

Exercise 8.2

PT is a tangent at T to a circle with center O.
 $OP = 17$ cm, $OT = 8$ cm

$OP = 17 \text{ cm}$, $OT = 8 \text{ cm}$.

As ΔOPA is a right Δ

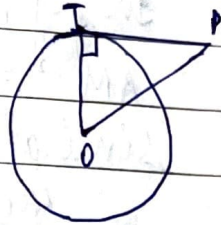
$$OT^2 + PT^2 = OP^2$$

$$PT^2 = OP^2 - OT^2$$

$$PT^2 = 17^2 - 8^2$$

$$PT = \sqrt{289 - 64} = \sqrt{225}$$

$$PT = 15 \text{ cm}$$



(Pythagoras theorem)

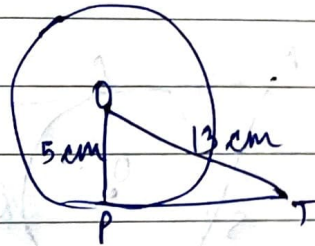
Q.2 In right ΔOPT ,

$$OT^2 = OP^2 + PT^2$$

$$(13)^2 = (5)^2 + PT^2$$

$$PT^2 = 169 - 25 = 144$$

$$P_T = \sqrt{144} = 12 \text{ cm}$$



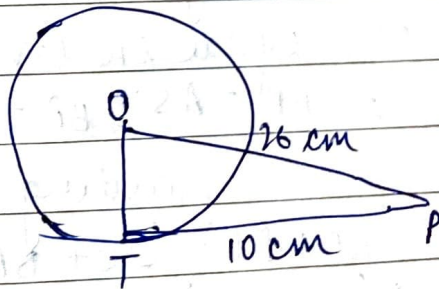
4.3 In night ΔOTP

$$OP^2 = TP^2 + OT^2$$

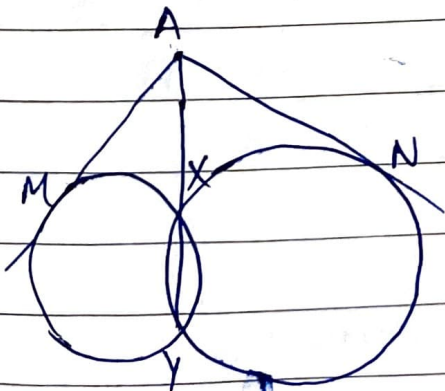
$$OT^2 + 10^2 = 26^2$$

$$OT^2 = 576 - 100$$

$$OT = \sqrt{476} = 24 \text{ cm}$$



Q. 4



Let the two circles intersect at X and Y, XY is the common chord.

Let A be a point on ~~the~~ the common chord & AM and AN be the tangents drawn from A to the circles.

In fig, AM is the tangent and AX Y is a secant,

$$AM^2 = AX \times AY \quad \text{--- (1)}$$

$$\text{Similarly, } AN^2 = AX \times AY \quad \text{--- (2)}$$

From (1) & (2)

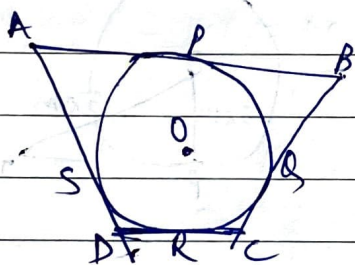
$$AM^2 = AN^2$$

$$\therefore \boxed{AM = AN}$$

Hence, proved

If AB is a tangent from external point A and a secant to the circle through A intersects the circle at C & D. $\therefore$
 $AB^2 = AC \times AD$

Q.5



Since tangents drawn from external point to a circle are equal in length.

$$\therefore AP = AS, BP = BQ, CR = CQ, DR = DS$$

Adding all,

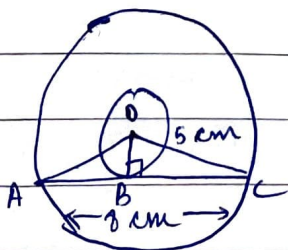
$$AP + BP + CR + DR = AS + BQ + CQ + DS$$

$$\Rightarrow (AP + BP) + (CR + DR) = (AS + DS) + (BQ + CQ)$$

$$\Rightarrow \boxed{AB + CD = AD + BC}$$

Hence, proved

Q.6



Since AC is a tangent to the inner circle,

$\therefore \angle OBC = 90^\circ$ (Tangent is perpendicular to the radius of a circle)

