CHORDS OF A CIRCLE

Unit 25

- Weightage = 6%

Student Learning Outcomes (SLOs)

After completing this unit, students will be able to:

- Understand the following theorems along with their corollaries and apply them to solve allied problems.
  - One and only one circle can pass through three non-collinear points.
  - A straight line, drawn from the centre of a circle to bisect a chord (which is not a diameter) is perpendicular to the chord.
  - Perpendicular from the centre of a circle to a chord bisects it.
  - If two chords of a circle are congruent then they will be equidistant from the centre.
  - Two chords of a circle which are equidistant from the centre are congruent.

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Introduction

In previous classes and units, we studied detailed geometry involving triangles and quadrilaterals which are all formed by line segments. Line segments do not have bends. Here, we focus on theorems with proofs and allied examples related with circles.

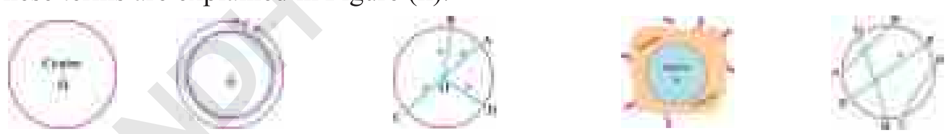
Circles play an important role in understanding the shapes of real world objects. Without circles, we will be unable to understand movement of a vehicle around a curve on the road, the starting developments about the orbits of planets, movements of electrons in an atom, shapes of cyclones, etc. Circles form a basis to study advanced shapes: ellipses, spheres, cylinders, and cones which are used in trunks, trees, water drops, wires, pipes, balloons, pies, wheels, ball-bearings, etc.

The path followed by a moving point is termed as **curve**. An **open curve** has different starting and ending points. A **closed curve** starts and ends at the same point (or) which has no starting and ending points. A curve which does not cross itself is a **simple curve**, otherwise **non-simple**. A curve which is simple as well as closed is known as a **simple closed curve**. For examples, refer to the curves in Figure (i).

(A) Simple, open | (B) Simple, closed | (C) Non-simple, open | (D) Non-simple, closed | (E) Simple, closed

Figure (i). Open, closed, simple and non-simple curves

A **circle** is a simple closed curve and all its points are at the same distance from a fixed point, called its **centre**. The length of the boundary of a circle is called its **circumference**. A line segment joining centre of a circle and any point on its boundary is a **radial segment**, and its length is called the **radius** of the circle. The points lying inside the boundary of a circle form its **interior**, and those outside form its **exterior**. A line segment joining any two points of circle is a **chord** of the circle. A chord passing through the centre of circle is called a **diameter** or a **central chord**, and its length is highest of all the lengths of chords of a circle. These terms are explained in Figure (ii).



(A) Circle centred at O (O) | (B) Circumference "C" of O | (C) Radius r and radial segments $\overline{OA}$, $\overline{OB}$, $\overline{OC}$, $\overline{OD}$ | (D) Interior $(\equiv)$ and exterior of O | (E) Chords $\overline{AB}, \overline{CD}, \overline{EF}, \overline{GH}$, diameter $\overline{EF}\left(m\overline{EF} = 2r\right)$

Figure (ii)

If r is radius of a circle, then its diameter, circumference and **circular area** are equal to: $2r, 2\pi r$ and πr^2, where π (Greek letter PIE) is an irrational number. $\boldsymbol{\pi}$ is ratio of circumference of a circle to its diameter. It is approximated by $\frac{22}{7}$, but is not equal to it. In

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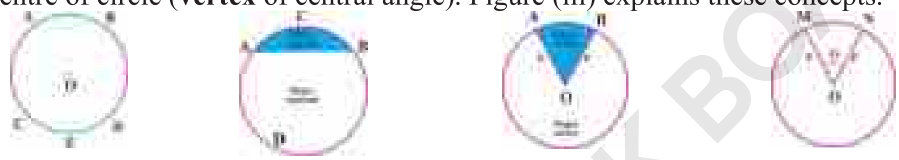
real, $\pi = 3.141592653$. We see that $\frac{22}{7} = 3.142857142$ matches with only first two decimal places of π.

