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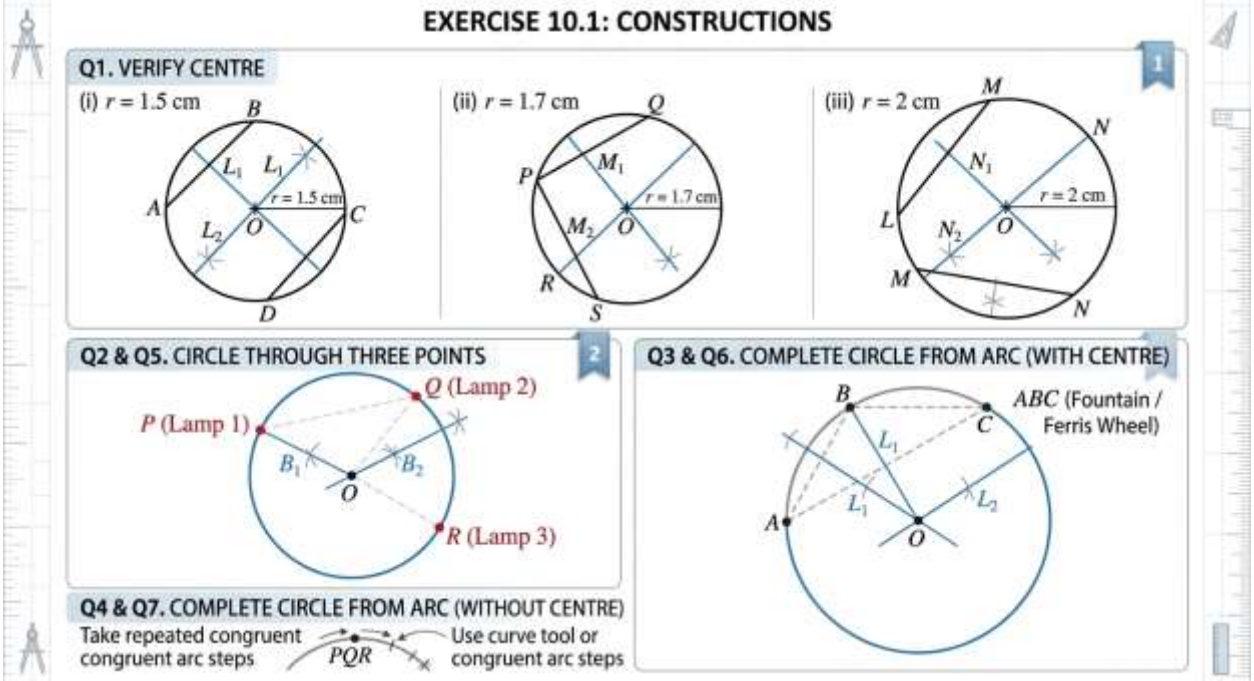
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Class	10th	Chapter	10
Subject	Mathematics	Board	Punjab

CHAPTER 10: Practical Geometry of Circles

EXERCISE 10.1



Question 1

Construct a circle with the help of given radius and verify its centre by construction:

General Method to Verify the Centre:

1. Draw two non-parallel chords on the circle.
2. Draw the perpendicular bisectors of both chords.
3. The point where the two perpendicular bisectors intersect will be the exact center of the circle.

(i) $r = 1.5$ cm

Steps of Construction:

1. **Draw Initial Circle:**
   - Mark a point O on paper.

- Open the pair of compasses to a radius of 1.5 cm using a ruler.
- Keeping the pointer at O, draw a complete circle.

2. **Verification of Centre:**
   - Mark three points A, B, and C on the boundary (circumference) of the circle.
   - Join A to B to form chord AB, and join B to C to form chord BC.
   - With A as center and radius greater than half of AB, draw arcs above and below line segment AB.
   - With B as center and the same radius, draw arcs intersecting the previous arcs at points P and Q. Join line PQ (perpendicular bisector of AB).
   - Similarly, construct the perpendicular bisector XY of chord BC.
   - Extend both perpendicular bisectors PQ and XY; they will intersect precisely at point O.

Conclusion: The intersection point of the perpendicular bisectors coincides with the original center O, verifying its position.

