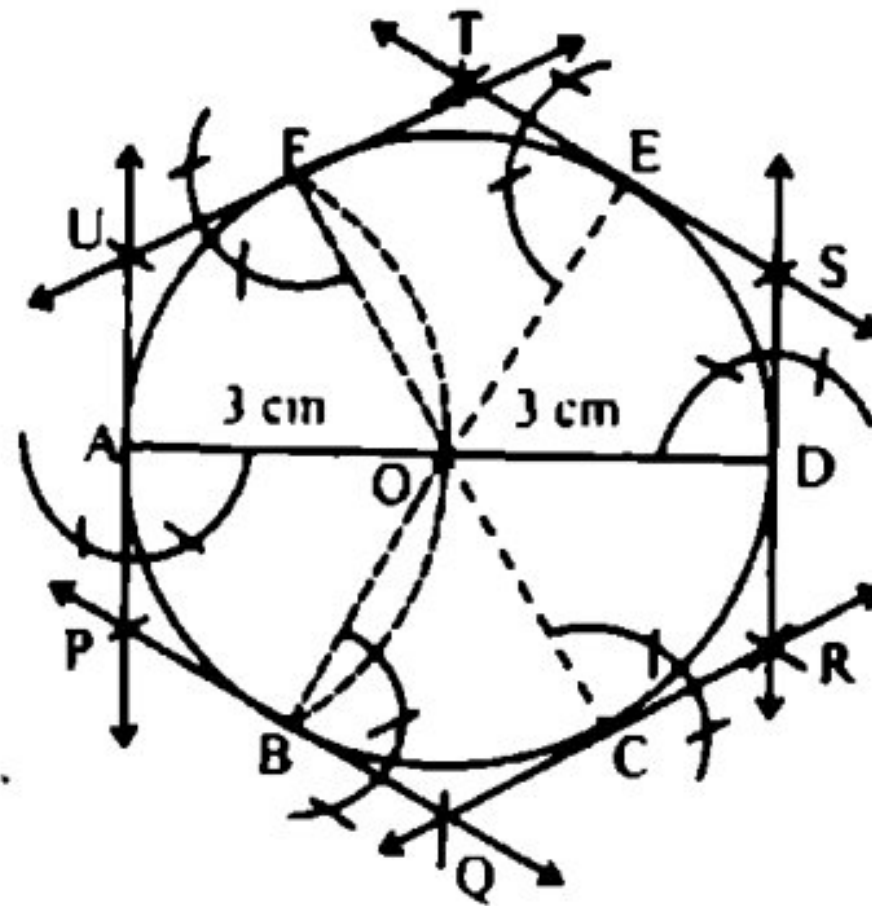


1. Draw a diameter $\overline{AD} = 6$ cm.
2. From point A draw an arc of radius $\overline{AO} = 3$ cm (the radius of the circle), which cuts the circle at points B and F.
3. Join B with O and extend it to meet the circle at E.
4. Join F with O and extend it to meet the circle at C.
5. Draw tangents to the circle at points A, B, C, D, E and F intersecting one another at points P, Q, R, S, T and U respectively.
6. Thus PQRSTU is the circumscribed regular hexagon.