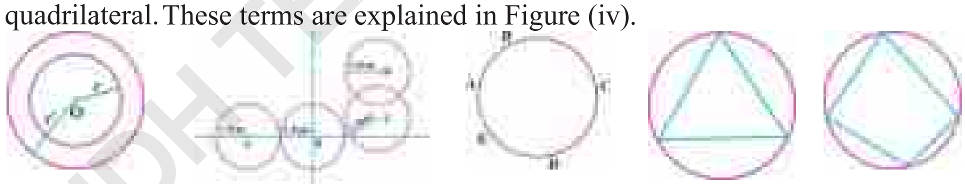
A portion of the circumference of a circle is an **arc** of the circle. A chord chops the interior of a circle into exactly two parts or segments. The diameter divides the circle into two equal segments. The **segments** are bounded by an arc and a respective chords of a circle. For a particular chord, a segment with larger portion of the interior of circle is **major segment** and the other one is **minor segment**. The corresponding arcs are referred as **major** and **minor arcs**. A portion in interior of a circle confined between two radii (plural of radius) and the intercepted arc in-between is a **sector** of the circle. This leads to the **minor** and **major sectors** for an arc and chosen radii. The word **subtend** means "holds under", is usually used for angles under a chord or an arc at a point in a circle. The **central angle** is an angle subtended by an arc with the centre of circle (**vertex** of central angle). Figure (iii) explains these concepts.



(A). Arcs AB, CED | (B). Minor arc ACB, major arc ADB, minor and major segments | (C). Sector bounded by AB and $\overline{OA}, \overline{OB}$. | (D). Central angle $\angle MON = \theta$. Vertex O, arms $\overline{OM}, \overline{ON}$.

Figure (iii)

The **location and size** of a circle are determined by its centre and radius, respectively. Two circles are **congruent** if their radii are equal. Two circles with same centres are **concentric**. Points lying on the same line are **collinear**, else **non-collinear**. Points lying on the boundary of a circle are **concyclic**. A circle through vertices of a triangle is a **circumscribed circle** (or) **circumcircle**. A quadrilateral whose all vertices lie on a single circle is called cyclic quadrilateral. These terms are explained in Figure (iv).



(A). Concentric circles | (B). Congruent circles | (C). Concyclic points | (D). Circumcircle | (E). Cyclic quadrilateral

Figure (iv)

25.1 Chords of a Circle:

Theorem 25.1: One and only one circle can pass through three non-collinear points.

Given:

Three non-collinear points, say A, B and C.

To prove:

One and only one circle can pass through A,B and C.

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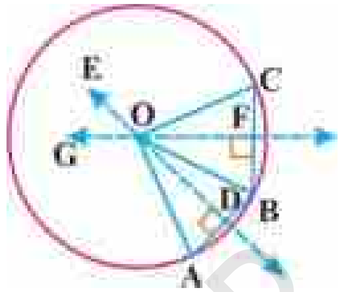
Construction:

Draw line segments $\overline{AB}$ and $\overline{BC}$. Draw right bisectors $\overleftrightarrow{ED}$ and $\overleftrightarrow{GF}$ of $\overline{AB}$ and $\overline{BC}$, respectively. $\overleftrightarrow{ED}$ and $\overleftrightarrow{GF}$ intersect at a point, say O. Draw $\overline{OA}$, $\overline{OB}$ and $\overline{OC}$.



Proof:

Statements	Reasons
All points on $\overleftrightarrow{ED}$ are equidistant from A and B, so $m\overline{OA} = m\overline{OB}$ (i)	$\overleftrightarrow{ED}$ is the right bisector of $\overline{AB}$, and O is a point on $\overleftrightarrow{ED}$
All points on $\overleftrightarrow{GF}$ are equidistant from B and C, so $m\overline{OB} = m\overline{OC}$ (ii)	$\overleftrightarrow{GF}$ is the right bisector of $\overline{BC}$, and $\overleftrightarrow{GF}$ passes through O.
O is the unique point of intersection of $\overleftrightarrow{ED}$ and $\overleftrightarrow{GF}$. (iii)	$\overleftrightarrow{ED}$ and $\overleftrightarrow{GF}$ are non-parallel lines.
The point O is equidistant from A, B and C, i.e.	From (i) and (ii).
$m\overline{OA} = m\overline{OB} = m\overline{OC} = r$, say (iv)	Transitive property.
The circle with centre only at O and radius r passes through A, B and C. (v)	$\overline{OA}$, $\overline{OB}$ and $\overline{OC}$ are radial segments, and by (iii).
A, B and C are non-collinear. (vi)	Given
Therefore, there exists one and only one circle centered at O and with radius r passing through non-collinear points A,B and C.	From (iii), (iv), (v) and (vi).