(ii) $r = 1.7$ cm

Steps of Construction:

1. **Draw Initial Circle:**
   - Mark a point O on paper.
   - Set compass width to 1.7 cm with a ruler.
   - Place the pointer at O and draw the circle.
2. **Verification of Centre:**
   - Mark two distinct chords DE and EF on the circle's boundary.
   - Draw the perpendicular bisector of chord DE.
   - Draw the perpendicular bisector of chord EF.
   - The two bisector lines intersect at point O.

(iii) $r = 2$ cm

Steps of Construction:

1. **Draw Initial Circle:**
   - Mark a point O on paper.
   - Set compass width to 2 cm using a ruler.
   - Place the pointer at O and draw the circle.
2. **Verification of Centre:**
   - Choose two non-parallel chords LM and MN on the circumference.
   - Construct the perpendicular bisector of LM.
   - Construct the perpendicular bisector of MN.
   - Notice that both bisectors meet exactly at the original center O.

Question 2

Take any three non-collinear points P, Q, R and construct a circle passing through these points.

Steps of Construction:

1. Mark three points P, Q, and R on a paper such that they do not lie on a single straight line (non-collinear).
2. Join point P to Q to form line segment PQ, and join Q to R to form line segment QR.
3. **Perpendicular Bisector of PQ:**
    - Place the compass at P, set radius $> \frac{1}{2}PQ$, and draw arcs on both sides of PQ.
    - Place compass at Q with the same radius and draw arcs to intersect the first two arcs.
    - Draw a straight line through these intersection points.
4. **Perpendicular Bisector of QR:**
    - Repeat the same bisecting process for line segment QR.
    - Draw a straight line through the intersection points.
5. Let the two perpendicular bisectors intersect at point O. Point O is the center of the required circle.
6. Place the compass point at O and open it up to distance OP (or OQ or OR).
7. Draw a circle. It will pass through all three points: P, Q, and R.

Question 3

Draw an arc ABC and complete a circle by finding its centre.

Steps of Construction:

1. Draw any arbitrary arc and label three points on it as A, B, and C.
2. Join point A to B to form chord AB.
3. Join point B to C to form chord BC.
4. Construct the right bisector (perpendicular bisector) of line segment AB.
5. Construct the right bisector (perpendicular bisector) of line segment BC.
6. Mark the intersection point of these two right bisectors as O (this is the center of the circle).
7. With O as the center and radius equal to OA (or OB / OC), draw a complete circle around arc ABC.

Question 4

Draw an arc PQR and complete a circle without finding its centre.

Steps of Construction (Method of Symmetrical Arcs / Equidistant Method):

1. Draw an arc PQR and mark three points P, Q, and R on it.
2. Join P to Q and Q to R.
3. Extend the arc symmetrically by taking equal segment lengths along the curvature:
    - Set compass width to segment PQ.
    - Place compass at R and draw an arc along the curvature to locate point S.
    - Move compass to S with the same length to locate the next point T, and continue around the perimeter.

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4. Alternatively, use a curved flexible ruler/french curve matching the curvature of arc PQR to smoothly trace and extend the arc in a full $360°$ loop until it closes into a complete circle.

Question 5

Take any three non-collinear points (locations of the lamp posts in the park), construct a circle passing through all these points.

Steps of Construction:

1. Mark three points L_1, L_2, and L_3 representing the locations of the three lamp posts in the park.
2. Draw line segments L_1L_2 and L_2L_3.
3. Construct the perpendicular bisector of segment L_1L_2.
4. Construct the perpendicular bisector of segment L_2L_3.
5. Mark the point where both perpendicular bisectors cross each other as point O.
6. Place the compass sharp tip at O, measure the distance to L_1, and draw a full circle.
7. The resulting circle will pass through all three lamp post locations (L_1, L_2, and L_3).

Question 6

A part of the Ferris wheel rim is visible as an arc. Using any three points on the arc, construct the circle by finding its centre.

Steps of Construction:

1. Draw an arc representing the visible portion of the Ferris wheel rim.
2. Mark any three points A, B, and C along this arc.
3. Draw line segments (chords) AB and BC.
4. **Bisect AB:** Construct the perpendicular bisector L_1 of chord AB.
5. **Bisect BC:** Construct the perpendicular bisector L_2 of chord BC.
6. Mark the point of intersection of lines L_1 and L_2 as O (the center of the Ferris wheel).
7. Place compass tip at O with radius OA, and draw the full circle to complete the Ferris wheel rim.