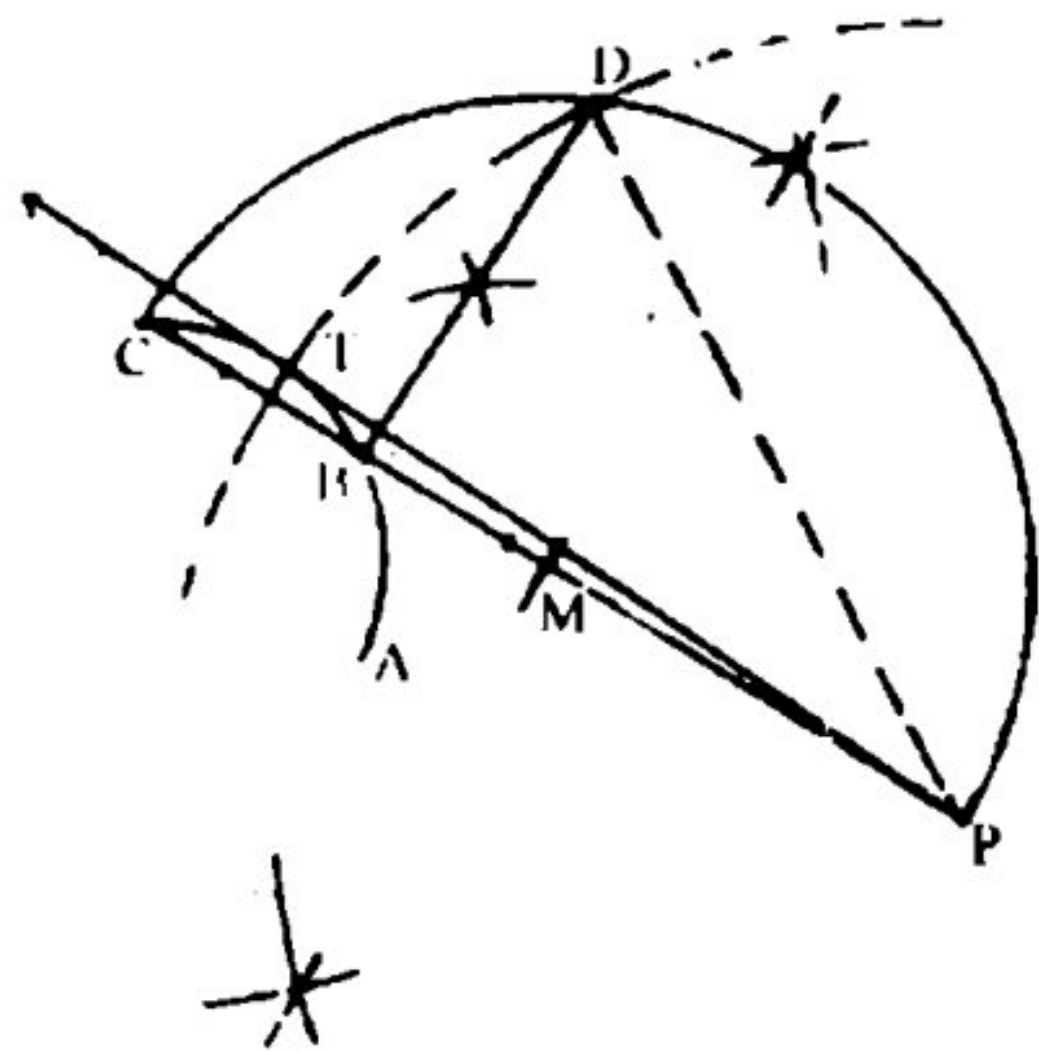


SOLVED EXERCISE 13.3

1. In an arc ABC the length of the chord $|BC| = 2$ cm. Draw a secant $|PBC| = 8$ cm, where P is the point outside the arc. Draw a tangent through point P to the arc.

Steps of Construction:

- (i) Draw an arc \overline{ABC}
- (ii) Take a chord $\overline{BC} = 2$ cm.
- (iii) Produce \overline{CB} towards B and take point P that \overline{PBC} secant in 8 cm.
- (iv) Find M, the midpoint of \overline{CP} .
- (v) Take M as centre and draw a semi circle.
- (vi) Draw $\overline{DB} \perp \overline{CP}$ which meets the semi circle at point D.
- (vii) Take P as centre and draw an arc of radius $m \overline{PD}$, this arc intersect the given arc at T.
- (viii) Join P to T and produce it.



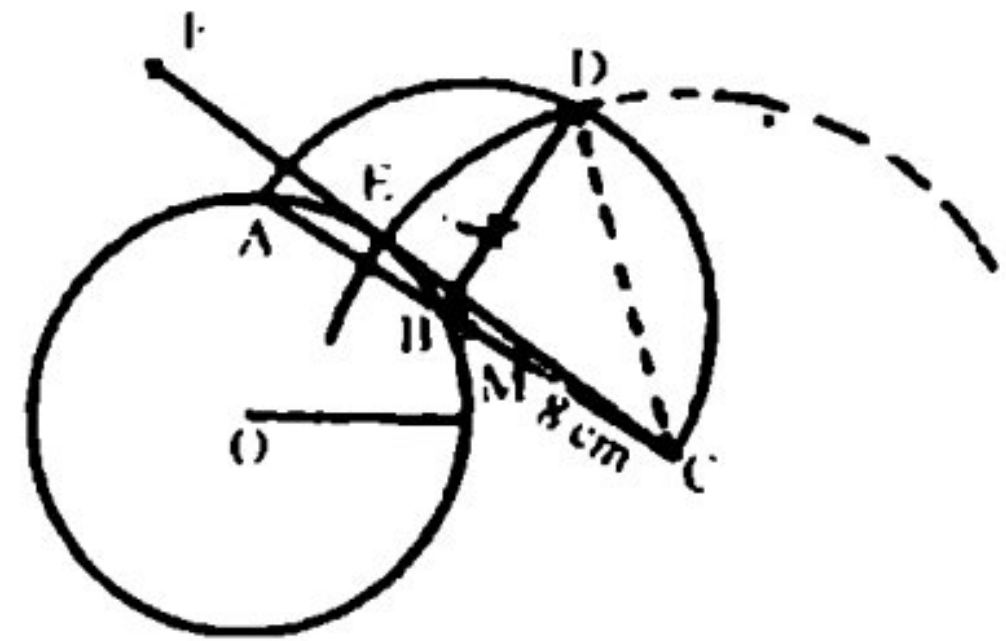
Result:

\overline{PT} is the required tangent.

2. Construct a circle with diameter 8 cm. Indicate a point C, 5 cms away from its circumference. Draw a tangent from point C to the circle without using its centre.

Steps of Construction:

- (i) Draw a circle of radius $\frac{8}{2} = 4\text{cm}$ with centre at O.
- (ii) Take a secant \overline{ABC} such that point C is 5cm away from circumference of the circle.
- (iii) Find M, the midpoint of \overline{AC} .
- (iv) Draw a semi-circle of radius $|\overline{AM}| = |\overline{CM}|$ with centre at M.
- (v) Draw a perpendicular at point B which meets the semi-circle at D.
- (vi) Draw an arc of radius $|\overline{CD}|$ with centre at C. This arc cuts the given circle at point E.
- (vii) Join C with E.