Q.E.D

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Corollary:

Any three distinct points on a circle are non-collinear.

Note 1:

Theorem 25.1 demonstrates the existence and uniqueness of the circle which can be drawn through any three non-collinear points.

Note 2:

Any number of distinct points more than three on a circle are non-collinear.

Example 1:

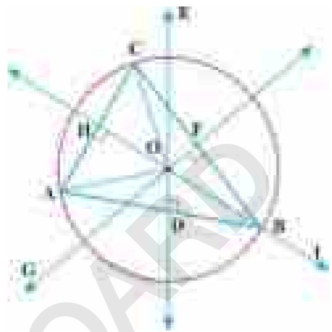
Prove that one and only one circle can pass through three vertices of a triangle.

Given:

$\triangle ABC$ with vertices A, B and C.

To prove:

One and only one circle can pass through vertices of $\triangle ABC$.



Construction:

Draw right bisectors: $\overleftrightarrow{DE}$, $\overleftrightarrow{FG}$ and $\overleftrightarrow{HI}$ of sides of $\triangle ABC$: $\overline{AB}$, $\overline{BC}$ and $\overline{AC}$, respectively, intersecting at the point O, say. Draw $\overline{OA}, \overline{OB}$ and $\overline{OC}$.

Proof:

Statements	Reasons
O is the unique point of intersection of $\overleftrightarrow{DE}, \overleftrightarrow{FG}$ and $\overleftrightarrow{HI}$.	$\overleftrightarrow{DE}$, $\overleftrightarrow{FG}$ and $\overleftrightarrow{HI}$ are non-parallel lines, and O lies on all of these.
The point O is circumcenter of $\triangle ABC$.	By definition of triangle.
The point O is equidistant from vertices of $\triangle ABC$, i.e. $m\overline{OA} = m\overline{OB} = m\overline{OC} = r$	By definition of circumcentre.
The circle with centre O and radius r passes through vertices of $\triangle ABC$.	$\overline{OA}, \overline{OB}$ and $\overline{OC}$ are radial segments.

Q.E.D

Example 2:

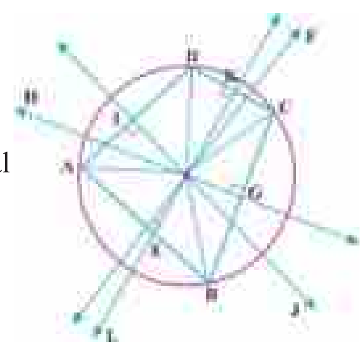
Show that one and only one circle can pass through vertices of a quadrilateral.

Given:

A quadrilateral ABCD.

To prove:

Only one circle passes through vertices of quadrilateral ABCD.



Construction:

Draw $\perp$ bisectors $\overleftrightarrow{EF}, \overleftrightarrow{GH}, \overleftrightarrow{IJ}$ and $\overleftrightarrow{KL}$ on $\overline{AB}, \overline{BC}, \overline{CD}$ and $\overline{AD}$. These all meet at point O. Construct $\overline{OA}, \overline{OB}, \overline{OC}$ and $\overline{OD}$.