Question 7

ABC an arc of a fountain, complete a circle without finding its centre.

Steps of Construction:

1. Draw arc ABC representing the fountain boundary.
2. Mark points A, B, and C on the arc.
3. Measure the angle $\angle ABC$ subtended on the arc segment.
4. Using a flexible curve tool or step-by-step congruent arc extensions:
    - Measure chord length AB using compasses.
    - Mark successive congruent chord steps CD, DE, EF, etc., along the continuous trajectory maintained by curvature angle $\angle ABC$.
5. Connect these continuous arc points smoothly to complete the full circular shape of the fountain without explicitly locating center point O.

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EXERCISE 10.2.

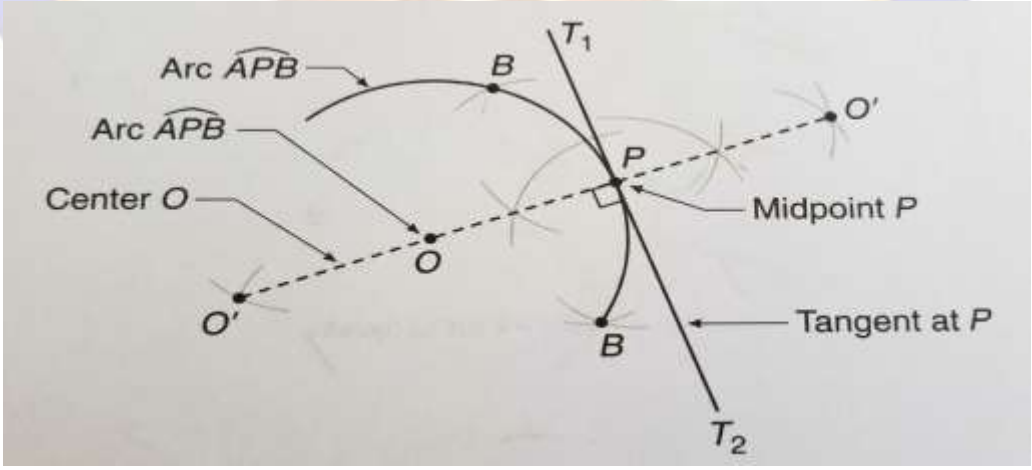
Exercise 10.2 — Step-by-Step Geometric Solutions

Question 1

Draw a tangent to arc $\overset{\frown}{APB}$ at point P, when P is the midpoint of the arc.

Steps of Construction:

1. **Given:** Arc $\overset{\frown}{APB}$ with midpoint P.
2. **Join Endpoints:** Draw line segment AB connecting the endpoints of arc $\overset{\frown}{APB}$.
3. **Perpendicular Bisector / Altitude:**
   - Since P is the midpoint of arc $\overset{\frown}{APB}$, the line segment AB is parallel to the tangent line at P.
   - Join point A to point P and point B to point P to form chords AP and PB.
4. **Find Circle Center (Optional) / Direct Method:**
   - Draw the perpendicular bisector of chord AB. This line passes through the midpoint P of the arc and acts as the normal (radius line).
5. **Construct Tangent Line:**
   - At point P, construct an angle of $90°$ with the normal line (perpendicular to the bisector line at P).
   - Draw line XY passing through P perpendicular to the normal line.
6. **Conclusion:** Line XY is the required tangent to arc $\overset{\frown}{APB}$ at its midpoint P.



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Question 2

Draw a tangent to arc $\widehat{PQR}$ at point P, when P is an endpoint of the arc.

Steps of Construction:

1. **Given:** Arc $\widehat{PQR}$ where P is an endpoint.
2. **Find the Center of the Circle:**
    - Select three points on the arc: P, Q, and R.
    - Join P to Q (chord PQ) and Q to R (chord QR).
    - Draw the perpendicular bisectors of chord PQ and chord QR.
    - Let the two perpendicular bisectors intersect at point O. Point O is the center of the arc/circle.
3. **Join Radius:**
    - Draw the radius line segment OP.
4. **Construct Tangent at P:**
    - At point P, construct a line perpendicular ($90°$) to radius OP.
    - Draw a straight line XY passing through P.
5. **Conclusion:** Line XY is the required tangent to the arc at point P.