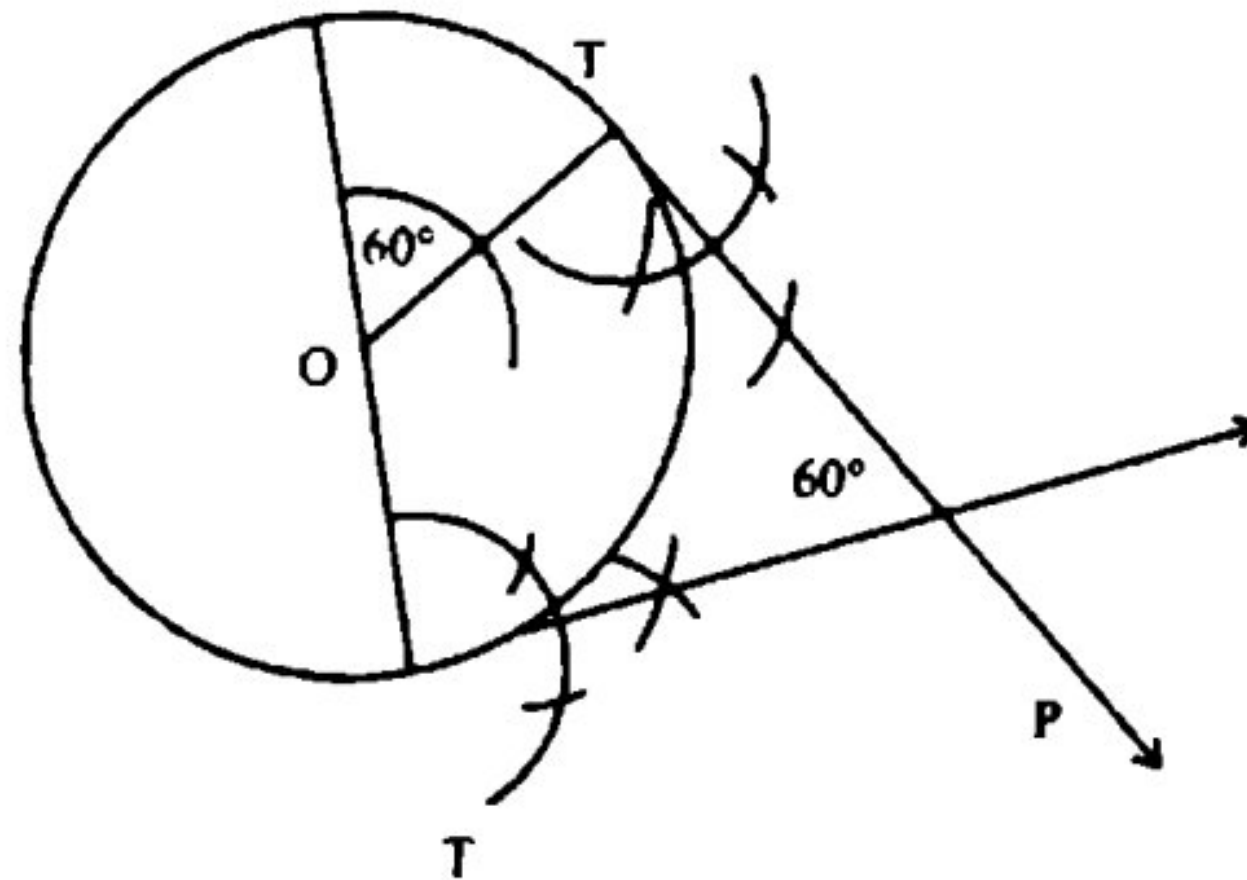


Result:

\overline{CEF} is the required tangent.

3. Construct a circle of radius 2cm. Draw two tangents making an angle of 60° with each other.

Steps of Construction:



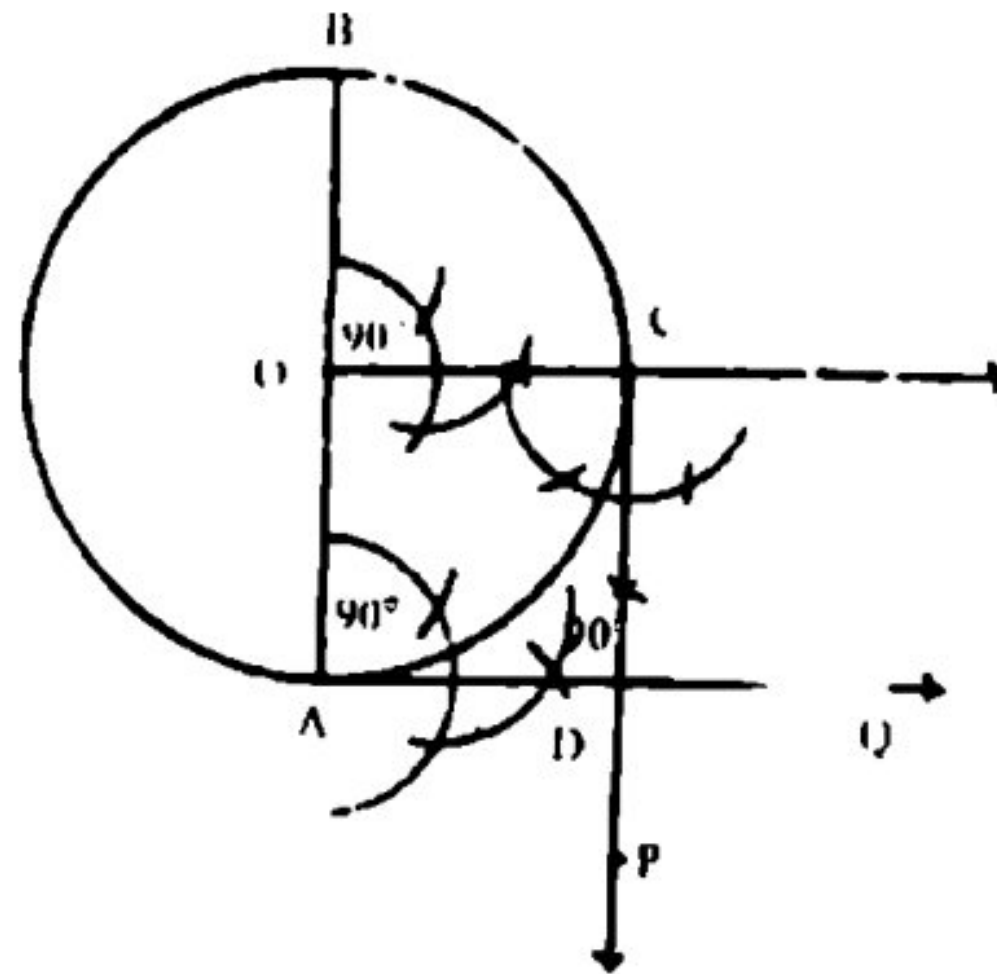
- (i) Take a point O.
- (ii) Take O as centre and draw a circle with radius 2cm.
- (iii) Draw \overline{AOT} any diameter.
- (iv) Draw $\angle AOT = 60^\circ$
- (v) Draw \overline{TP} and $\overline{T'P}$ tangents at T, T', that intersect at P.

Result:

\overline{TP} and \overline{TP} are the required tangents.

4. Draw two perpendicular tangents to a circle of radius 3cm.

Steps of Construction:



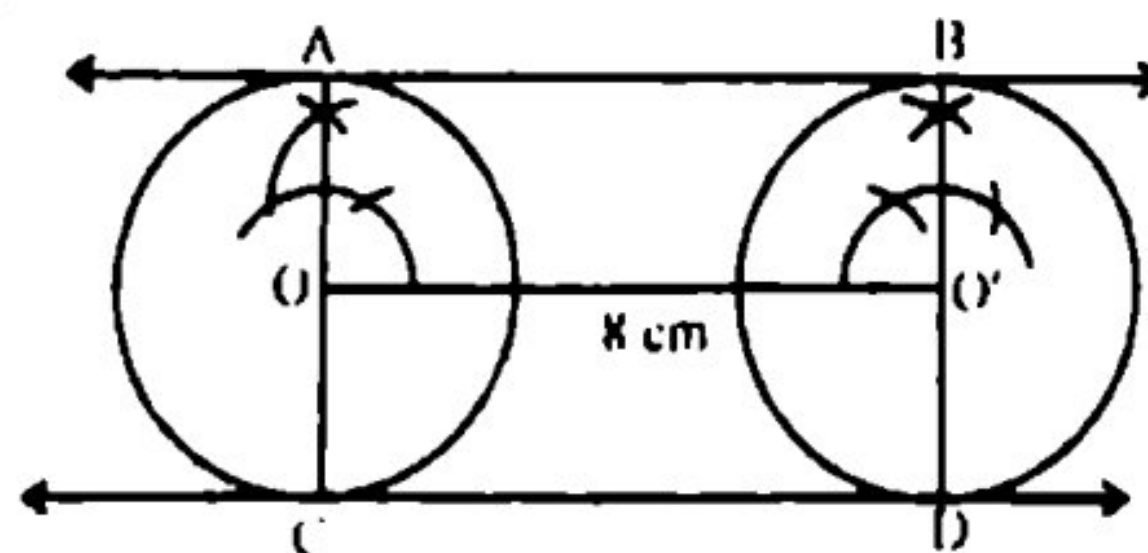
- (i) Take a point O.
- (ii) Take O as centre and a circle of radius 3cm.
- (iii) Take \overline{AOB} any diameter of the circle.
- (iv) Draw $m\angle BOC = 90^\circ$.
- (v) Draw tangents at point A, C.

These are \overline{CP} , \overline{AQ}

Result:

\overline{AQ} , \overline{CP} are the required tangents that meet at point D at 90° .