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Proof:

Statements	Reasons
All points on EF are equidistant from A and B.	EF is $\perp$ bisector of $\overline{AB}$.
$\therefore \quad \overline{OA} \cong \overline{OB}$ (i)	O lies on $\overleftrightarrow{EF}$.
Similarly, $\overline{OB} \cong \overline{OC}$ (ii) $\overline{OC} \cong \overline{OD}$ (iii) $\overline{OD} \cong \overline{OA}$ (iv)	Using similar reasoning for $\overleftrightarrow{GH}$ and $\overleftrightarrow{BC}$, $\overleftrightarrow{IJ}$ and $\overleftrightarrow{CD}$, $\overleftrightarrow{KL}$ and $\overleftrightarrow{AD}$, as above.
O is the unique point of intersection of $\overleftrightarrow{EF}, \overleftrightarrow{GH}, \overleftrightarrow{IJ}$ and $\overleftrightarrow{KL}$	O lies on all these lines.
O is equidistant from vertices A, B, C and D of the quadrilateral so: $m\overline{OA} = m\overline{OB} = m\overline{OC} = m\overline{OD} = r$	From (i) to (iv).
The unique circle with centre O and radius r passes through vertices A, B, C and D of quadrilateral.	$\overline{OA}, \overline{OB}, \overline{OC}$ and $\overline{OD}$ form radial segments.

Q.E.D

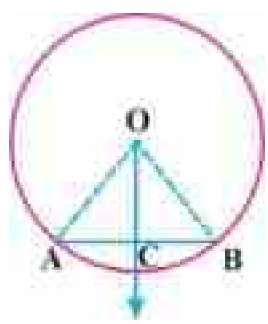
EXERCISE 25.1

1. Can a circle pass through three collinear points? Explain with reason.
2. Can you draw a circle from any four non-collinear points? Explain with reasons.
3. Show that one and only one circle can pass through the vertices of a square.
4. Show that only one circle can pass through the vertices of a regular pentagon.
5. Three villages are situated in a way that B is east of A at a distance of 6km and C is north of B at a distance of 8km. Determine the location of mosque so that all have to walk same distance from each village by using ruler, compass and divider. How much distance each villager has to walk down?

Theorem 25.2: A straight line, drawn from the centre of a circle to bisect a chord (which is not a diameter) is perpendicular to the chord.

Given:

A circle with centre O and a chord $\overline{AB}$ which does not pass through O, i.e. not a diameter. A straight line OC bisects $\overline{AB}$ at C, i.e. $m\overline{AC} = m\overline{BC}$.



To prove: $OC \perp \overline{AB}$

Construction:

Draw $\overline{OA}$ and $\overline{OB}$.

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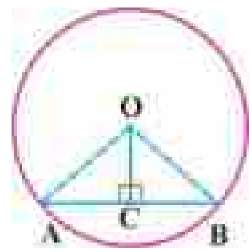
Proof:

Statements			Reasons
In	$\Delta OCA \leftrightarrow \Delta OCB$		
	$m\overline{OA} = m\overline{OB}$		Radii of same circle.
	$m\overline{AC} = m\overline{BC}$		Given.
	$m\overline{OC} = m\overline{OC}$		Common side.
	$\Delta OCA \cong \Delta OCB$		$S.S.S \cong S.S.S$.
or	$m\angle OCA = m\angle OCB$	(i)	Corresponding $\angle$s of congruent Δs.
	$m\angle OCA + m\angle OCB = 180^\circ$	(ii)	Supplement postulate.
	$m\angle OCA = 90^\circ = m\angle OCB$		From (i) and (ii).
Thus,	$OC \perp \overline{AB}$		By definition of perpendicular.

Q.E.D

Theorem 25.3: Perpendicular from the centre of a circle to a chord bisects it.



Given: A circle with centre O and its chord $\overline{AB}$. The perpendicular $\overline{OC}$ from O meets $\overline{AB}$ at C, i.e. $\overline{OC} \perp \overline{AB}$, so $\angle OCA$ and $\angle OCB$ are right angles.

To prove: $\overline{OC}$ bisects $\overline{AB}$ at C.

Construction: Draw $\overline{OA}$ and $\overline{OB}$.

Proof:

Statements		Reasons
In	$\Delta AOC \leftrightarrow \Delta BOC$	
	$m\angle OCA = 90^\circ = m\angle OCB$	Given.
	$\overline{OA} \cong \overline{OB}$	Radial segments of same circle.
	$\overline{OC} \cong \overline{OC}$	Common side.
So,	$\Delta AOC \cong \Delta BOC$	$H.S \cong H.S$.
$\therefore$	$\overline{AC} \cong \overline{BC}$	Corresponding sides of congruent Δs.
$\therefore$	$\overline{OC}$ bisects the chord $\overline{AB}$.	C is the midpoint of $\overline{AB}$.

