjoining figure, ∠QPR = 60°. Find:
   (i) ∠QSR
   (ii) ∠PRS
   (iii) ∠PQS
   (iv) ∠QTR
   (v) Why ∠QTR is acute angle?



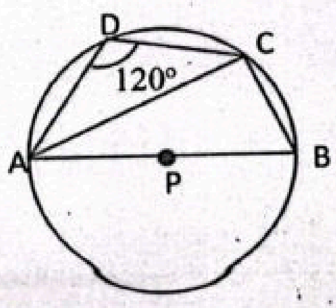
9. In the given figure, P is the centre of the circle and ∠BPD = 130°. Find:
   (i) ∠BAD
   (ii) ∠BCD
   (iii) ∠ABC + ∠ADC



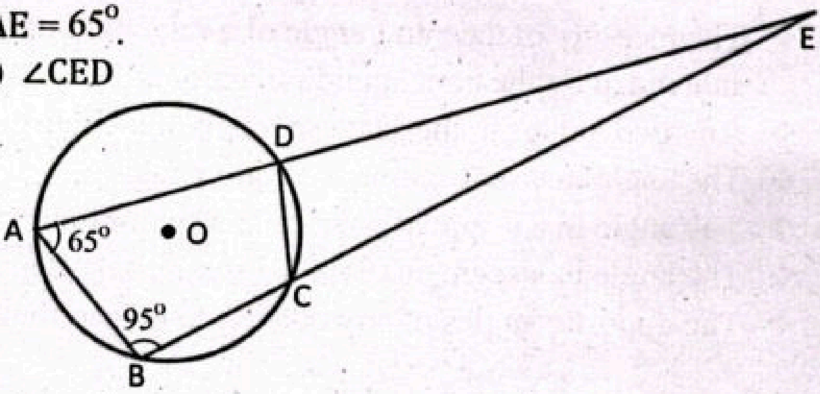
10. In the given figure, $\overline{PQ} \parallel \overline{SR}$ and ∠QPS = 95°. Find:
   (i) ∠QRS
   (ii) ∠PQR
   (iii) ∠PSR



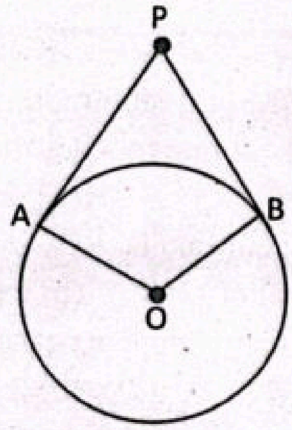
11. In the adjoining figure, ∠ADC = 120°.
   (i) Find ∠BAC.
   (ii) Find ∠CAD if AD = CD.



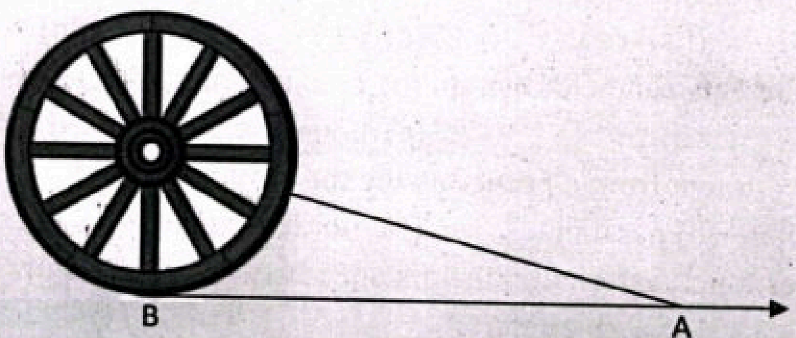
12. In the figure, $\angle ABE = 95^{\circ}$ and $\angle BAE = 65^{\circ}$.
Find (i) $\angle ECD$ (ii) $\angle CDE$ (iii) $\angle CED$



13. A circular wall clock of radius 1ft is hung by a 4 feet long string with a nail at P.
(i) Find distance between centre of clock and nail.
(ii) How far above the clock is the nail?



14. A wooden wheel moving on the ground is 99cm away from a point A. Find diameter of the wheel if the distance between centre of wheel and point A is 101 cm. How much distance does the wheel cover in one round?



I have Learnt

- If a line is drawn perpendicular to a radial segment of a circle at its outer end point, it is tangent to the circle.
- The tangent to a circle and the radial segment joining the point of contact and the centre are perpendicular to each other.
- The two tangents drawn to a circle from a point outside the circle are equal in length.
- If two circles touch externally (internally), the distance between their centres is equal to the sum (difference) of their radii.