5. Two equal circles are at 8cm apart. Draw two direct common tangents of this pair of circles.



Steps of Construction:

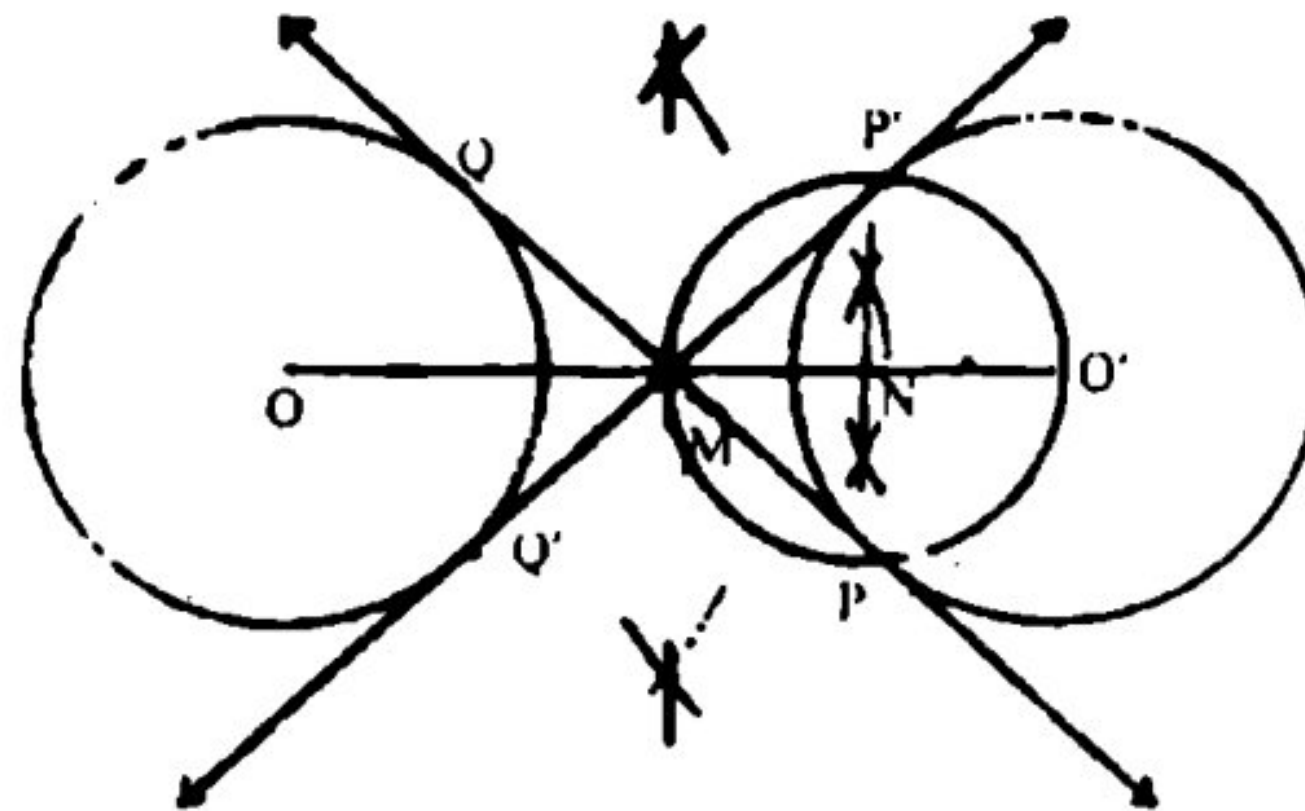
- (i) Draw $\overline{OO'} = 8\text{cm}$.
- (ii) Draw two circles of equal size on O and O'.
- (iii) Draw $\overline{OA} \perp \overline{OO'}$ and produce towards O. \overline{OA} produced meets the circle at C.

- (iv) Draw $\overline{O'B} \perp \overline{OO'}$ and produce it towards O' . $\overline{O'B}$ produced meets the circle at D .
- (v) Join A with B and produce it both sides.
- (vi) Join C with D and produce both sides.

Result:

\overline{AB} and \overline{CD} are the common external tangents.

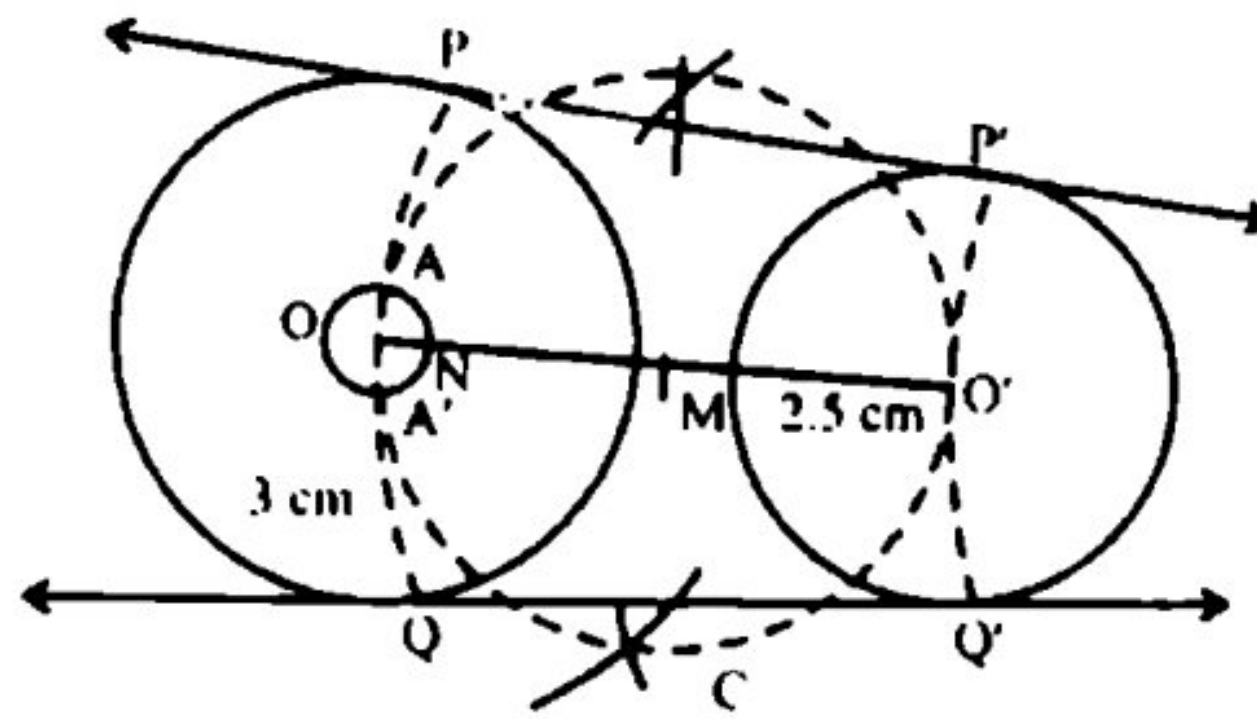
- 6. Draw two equal circles of each radius 2.4cm. If the distance between their centres is 7cm then draw their transverse tangents.**