Q.E.D

Corollary 1:

Perpendicular bisector of the chord of a circle passes through the centre of the circle.

Corollary 2:

The shortest distance from a point on chord and the centre of the circle is from its midpoint.

Note:

Theorems 25.2 and 25.3 highlight relationship between a chord of a circle and a line segment dividing it equally through the centre of circle. With these and the Pythagoras' theorem, we can find length of a chord of a circle.

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Example 1:

Calculate length of a chord which stands at a perpendicular distance of 5cm from the centre of a circle with radius 9cm.

Solution:

Consider a circle with centre O and its chord AB. The perpendicular from centre O meets chord AB at a point C, as shown in the adjacent figure. Using Pythagoras' theorem in ΔOCA, we have:

$\left(m\overline{OA}\right)^2 = \left(m\overline{OC}\right)^2 + \left(m\overline{AC}\right)^2$ (or) $9^2 = 5^2 + \left(m\overline{AC}\right)^2$

$\therefore\ m\overline{AC} = \sqrt{81-25} = \sqrt{56} = 2\sqrt{14}$ cm.

Finally,

$$\text{Length of chord} = \overline{AB} = 2\left(m\overline{AC}\right) \quad (\text{As } \overline{OC} \text{ bisects } \overline{AB})$$
$$= 2\left(2\sqrt{14}\right) = 4\sqrt{14} = 14.967\text{cm}$$

Example 2:

If length of a chord in a circle is 8cm, and perpendicular distance from centre of circle to the chord is 3cm, what is radius of that circle?

Solution:

Consider a circle with centre O and its chord AB. The perpendicular from centre O meets chord AB of length 8 cm at a point C, as shown in the adjacent figure. Using Pythagoras' theorem in ΔOCA, we have:

$\left(m\overline{OA}\right)^2 = \left(m\overline{OC}\right)^2 + \left(m\overline{AC}\right)^2$

(or) $x^2 = 3^2 + 4^2$ ($\overline{OC}$ bisects $\overline{AB}$)

$\therefore\ x^2 = 25 \Rightarrow x = 5$, ignoring negative sign.

Thus, Radius $= m\overline{OA} = x = 5$ cm.

EXERCISE 25.2

1. Show that the diameters of a circle bisect each other.
2. Show that angle subtended by the centre of a circle and midpoint of a chord is right angle.
3. If length of the chord is 8cm. Its perpendicular distance from the centre of circle is 3cm, then find circumference and area of the circle.
4. Calculate length of a chord which stands at a perpendicular distance of k from the centre of a circle with radius r when:
   a. k=4cm, $r = 9$cm b. k=3cm, $r = 6$cm
5. What will be radius of a circle in which the distance of a chord of length 10cm from the centre of circle is 3cm?

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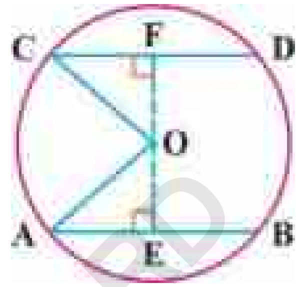
Theorem 25.4: If two chords of a circle are congruent then they will be equidistant from the centre.

Given:

A circle with centre O. Two congruent chords: $\overline{AB}$ and $\overline{CD}$ of circle, where $\overline{OE} \perp \overline{AB}$ and $\overline{OF} \perp \overline{CD}$.



To prove:

$\overline{OE} \cong \overline{OF}$

Construction:

Draw $\overline{OA}$ and $\overline{OC}$.

Proof:

Statements		Reasons
$m\overline{AE} = \frac{1}{2} m\overline{AB}$	(i)	Perpendicular $\overline{OE}$ bisects the chord $\overline{AB}$.
$m\overline{CF} = \frac{1}{2} m\overline{CD}$	(ii)	Perpendicular $\overline{OF}$ bisects the chord $\overline{CD}$.
$m\overline{AB} = m\overline{CD}$	(iii)	$\overline{AB} \cong \overline{CD}$ (Given).
$\therefore$ $\overline{AE} \cong \overline{CF}$		Using (i), (ii) and (iii).
In right $\Delta AEO \leftrightarrow \Delta CFO$		
$\overline{OA} \cong \overline{OC}$		Radial segments of same circle.
$\overline{AE} \cong \overline{CF}$		Proved above.
$\therefore$ $\Delta AEO \cong \Delta CFO$		H.S. $\cong$ H.S.
$\Rightarrow$ $\overline{OE} \cong \overline{OF}$		Corresponding sides of congruent Δs.