Question 3

Draw a tangent to arc $\widehat{ABC}$ from a point P, when P is outside the arc.

Steps of Construction:

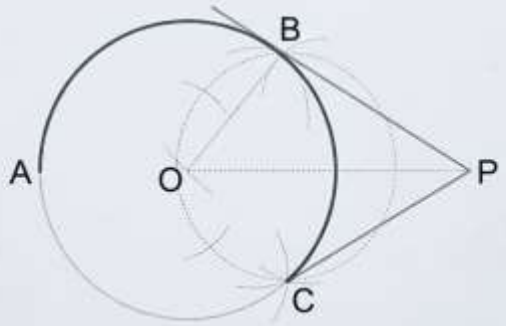
1. **Find Center of Arc:**
    - Take three points A, B, and C on the given arc.
    - Draw chords AB and BC.
    - Draw the perpendicular bisectors of chords AB and BC. Mark their intersection point as O (the center of the circle).
2. **Connect External Point:**
    - Draw a straight line segment joining center O to external point P.
3. **Find Midpoint of OP:**

- Draw the perpendicular bisector of line segment OP to find its midpoint M.

4. **Draw Auxiliary Circle:**
   - With M as center and radius MO (or MP), draw a circle (or arc) that cuts the original arc/circle at point T.
5. **Draw Tangent:**
   - Join point P to point T with a straight line and extend it.
6. **Conclusion:** Line PT is the required tangent from external point P to arc $\overset{\frown}{ABC}$.

EXERCISE 10.2

3. Draw tangent to $\overset{\frown}{ABC}$ from a point P, when P is outside the arc.



6. Draw a circle of radius 1.6 cm. Draw two tangents that meet an angle of 30°.
7. Draw a tangent to any point on a circular part of the track having radius = 2 cm.
8. From a pulley point, construct two tangents to a machine wheel having r = 2.1cm, such that the angle between them is 30°.

Question 4

Draw a circle of radius 1.3 cm and draw a tangent at point P, when P lies on its circumference.

Steps of Construction:

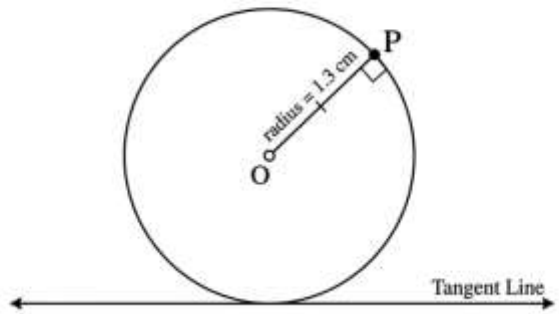
1. **Draw Circle:**
   - Mark a point O as the center.
   - Using a ruler and compass set to a radius of $r = 1.3$ cm, draw a complete circle.
2. **Mark Point P:**
   - Mark any point P on the circumference of the circle.

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3. **Draw Radius:**
    - Draw a straight line from center O to point P (radius $OP = 1.3$ cm).
4. **Construct Perpendicular:**
    - At point P, construct a line XY perpendicular (90°) to radius OP.
5. **Conclusion:** Line XY is the required tangent at point P.

Geometric Construction: Tangent at point P on Circle Circumference.

Diagram showing a circle of radius 1.3 cm with center O and a tangent line at point P, which lies on the circumference. **Note:** Small compass and ruler construction artifacts like light arcs are subtly included for authenticity.



Question 5

Draw a circle of radius 1.5 cm and draw a tangent at point P, when P is at a distance of 8 cm from its center.

Steps of Construction:

1. **Draw Base Circle:**
    - Mark point O as the center.
    - With compass opened to 1.5 cm, draw a circle.
2. **Locate External Point P:**
    - From center O, draw a straight line of length 8 cm in any direction and mark the endpoint as P ($OP = 8$ cm).
3. **Bisect Segment OP:**
    - Draw the perpendicular bisector of line segment OP to mark its midpoint M (at 4 cm from O).
4. **Locate Tangency Points:**
    - With M as center and radius $MO = 4$ cm, draw a secondary circle.

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- Mark the points where this secondary circle intersects the original circle as T_1 and T_2.

5. **Draw Tangent:**
   - Join point P to T_1 (and/or T_2) using a ruler.
6. **Conclusion:** Line PT_1 (or PT_2) is the required tangent to the circle from distance 8 cm.