Steps of Construction:

- (i) Draw $m \overline{OO'} = 7\text{cm}$.
- (ii) Draw two circles of 2.4cm radius on O and O' .
- (iii) Find M , the mid point of $\overline{OO'}$.
- (iv) Find N , the mid point of $\overline{MO'}$.
- (v) Draw a circle with centre at N and of radius $\overline{NO'}$. This circle intersects the circle at P and P' .
- (vi) Join P' with M and produce towards M , it touch the second circle at Q' .
- (vii) Join P with M and produce towards M .
 \overline{PM} produced touches the second circle at Q .
 \overline{PQ} $\overline{P'Q'}$ are the required tangents.

- 7. Draw two circles with radii 2.5cm and 3cm of their centres are 6.5cm apart then draw two direct common tangents.**



Steps of Construction:

- (i) Draw $\overline{OO'}$ of length 6.5 cm.
- (ii) Take O as centre and draw a circle with radius 3 cm.
- (iii) Take O' as centre and draw a circle with radius 2.5 cm.
- (iv) Find M, mid-point of $\overline{OO'}$. Take M as centre and draw a circle with radius $m\overline{MO'}$.
- (v) Cut $m\overline{ON} = 3 - 2.5 = .5$ cm and take O as centre, draw the circle with radius $m\overline{ON}$. This circle intersects the circle C, at point A, A' .
- (vi) Join O with A, A' and produce on both sides. \overline{OA} and $\overline{OA'}$ produced intersect the larger circle at P and Q
- (vii) Draw $\overline{O'P'} \parallel \overline{OP}$ and $\overline{O'Q'} \parallel \overline{OQ}$.
- (viii) Join P with P' and Q with Q' .

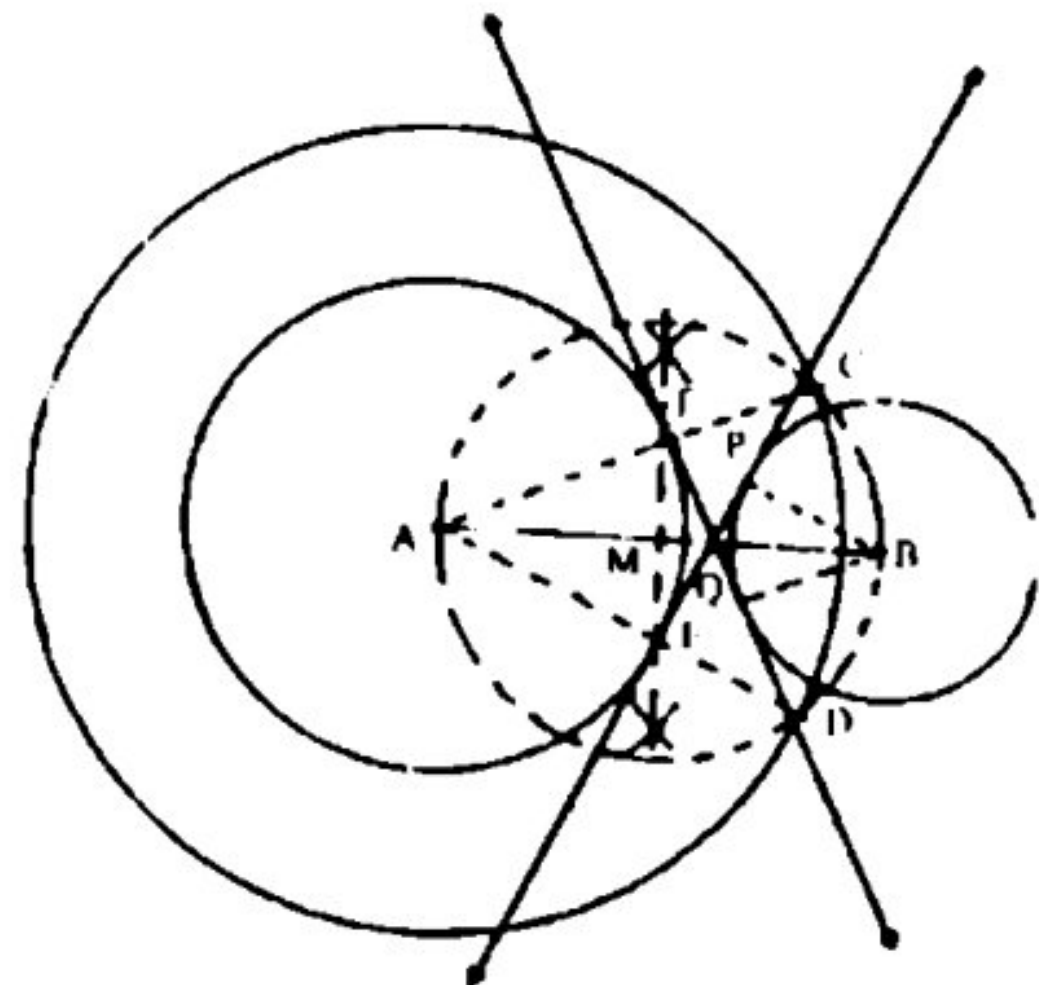
Result:

$\overline{PP'}$ and $\overline{QQ'}$ are the required tangents.

8. Draw two circles with radii 3.5cm and 2cm of their centres are 6cm apart then draw two transverse common tangents.

Ans. Construction:

- (i) Take a line segment of measure $\overline{AB} = 6$ cm.
- (ii) Draw two circles of radii 3.5 and 2cm with centres at A and B respectively.
- (iii) Taking A as centre draw a circle of radius $3.5 + 2 = 5.5$ cm.
- (iv) Bisect the line segment \overline{AB} at point M.
- (v) Take M as centre and draw a circle of radius \overline{MA} which intersects the big circle at points C and D.

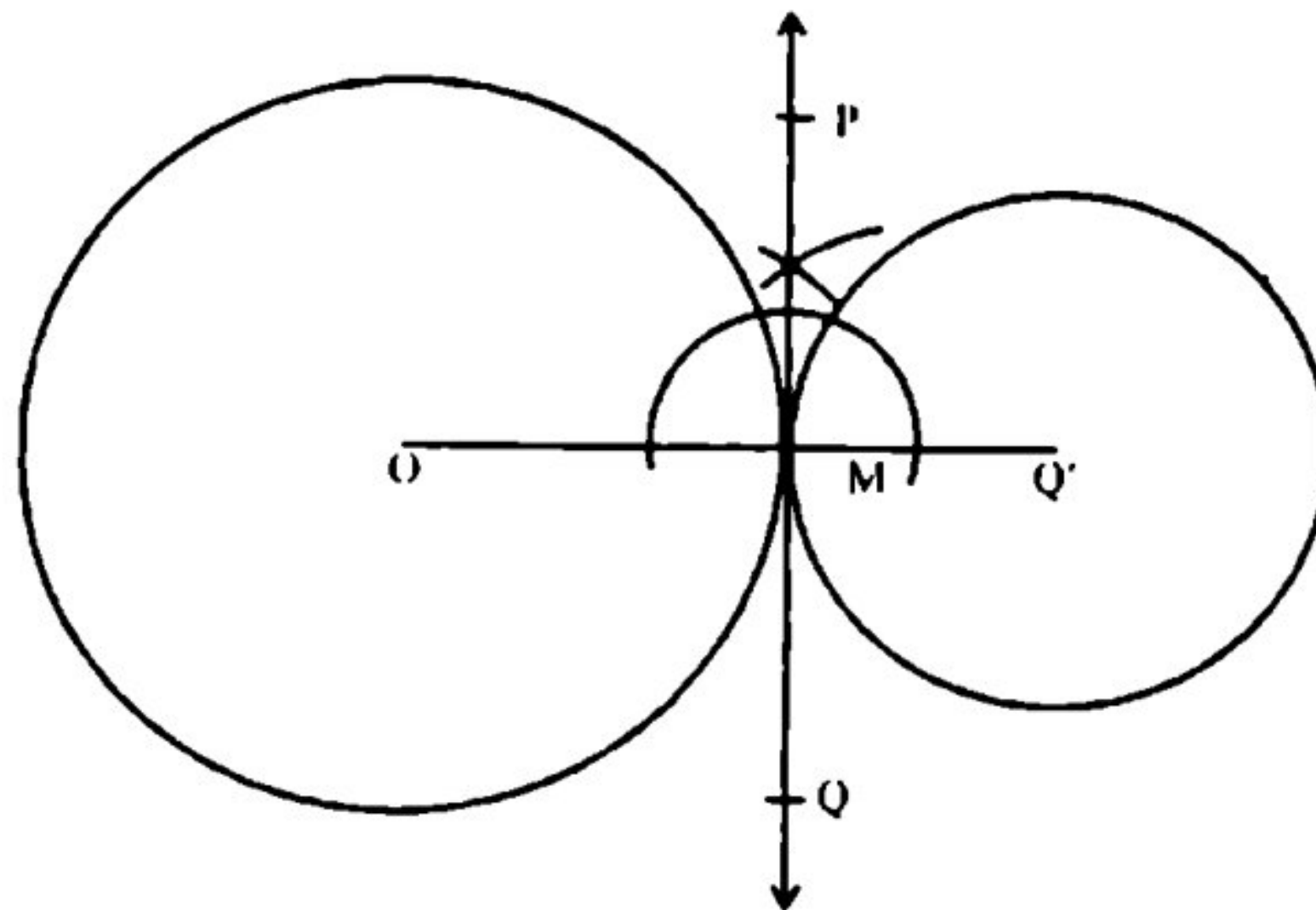


- (vi) Join A with C and D to produced \overline{AD} and \overline{AC} .
 \overline{AD} and \overline{AC} meet the inner circle at E and F.
- (vii) Draw $\overline{BQ} \parallel \overline{AE}$ and $\overline{BP} \parallel \overline{AF}$.
- (viii) Join E with Q and produce on both sides.
 Join F with P and produce on both sides.

Result:

\overline{EQ} and \overline{FP} are the required tangents.

9. Draw two common tangents to two touching circles of radii 2.5cm and 3.5 cm.



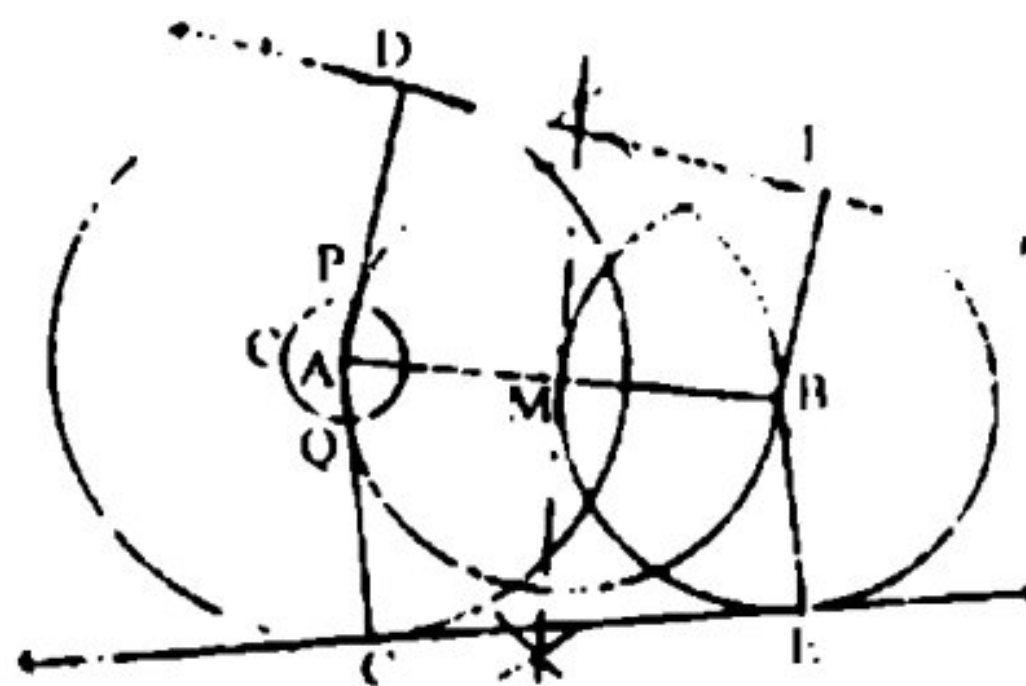
Steps of Construction:

- (i) Draw a line segment $\overline{OO'}$ of measure $2.5 + 3.5 = 6.0$ cm.
- (ii) Take O as centre and draw a circle with radius $m\overline{OM} = 3.5$ cm.
- (iii) Take O' as centre and draw a circle with radius 2.5cm. These circle touch each other at point M.