- The measure of a central angle of a minor arc of a circle, is double that of the angle subtended by the corresponding major arc.
- Any two angles in the same segment of a circle are equal.
- The angle in a semi-circle is a right angle.
- The angle in a segment greater than semi-circle is less than a right angle.
- The angle in a segment less than semi-circle is greater than a right angle.
- The opposite angles of any quadrilateral inscribed in a circle are supplementary.

MISCELLANEOUS EXERCISE-10

1. Encircle the correct option in the following.

i. A tangent line touches the circle at .... point(s).
(a) 1 (b) 2 (c) 3 (d) 4

ii. A tangent line is .... to radial segment.
(a) parallel (b) equal (c) perpendicular (d) similar

iii. How many tangents can be drawn on the circle from a point outside the circle?
(a) 1 (b) 2 (c) 3 (d) infinite

iv. If two tangents are drawn on both ends of diameter of a circle, they are:
(a) perpendicular (b) parallel (c) intersecting (d) none

v. Given that radius of a circle is 4 cm. The distance between two tangents drawn at the outer ends of diameter is:
(a) 2 cm (b) 4 cm (c) 6 cm (d) 8 cm

vi. How many tangents can be drawn on the circle from a point on the circle?
(a) 1 (b) 2 (c) none (d) infinite

vii. Two tangents drawn from a point outside the circle are:
(a) perpendicular (b) parallel (c) not congruent (d) congruent

viii. If two circles touch externally, the distance between their centres is equal to sum of .... of both circle.
(a) radii (b) diameters (c) circumferences (d) area

ix. If two congruent circles touch externally, the distance between their centres is equal to .... of a circle.
(a) radius (b) diameter (c) chord (d) sector

x. If two circles of radii 1.4cm and 2.5 cm touch internally, the distance between their centres is equal to:
(a) 1.4 cm (b) 2.5 cm (c) 1.1 cm (d) 3.9 cm

xi. Angle subtended by an arc at centre of circle is called .... angle.
(a) reflex (b) inscribed (c) straight (d) central

xii. An angle inscribed in a half circle is:
(a) 0° (b) 45° (c) 90° (d) 180°

xiii. If central angle of minor arc of a circle is 100°, angle inscribed in corresponding major arc is:

(a) 200° (b) 100° (c) 75° (d) 50°

xiv. Central angle of minor arc of a circle is:

(a) less than 360° (b) less than 180°
(c) greater than 360° (d) greater than 180°

xv. Central angle of major arc of a circle is:

(a) less than 90° (b) less than 180°
(c) greater than 90° (d) greater than 180°

xvi. All angles in a same segment of a circle are:

(a) equal (b) acute (c) obtuse (d) supplementary

xvii. If ABCD is a cyclic quadrilateral and $\angle A = 60°$, then $\angle C = ...$

(a) 180° (b) 150° (c) 120° (d) 60°

xviii. An exterior angle of a cyclic quadrilateral is .... the opposite interior angle.

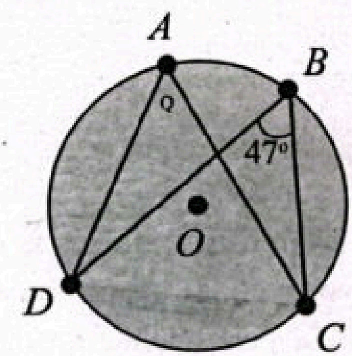
(a) greater than (b) less than (c) equal to (d) supplement of

xix. Inscribed angle of a quadrant of a circle is:

(a) 45° (b) 90° (c) 145° (d) 130°

xx. In the figure, angle θ is equal to:

(a) 45° (b) 94°
(c) 23.5° (d) 47°



2. In a circle whose diameter is 12 cm, there is a central angle whose measure is 90°. A chord joins the endpoints of the arc cut off by the angle. Find the length of the chord.
3. The diameter of a circle is 20 cm long and a chord parallel to it is 12cm long. Find the distance between the chord and the center of the circle.

4. In a cyclic quadrilateral ABCD with sides a = AB, b = BC, c = CD, and d = DA, and diagonals p = AC and q = BD. We can express diagonals in terms of the sides as:
$p \times q = (a \times c) + (b \times d)$.
Find q if a = 4cm, b = 5cm, c = 6 cm, d = 3 cm and p = 8 cm.