Q.E.D

Corollary:

Two congruent chords of a circle subtend equal angles at the centre.

Note 1:

Theorem 25.4 explains the association between congruence of two chords and their distances from the centre of the circle.

Note 2:

If two chords are not congruent, then they are not equidistant from the centre.

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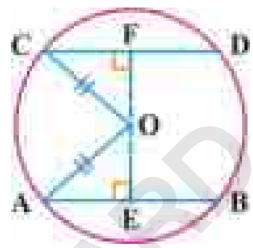
Theorem 25.5: Two chords of a circle which are equidistant from the centre are congruent.

Given:

A circle with centre O. Two chords $\overline{AB}$ and $\overline{CD}$ of circle, which are equidistant from O. i.e. $\overline{OE} \cong \overline{OF}$. This also means that $\overline{OE} \perp \overline{AB}$ and $\overline{OF} \perp \overline{CD}$.



To prove:

$\overline{AB} \cong \overline{CD}$

Construction:

Draw $\overline{OA}$ and $\overline{OC}$.

Proof:

Statements	Reasons
In right $\Delta AEO \leftrightarrow \Delta CFO$	
$\overline{OA} \cong \overline{OC}$	Radial segments of same circle.
$\because$ $\overline{OE} \cong \overline{OF}$	Given.
$\therefore$ $\Delta AEO \cong \Delta CFO$	H.S. $\cong$ H.S.
So, $m\overline{AE} = m\overline{CF}$ (i)	Corresponding sides of congruent Δs.
$m\overline{AE} = \frac{1}{2} m\overline{AB}$ (ii)	Perpendicular $\overline{OE}$ bisects the chord $\overline{AB}$.
$m\overline{CF} = \frac{1}{2} m\overline{CD}$ (iii)	Perpendicular $\overline{OF}$ bisects the chord $\overline{CD}$.
$\because$ $\frac{1}{2} m\overline{AB} = \frac{1}{2} m\overline{CD}$	Using (i), (ii), (iii)
$\therefore$ $\overline{AB} \cong \overline{CD}$	

Q.E.D

Corollary:

If two chords subtend equal angles at the centre, then they are congruent.

Note 1:

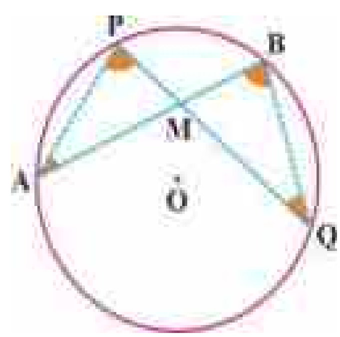
Theorems 25.5 is converse of Theorem 25.4

Note 2:

If two chords are not equidistant from the centre, they are not congruent.

Example 1:

Show that if two chords of a circle intersect each other, then the product of their lengths of segments are equal.



Given: Two chords $\overline{AB}$ and $\overline{PQ}$ of a circle centered at O intersecting each other at M.

To prove: $(m\overline{AM}) \times (m\overline{MB}) = (m\overline{PM}) \times (m\overline{QM})$

Construction: Draw $\overline{AP}$ and $\overline{BQ}$.

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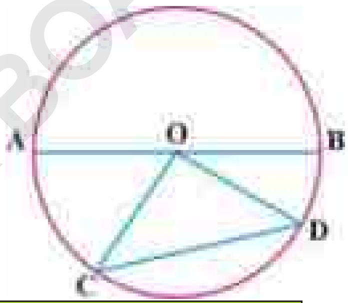
Proof:

Statements		Reasons
$\angle PAM \cong \angle BQM$	(i)	Angles of same arc PB.
$\angle APM \cong \angle QBM$	(ii)	Angles of same arc AQ.
$\Delta APM \sim \Delta QBM$		From (i) and (ii): A.A~ A.A.
$\dfrac{m\overline{AM}}{m\overline{QM}} = \dfrac{m\overline{PM}}{m\overline{BM}}$	(iii)	Corresponding sides of similar Δs.
$\left(m\overline{AM}\right)\times\left(m\overline{BM}\right)=\left(m\overline{PM}\right)\times\left(m\overline{QM}\right)$		Cross multiplication in (iii)

Q.E.D

Example 2:

Show that the largest chord in a circle is the diameter.