Question 6

Draw a circle of radius 1.6 cm. Draw two tangents that meet at an angle of 30°.

Mathematical Calculation First:

- Angle between two tangents (θ) = 30°.
- Angle between radii at center (α) = $180° - \theta = 180° - 30° = 150°$.

Steps of Construction:

1. **Draw Circle:**
   - Set compass to 1.6 cm radius and draw a circle with center O.
2. **Draw First Radius:**
   - Draw a radius line segment OA.
3. **Construct Central Angle:**
   - At center O, construct an angle of 150° with OA using a protractor/compass.
   - Let the terminal arm cut the circle at point B. Thus, $\angle AOB = 150°$.
4. **Construct Tangents:**
   - At point A, draw a perpendicular line (90°) to radius OA.
   - At point B, draw a perpendicular line (90°) to radius OB.
5. **Intersection Point:**
   - Extend both perpendicular lines until they intersect at point P.
6. **Conclusion:** PA and PB are the two required tangents meeting at an angle $\angle APB = 30°$.

Question 7

Draw a tangent to any point on a circular part of the track having radius = 2 cm.

Steps of Construction:

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1. **Draw Circular Track:**
    - Mark center O.
    - With radius $r = 2$ cm, draw the circular track.
2. **Select Point:**
    - Choose any convenient point P on the circular path.
3. **Draw Radius:**
    - Join center O to point P with line segment OP.
4. **Construct Tangent:**
    - Using a compass/protractor, draw a line AB passing through P perpendicular ($90°$) to OP.
5. **Conclusion:** Line AB is the required tangent at point P on the circular track.

Question 8

From a pulley point, construct two tangents to a machine wheel having radius $r = 2.1$ cm, such that the angle between them is $30°$.

Mathematical Calculation First:

- Radius $r = 2.1$ cm.
- Angle between tangents (θ) = $30°$.
- Angle at center between radii (α) = $180° - 30° = 150°$.

Steps of Construction:

1. **Draw Machine Wheel:**
    - With center O and radius $r = 2.1$ cm, draw a circle representing the machine wheel.
2. **Draw Base Radius:**
    - Draw radius OA.
3. **Construct Central Angle:**
    - At center O, construct an angle of $150°$ relative to OA.
    - Mark point B on the circumference where this angle arm touches. ($\angle AOB = 150°$).

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4. **Construct Perpendiculars (Tangents):**
    - At point A, construct line L_1 perpendicular ($90°$) to radius OA.
    - At point B, construct line L_2 perpendicular ($90°$) to radius OB.
5. **Find Pulley Point:**
    - Extend lines L_1 and L_2 until they meet at point P. Point P is the pulley point.
6. **Conclusion:** PA and PB are the two tangents from pulley point P to the wheel meeting at an angle of $30°$.

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REVIEW EXERCISE 10

1. Multiple Choice Questions

(i) In the adjacent figure, $\overleftrightarrow{ABC}$ is:

- (a) a chord
- (b) an arc
- (c) a tangent
- (d) a secant

Answer: (d) a secant

(ii) There are _____ types of arcs.

- (a) 2
- (b) 3
- (c) 4
- (d) 5

Answer: (a) 2 (Minor arc and major arc)

(iii) Right bisector of the chord of a circle always passes through the:

- (a) diameter
- (b) non-collinear points
- (c) radius
- (d) centre

Answer: (d) centre

(iv) A circle has only one:

- (a) chord
- (b) centre
- (c) diameter
- (d) secant

Answer: (b) centre

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(v) The point where two tangents meet outside a circle forms:

- (a) a semicircle
- (b) a diameter
- (c) a radius
- (d) an angle

Answer: (d) an angle

(vi) Two equal tangents from a point to a circle can be drawn when the point is _____ the circle.

- (a) on
- (b) inside
- (c) outside
- (d) at centre of

Answer: (c) outside

(vii) Tangents drawn from a single external point to a circle are:

- (a) unequal in length
- (b) perpendicular to each other
- (c) equal in length
- (d) inside the circle

Answer: (c) equal in length

(viii) At least how many chords are needed to locate the centre of the circle?