- (iv) Draw $\overline{PQ} \perp \overline{OO'}$.

Result:

\overline{PQ} is the required common tangents.

10. Draw two common tangents to two intersecting circle of radii 3cm and 4cm.



Steps of Construction:

- (i) Take a line segment \overline{AB} that $m\overline{AB} = 3 + 4 = 7$ cm.
- (ii) Draw two circles of radii 4cm, 3cm with centres at A, B.
- (iii) Taking A as centre draw a circle with radius $4 - 3 = 1$ cm.
- (iv) Bisect the line segment \overline{AB} at point M.
- (v) Take M as centre and draw a circle of radius $m\overline{MB}$, this circle intersects Circle C, at P, Q.
- (vi) Join A with P and Q and produce \overline{AP} , \overline{AQ} to meet the larger circle at D, C.
- (vii) Draw $\overline{BT} \parallel \overline{AD}$ and $\overline{BE} \parallel \overline{AC}$.
- (viii) Join D with T and produce both sides.
- (ix) Join C with E and produce both sides.

Result:

\overline{DT} and \overline{CE} are the required tangents.

11. Draw circles which touches both the arms of angles

- (i) 45°
- (ii) 60°

(i) 45°

Steps of Construction:

- (i) Draw an angle ABC of 45° .
- (ii) Draw \overline{BP} bisector of angle $\angle ABC$.
- (iii) Take any point O and \overline{BP} .
- (iv) Drop $\overline{OM} \perp \overline{BA}$.
- (v) Take O as centre and draw a circle with radius $m\overline{OM}$.

This circle touches arm \overline{BC} at N also.