AC is a chord. As perpendicular from ~~the~~ centre to chord, bisects the chord,

$$\therefore AC = 2BC \Rightarrow BC = 4 \text{ cm}$$

In $\triangle OBC$,

$$OC^2 = OB^2 + BC^2$$

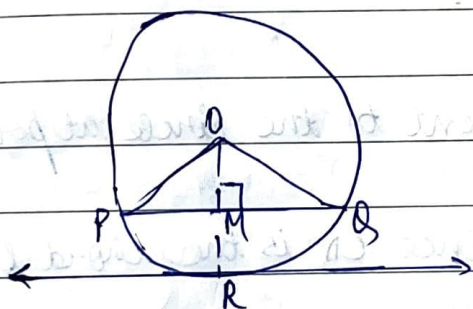
$$5^2 = x^2 + 4^2$$

$$x^2 = 25 - 16$$

$$x = \sqrt{9}$$

$$x = 3 \text{ cm}$$

(Pythagoras theorem)



Given - Chord PQ is $\parallel$ to a tangent drawn at point R.

To prove - R bisects the arc PRQ

Cons. - Join OR intersecting PQ at M.

Proof - $OR \parallel l$ (Radius is perpendicular to the tangent at the point of contact)

$PQ \parallel l$ (Given)

$\therefore \angle OMP = \angle OMQ = 90^\circ$ (Corresponding $\angle$ s)

In $\triangle OPM$ & $\triangle OQM$,

$OP = OQ$ (radii)

$OM = OM$ (common)

$\angle OMP = \angle OMQ = 90^\circ$

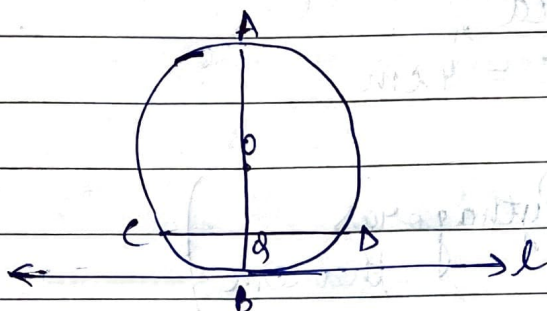
$\therefore \triangle OPM \cong \triangle OQM$ (RHS congruency)

$$\therefore \angle POM = \angle QOM \text{ (C.P.C.T.)}$$

$$\Rightarrow \text{arc}(PR) = \text{arc}(QR)$$

$\therefore$ Point P bisects arc PRQ.

Hence, proved



Given - l is the tangent to the circle with centre O at B and AB is the diameter that passes through chord CD at Q.

To prove - $CQ = DQ$.

Proof - Since l is the tangent to the circle at point B.

$$\therefore AB \perp l$$

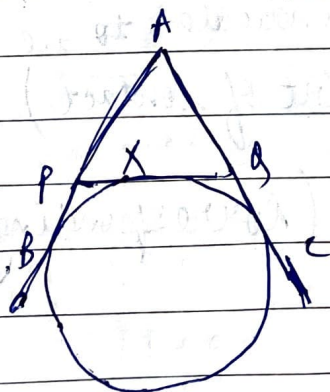
also, $l \parallel CD$ (Since CD is the chord & $AB \perp l$)

$\therefore OQ$ bisects CD.

$\therefore AB$ bisects CD

$$\Rightarrow \boxed{AQ = QD}$$

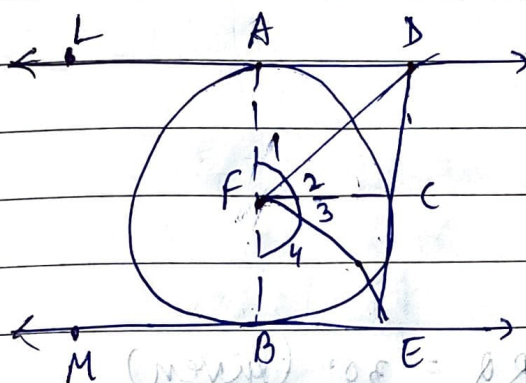
Hence, proved



Since tangents drawn from an external point to a circle are equal in length.