- (a) 1
- (b) 2
- (c) 3
- (d) 4

Answer: (b) 2

(ix) To draw a tangent at middle point of an arc, first step is to:

- (a) join endpoints of an arc

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- (b) draw radius
- (c) draw a line perpendicular to chord
- (d) draw an angle

Answer: (a) join endpoints of an arc

(x) The angle between the radius and a tangent at the point of contact is:

- (a) 30°
- (b) 60°
- (c) 90°
- (d) 120°

Answer: (c) 90°

2. Subjective Questions & Step-by-Step Construction Procedures

Question 2

Draw a circle of radius 1.4 cm *and draw a tangent at point P, when P lies on its circumference.*

Steps of Construction:

1. **Step 1:** Open a pair of compasses to a radius of 1.4 cm.
2. **Step 2:** Mark a point O on the paper as the center of the circle.
3. **Step 3:** Draw the circle with center O and radius 1.4 cm.
4. **Step 4:** Choose a point P on the circumference of the circle.
5. **Step 5:** Join the center O to point P to form the radius line segment $\overline{OP}$.
6. **Step 6:** At point P, construct a perpendicular line to the radius $\overline{OP}$ using a compass or set square. This perpendicular line is the required tangent to the circle at point P.

Question 3

Draw a circle of radius 1.2 cm *and draw a tangent at point P, when P is at a distance of* 5 cm *from the centre.*

Steps of Construction:

1. **Step 1:** Draw a line segment $OP = 5$ cm where O is the center.
2. **Step 2:** With center O and radius equal to 1.2 cm, draw a circle.

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3. **Step 3:** Bisect the line segment OP to find its midpoint, say M.
4. **Step 4:** With center M and radius equal to MP (or MO), draw a circle that intersects the given circle at two points. Let one of these points be T.
5. **Step 5:** Join point P to point T and extend it.
6. **Step 6:** $\overline{PT}$ is the required tangent drawn from the external point P to the circle.

Question 4

Draw a circle of radius 1.7 cm. *Draw two tangents that meet an angle of* 30°.

Steps of Construction:

1. **Step 1:** Draw a circle with center O and radius $r = 1.7$ cm.
2. **Step 2:** Draw any radius OA of the circle.
3. **Step 3:** Construct a radius OB such that the angle between the two radii ($\angle AOB$) is supplementary to the given angle between the tangents ($180° - 30° = 150°$).
4. **Step 4:** At point A, draw a perpendicular line to radius OA.
5. **Step 5:** At point B, draw a perpendicular line to radius OB.
6. **Step 6:** Produce these two perpendicular lines outward until they intersect each other at an external point, say P.
7. **Step 7:** The angle between these two tangents at point P will measure exactly 30°.

Question 5

Take a part of the circular track, use chords and perpendicular bisectors to complete a circular track.

Steps of Construction:

1. **Step 1:** Consider the given arc representing a portion of the circular track.
2. **Step 2:** Choose any two non-parallel chords, say chord AB and chord BC, on this arc.
3. **Step 3:** Draw the perpendicular bisector of chord AB.
4. **Step 4:** Draw the perpendicular bisector of chord BC.
5. **Step 5:** Extend both perpendicular bisectors so that they intersect each other at a point. Label this intersection point as O, which represents the center of the circular track.
6. **Step 6:** Taking O as the center and the distance from O to any point on the arc as the radius, rotate the compass to complete the full circular track.

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Question 6

Two decorative fences touch the circular flower bed of radius 2.1 cm *and meet outside it at an angle of* 30° *to form an entrance arch. Draw two tangents to the flower bed from the point where the fences meet at an angle of* 30°.

Steps of Construction:

1. **Step 1:** Draw a circle representing the flower bed with center O and radius $r = 2.1$ cm.
2. **Step 2:** Draw a radius OA of the circle horizontally to the right.
3. **Step 3:** Calculate the central angle between the two radii:

$$\text{Central Angle} = 180° - 30° = 150°$$

4. **Step 4:** Draw another radius OB such that $\angle AOB = 150°$.
5. **Step 5:** At point A on the circumference, construct a perpendicular line to OA.
6. **Step 6:** At point B on the circumference, construct a perpendicular line to OB.
7. **Step 7:** Extend these two perpendicular lines until they intersect at an external point P.
8. **Step 8:** The meeting point P represents the entrance where the two fences meet, forming an angle of 30°, and segments PA and PB are the required tangents representing the decorative fences.