Given: A circle with centre O and its diameter $\overline{AB}$. $\overline{CD}$ is any other chord of circle except $\overline{AB}$.

To prove: $m\overline{AB} > m\overline{CD}$

Construction: Draw $\overline{OC}$ and $\overline{OD}$ to complete ΔOCD.

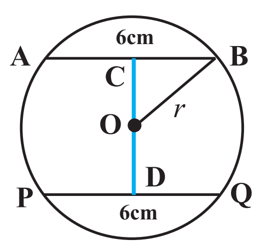
Proof:

Statements		Reasons
In ΔOCD,		
$m\overline{OC} + m\overline{OD} > m\overline{CD}$	(i)	Sum of two sides of a Δ is greater than the third.
$m\overline{OC} + m\overline{OD} = m\overline{AB}$	(ii)	$\overline{OC}$ and $\overline{OD}$ are radial segments, and by definition of diameter.
$m\overline{AB} > m\overline{CD}$	(iii)	Using (i) and (ii).
The length of chord $\overline{AB}$, which is also the diameter is larger than length of any other chord $\overline{CD}$ of the circle.		From (iii), and for any chord $\overline{CD}$ except diameter.

Q.E.D

Example 3:

Find distance between two congruent chords of lengths 6cm each in circle whose circumference is 10π cm.



Solution:

Two congruent chords $\overline{AB}$ and $\overline{PQ}$ of length 6 cm of a circle centred at O with radius r are shown in the adjacent figure. We need $m\overline{CD}$.

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Radius of the circle: $m\overline{OB} = r = \frac{C}{2\pi} = \frac{10\pi}{2\pi} = 5\text{cm}.$

Using Pythagoras' theorem in right ΔOCB, we have:

$$\left(m\overline{OB}\right)^2 = \left(m\overline{OC}\right)^2 + \left(m\overline{CB}\right)^2$$

$$5^2 = \left(m\overline{OC}\right)^2 + \left(\frac{1}{2}m\overline{AB}\right)^2$$ (Perpendicular $\overline{OC}$ from centre O bisects the chord $\overline{AB}$)

$$5^2 = \left(m\overline{OC}\right)^2 + 3^2 \qquad \Rightarrow m\overline{OC} = \sqrt{25-9} = \sqrt{16} = 4cm.$$

Because, two congruent chords are equidistant from the centre of a circle, so:

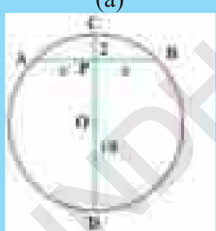
$m\overline{OD} = m\overline{OC} = 4\text{cm}.$

Finally, $m\overline{CD} = m\overline{OC} + m\overline{OD} = 4 + 4 = 8\text{cm}.$

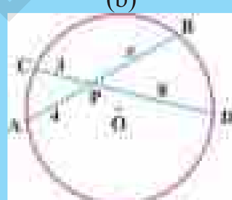
EXERCISE 25.3

1. Prove that two congruent chords of two congruent circles are equidistant from their centres.
2. Show that two chords of congruent circles equidistant from the centres are congruent.
3. Find distance between two congruent chords of length α in a circle of radius r for the following given values of α and r:
   (a). $\alpha = 7\text{cm}$ and $r = 6\text{cm}$ (b). $\alpha = 5\text{cm}$ and $r = 4\text{cm}$
   (c). $\alpha = 2\text{cm}$ and $r = 4\text{cm}$ (d). $\alpha = 4\text{cm}$ and $r = 9\text{cm}$
4. Find distance between two parallel chords of length α and β in a circle of radius r for the following given values of α, β and r:
   a. $\alpha = 6\text{cm}, \beta = 8\text{cm}, r = 5\text{cm}$ b. $\alpha = 3\text{cm}, \beta = 6\text{cm}, r = 14\text{cm}$
5. If two chords $\overline{AB}$ and $\overline{CD}$ of a circle with centre O intersect at P, find x in the following.