$$\therefore PB = PX, QC = QX, AB = AC$$

$$\begin{aligned}
 \text{Perimeter of } \triangle APQ &= AP + PQ + AQ \\
 &= AP + (PX + XQ) + AQ \\
 &= (AP + PX) + (AQ + XQ) \\
 &= (AP + PB) + (AQ + QC) \quad \left. \begin{array}{l} PX = PB \\ XQ = QC \end{array} \right\} \\
 &= AB + AC = 5 + 5 \\
 &= \boxed{10 \text{ cm}}
 \end{aligned}$$



Given - Two $\parallel$ tangents to a circle

To prove - $\angle DFE = 90^\circ$

Proof - $DA = DC$ (Since tangents drawn from an external point to a circle are equal)

In $\triangle DAF$ & $\triangle DFC$,

$$DA = DC$$

$$DF = FD \text{ (Common)}$$

$$AF = CF \text{ (Radii)}$$

$$\therefore \triangle DAF \cong \triangle DFC \text{ (SSS congruency)}$$

$$\therefore \angle ADF = \angle CDF \text{ (CPCT)}$$

$$\Rightarrow \angle ADC = 2\angle CDF \text{ — (1)}$$

$$\text{Similarly, } \angle BEF = \angle CEF$$

$$\Rightarrow \angle CEB = 2\angle CEF \text{ — (2)}$$

$$\begin{aligned}
 \angle ADC + \angle CEB &= 180^\circ \quad \left\{ \begin{array}{l} \text{Sum of } \angle\text{s on the} \\ \text{same side of the trans-} \\ \text{versal is } 180^\circ \end{array} \right. \\
 2\angle CDF + 2\angle CEF &= 180^\circ \\
 2(\angle CDF + \angle CEF) &= 180^\circ
 \end{aligned}$$

$$\angle CDF + \angle CEF = 90^\circ$$

In $\triangle DFE$,

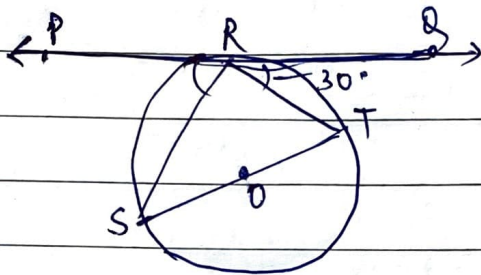
$$\angle EDF + \angle DEF + \angle DFE = 180^\circ \quad (\text{Angle sum prop. of } \triangle)$$

$$90^\circ + \angle DFE = 180^\circ$$

$$\boxed{\angle DFE = 90^\circ}$$

$\therefore$ The intercept of a tangent between two $\parallel$ tangents to a circle subtends a right $\angle$ at the centre.

Q.11



PQ is a tangent & $\angle TRQ = 30^\circ$ (given)

ST is the diameter.

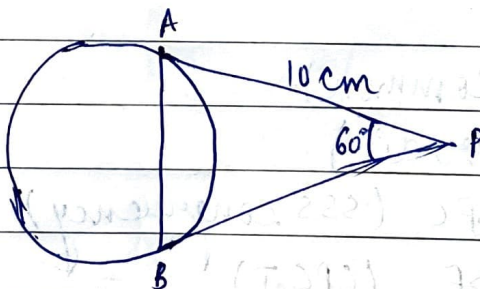
$\therefore \angle SRT = 90^\circ$ (angle in a semicircle is 90°)

$$\therefore \angle TRQ + \angle SRT + \angle PRS = 180^\circ \quad \left. \begin{array}{l} \text{Angle in a} \\ \text{straight line} \end{array} \right\}$$

$$30^\circ + 90^\circ + \angle PRS = 180^\circ$$

$$\boxed{\angle PRS = 60^\circ}$$

Q.12



Since tangents from an external point are equal in length,

$$\therefore PA = PB$$

$\Rightarrow \triangle PAB$ is an isosceles $\triangle$

$\therefore \angle PAB = \angle PBA$ (Opp. $\angle$ s of ~~eq~~ equal sides are equal)

$$\angle PAB + \angle PBA + \angle APB = 180^\circ$$

$$2\angle PAB + 60^\circ = 180^\circ$$

$$\angle PAB = 120^\circ - 60^\circ$$

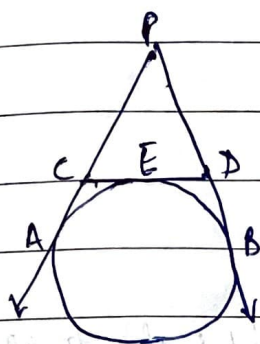
$$\therefore \angle PAB = \angle PBA = 60^\circ$$