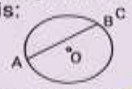
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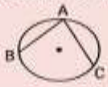
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(i) In the adjacent chorccle, ABC is:



(a) chord (b) a tangent (d) a secant

(ii) Right bisector of the chord of arc:



(a) chord (b) a tangent (d) a secant

(iv) A circle onzocrle has only one:



(a) chord (b) centre (d) secant

(v) The point where two tangents meet circle arm-outside forms:

(a) chord (b) diameter (d) secant

(vi) Two equal tangents from a point to a circle can be drawn whicn the point is the circle.

(a) on (b) inside (c) outside (d) at centre of

(vii) Tangents drawn from as a external point to a circle ansimate the tanpenticqual to each circle:

(a) on (b) inside (c) outside (d) equal

(viii) At least to how many chords as needed to the centre of the circle?

(a) join (b) ran line (c) draw prints (d) a perpendiculars

(ix) To to ro tangent intersect point of mid-arc, fics, step by (ꝛo) join lnwn pointst to arc?

(a) 1 (b) 2 (c) 3 (d) 4

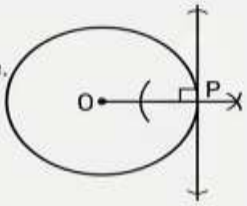
(x) The angle between the radia and arc at the point of contact, *P*, in its ircumference.

(a) 30° (b) 60° (c) 90° (d) 120°

QUESTION 2 CONSTRUCTION

Tangent at a Point P on the Circle
(Radius 1.4 cm)

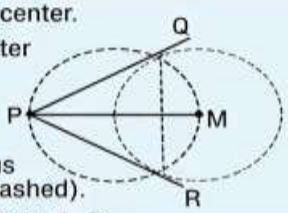
1. Draw circle with center O, radius 1.4cm.
2. Mark P on circumference.
3. Join OP.
4. At P, draw a perpendicular to OP using arcs.



QUESTION 3 CONSTRUCTION

Tangents from an External Point P
(Radius 1.2 cm, distance 5 cm)

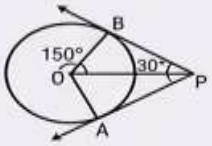
1. Draw OP=5cm, O is center.
2. Draw circle with center O, radius 1.2cm.
3. Bisect OP to find midpoint M.
4. With center M, radius MO, draw a circle (dashed).
5. Mark intersection points Q, R. Join PQ and PR.
6. Join PQ and PR.



QUESTION 4 CONSTRUCTION

Two Tangents meeting at an Angle of 30°
(Radius 1.7 cm)

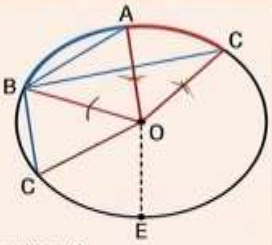
1. Calculate supplementary angle at center: 180° − 30° = 150°
2. Draw circle radius 1.7cm.
3. Draw two radii OA and OB with a 150° angle.
4. At A and B, draw tangents.
5. The tangents intersect at P. Angle APB is 30°.



QUESTION Q5 CONSTRUCTION

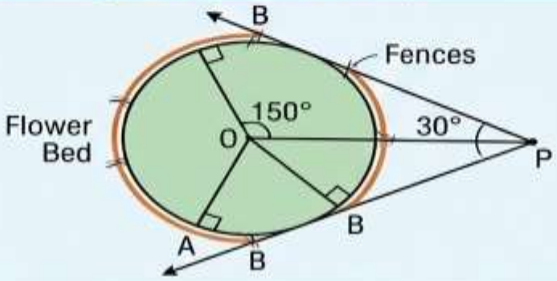
Completing a Circular Track from an Arc

1. Take arc section.
2. Mark points A, B, C.
3. Draw chords AB, BC
4. Draw perpendicular bisectors of AB, BC.
5. Their intersection is center O.
6. Complete circle with center O.



QUESTION 6 Fences for Flower Bed meeting at 30° (Radius 2.1 cm)

1. Calculate center angly angle at center: 180° − 30° = 150°
2. Draw circle radius 2.1cm.
3. Draw radii OA, OB with 150°.
4. At A., B, draw perpendiculars.
5. Tangents meet at P, angle APB is 30°.



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