(a)

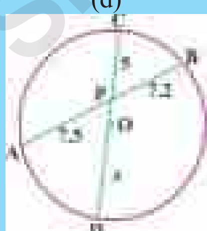


(b)

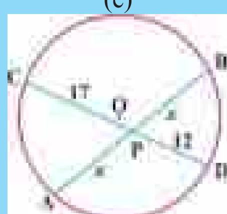


(c)

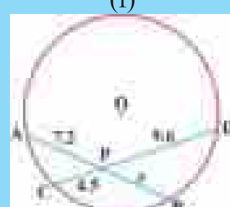
(d)



(e)



(f)



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Review Exercise 25

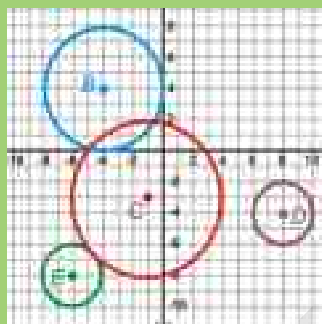
1. Tick the correct option.

i. All circles are always _____ .

(a) congruent (b) similar

(c) tangent (d) none of these

ii. In the following figure, circles centred at D and E are ________ .



(a) congruent (b) similar

(c) both (a) and (b) (d) none of these

iii. In the given figure, the length of the chord $\overline{AB}$ is _______ .

(a) 4cm (b) 6cm (c) 8cm (d) 15cm

iv. One and only one circle passes through three _______ points.

(a) collinear (b) non-collinear (c) disjoint (d) none of these

v. The hypothesis of the enunciation "If two chords of a circle are congruent, then they are equidistant from the centre." is:

(a) two chords of a circle are equidistant from the centre.

(b) two chords of a circle are congruent.

(c) a circle has two chords.

(d) the centre of circle is equidistant from chords.

vi. The conclusion of the enunciation "If two chords of a circle are congruent, then they are equidistant from the centre." is:

(a) two chords of the circle are equidistant from the centre.

(b) two chords of a circle are congruent.

(c) a circle has two chords.

(d) the centre of circle is equidistant from chords.

vii. The hypothesis of the enunciation "One and only one circle can pass through three non-collinear points" is:

(a) three points are non-collinear.

(b) one and only one circle passes through three points.

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(c) two circles pass through three points.
(d) three points are collinear.

viii. The conclusion of the enunciation "One and only one circle can pass through three non-collinear points" is:
(a) three points are non-collinear.
(b) one and only one circle passes through three points.
(c) two circles pass through three points.
(d) three points are collinear.

ix. A circle is an example of a __________ curve.

(a)	simple and closed	(b)	simple and open
(c)	non-simple and closed	(d)	non-simple and open

SUMMARY

- A circle is a simple closed curve.
- All points of a circle are equidistant from a fixed point. The fixed point is the centre and constant distance is radius of circle.
- A radial segment in a circle is a line segment from its centre to any point on it.
- A chord is a line segment joining any two points of a circle. A chord passing through the centre is known as diameter or central chord of the circle.
- For a circle of radius r, its diameter, circumference and circular area are equal to: $2r$, $2\pi r$ and πr^2, respectively.
- A portion of circumference of a circle is called an arc. These are further categorized as minor and major arcs.
- Sectors are portions of circle bounded by two radii and the intercepted arc. These can be further categorized as minor and major sectors.
- Segments are portions of circle bounded between a chord and the intercepted arc. These are further divided into major and minor sectors.
- All circles are similar to each other.
- Two circles are congruent if their radii are equal.
- Circles having same centre are concentric.
- Points lying on a circle are concyclic.
- One and only one circle can pass through three non-collinear points.
- A straight line, drawn from the centre of a circle to bisect a chord (which is not a diameter) is perpendicular to the chord.
- Perpendicular from the centre of a circle to a chord bisects it.
- If two chords of a circle are congruent then they will be equidistant from the centre.
- Two chords of a circle which are equidistant from the centre are congruent.

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