$\left. \begin{array}{l} \text{Angle sum prop.} \\ \text{of } \triangle \end{array} \right\}$

$\therefore \triangle PAB$ is an equilateral Δ .

$$\therefore PA = PB = AB$$

$$\Rightarrow \boxed{AB = 10 \text{ cm}}$$



Since tangents from an external point to a circle are equal in length.

$$\therefore AC = CE, BD = DE, AP = BP = 14 \text{ cm}$$

$$\text{Perimeter of } \triangle PCD = PC + CD + PD$$

$$= PC + (CE + ED) + PD$$

$$= (PC + CE) + (PD + ED)$$

$$= (PC + AC) + (PD + DB)$$

$$= PA + PB = 14 + 14$$

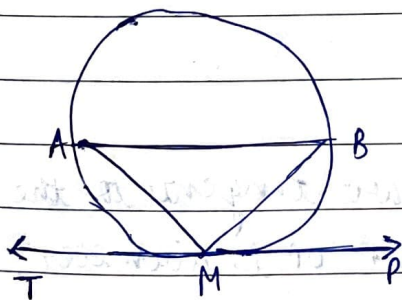
$$= \boxed{28 \text{ cm}}$$

$$\left. \begin{array}{l} AC = CE \\ BD = DE \end{array} \right\}$$

$$\left. \begin{array}{l} AC = CE \\ BD = DE \end{array} \right\}$$

Q.15 NCERT Ques.

Q.16



To prove - The tangent drawn at the midpoint of an arc of a circle is $\parallel$ to the chord joining the end points of the arc.

Proof - Let the midpoint of an arc AMB be M and TP be the tangent to the circle.

Join AB, AM & MB .

As, M is midpoint of arc.

$$\therefore \text{arc}(AM) = \text{arc}(MB)$$

$$\Rightarrow \text{chord } AM = \text{chord } MB$$

In $\triangle AMB$,

$$AM = MB$$

$$\Rightarrow \angle MAB = \angle MBA \quad \text{--- (1) (LS opp. to equal sides)}$$

Since, TP is tangent

$$\angle AMT = \angle MBA \quad (\text{Angle in alternate segments})$$

$$\therefore \angle AMT = \angle MAB$$

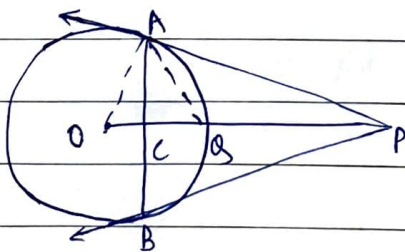
As, $\angle AMT$ & $\angle MAB$ are alternate angles,

$$\therefore AB \parallel TP.$$

Hence, the tangent drawn at the midpoint of an arc of a circle is parallel to the chord joining the end points of the arc.

Hence, proved

Q.17



Given - From point P , PA & PB are tangents to the circle with centre O such that OP is diameter.

To prove - $\triangle APB$ is an equilateral $\triangle$.

Cons. - Join OP, AQ & OA

Proof - $OP = d = 2r$

$$\therefore OQ + QP = 2r$$

$$\text{As } OQ = r$$

$$\therefore OQ = QP = r$$

In right $\triangle OAP$,

OP is the hypotenuse & A is the midpoint.

$\therefore OA = AQ = OQ$ (Midpoint of hypotenuse is equidistant from its vertices)

$\therefore OAQ$ is an equilateral $\triangle$.

$$\Rightarrow \angle AOQ = 60^\circ$$

$\therefore$ In right $\triangle OAP$,

$$\angle APO = 90^\circ - 60^\circ = 30^\circ$$

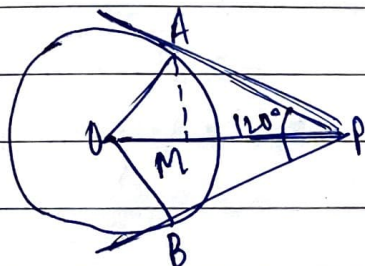
$$\Rightarrow \angle APB = 2\angle APO = 60^\circ$$

As, $PA = PB$ (Tangents from external point)

$$\therefore \angle PAB = \angle PBA = 60^\circ$$

$\therefore \triangle APB$ is an equilateral $\triangle$.

Hence, proved



Q.18

Given - PA and PB are tangents. $\angle APB = 120^\circ$

To prove - $OP = 2AP$

Cons. - ~~Take midpoint M of OP & join AM. Also join OA & OB~~

Proof - In right $\triangle OAP$,

$$\angle OPA = \frac{1}{2} \angle APB = 60^\circ$$

$$\angle AOP = 90^\circ - 60^\circ = 30^\circ$$

~~As M is the midpoint of hypotenuse OP of $\triangle OAP$.~~

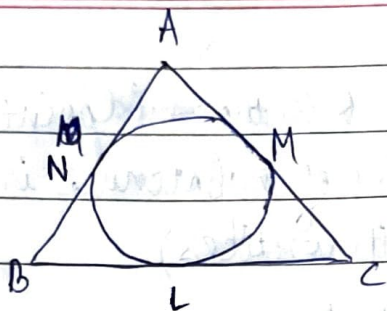
$$\therefore \text{~~MO = MA = MP, } \angle OAM = \angle~~$$

$$\text{In } \triangle OAP, \cos 60^\circ = \frac{AP}{OP}$$

$$\Rightarrow \frac{1}{2} = \frac{AP}{OP} \Rightarrow \boxed{OP = 2AP}$$

Hence, proved

Q.19



In $\triangle ABC$, } given
 $AB = AC$

Since tangents from external point are equal,
 $\therefore AN = AM, BN = BL, CM = CL$

As $AB = AC$

$$\Rightarrow AN + NB = AM + MC \quad (AN = AM)$$

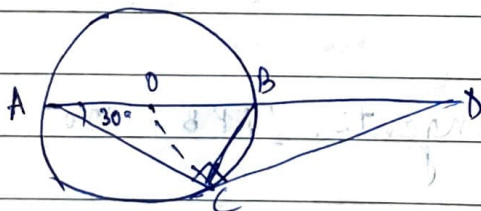
$$\Rightarrow NB = MC$$

As $NB = LB$ & $MC = LC$

$$\therefore \boxed{BL = CL}$$

Hence, L bisects BC .

Q.20



Given - $\angle BAC = 30^\circ$

To prove - $BC = BD$

Cons. - Join BC & OC ,

Proof - $\angle ACB = 90^\circ$ (Angle in a semicircle)

$\angle BAC = 30^\circ$ (Given)

$$\angle ACB + \angle BAC + \angle ABC = 180^\circ \quad (\text{Angle sum prop. of } \triangle)$$

$$90^\circ + 30^\circ + \angle ABC = 180^\circ$$

$$\angle ABC = 60^\circ \quad \text{--- ①}$$

$$\angle BCD = \angle BAC = 30^\circ \quad \text{--- ② (Angles in alternate segment)}$$

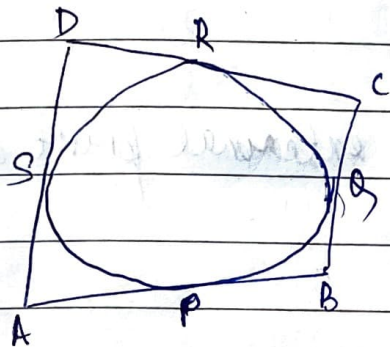
$$\angle ABC = \angle BCD + \angle BDC \quad (\text{Exterior } \angle \text{ equals to the sum of interior opp } \angle s)$$

$$60^\circ = 30^\circ + \angle BDC$$

$$\angle BDC = 30^\circ = \angle BCD$$

$$\therefore \boxed{BC = BD} \quad (\text{Sides opp. to equal } \angle s)$$

Hence, proved



$$AB = 6 \text{ cm}, BC = 7 \text{ cm}, CD = 4 \text{ cm} \quad (\text{Given})$$

Since tangents from external point are equal,

$$\therefore AP = AS, BP = BQ, CR = CQ, DR = DS$$

Adding all,

$$AP + BP + CR + DR = AS + BQ + CQ + DS$$

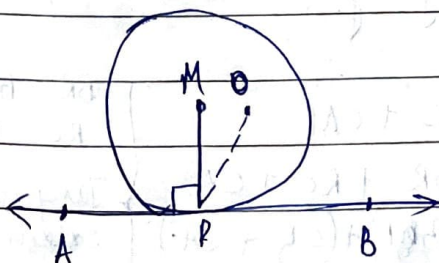
$$(AP + BP) + (CR + DR) = (AS + DS) + (BQ + CQ)$$

$$AB + CD = AD + BC$$

$$6 + 4 = AD + 7$$

$$AD = 10 - 7$$

$$\boxed{AD = 3 \text{ cm}}$$



Let ~~AB~~ APB be the tangent to the circle with centre O.

Let us suppose $MP \perp AB$ does not pass through the centre.

$$\therefore \angle OPA = 90^\circ \quad (\text{Tangent is perpendicular to the radius})$$

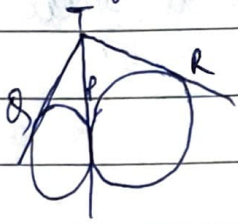
$$\text{But } \angle MPA = 90^\circ \quad (\text{Given, } MP \perp AB)$$

$$\therefore \angle OPA = \angle MPA$$

This is only possible when O & M coincide with each other.

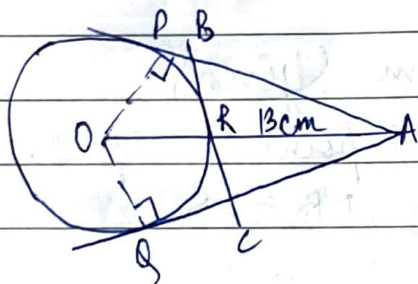
Hence, the perpendicular at the point of contact to the tangent to a circle passes through the centre of the circle.

Q. 23



Since, tangents drawn from external point are equal,
 $\therefore TP = TQ$ and $TP = TR$
 $\Rightarrow \boxed{TQ = TR}$

Q. 24



Given - AP & AQ are tangents, BC is a tangent at point R.
 $OR = 5 \text{ cm}$, $AO = 13 \text{ cm}$

To find - Perimeter of $\triangle ABC$

Solution - $\angle OPA = 90^\circ$ (Tangent is perpendicular to the radius through the point of contact)

$$\therefore OA^2 = OP^2 + PA^2$$

$$13^2 = 5^2 + PA^2$$

$$PA^2 = 169 - 25$$

$$PA = \sqrt{144} = 12 \text{ cm}$$

(Pythagoras theorem)

$$\text{Perimeter of } \triangle ABC = AB + BC + CA$$

$$= AB + BR + RC + CA$$

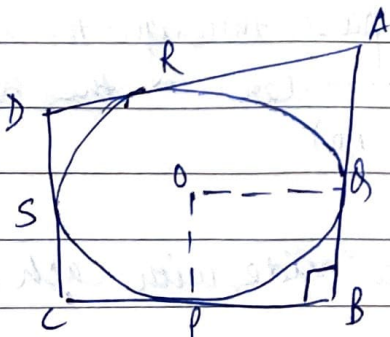
$$= (AB + BR) + (RC + CA)$$

$$= 12 + 12 = \boxed{24 \text{ cm}}$$

$$\left. \begin{array}{l} BR = BP, \\ RC = CQ. \end{array} \right\}$$

Tangents from external point are equal.

Q. 25



~~$\angle B = 90^\circ$~~ $\angle B = 90^\circ$
 $AD = 23 \text{ cm}$, $AB = 29 \text{ cm}$, $DS = 5 \text{ cm}$ } given

$OP = OQ$ (same radii)

AB & BC are tangents and OP & OQ are radii

$\therefore OP \perp BC$ and $OQ \perp AB$ (Tangent is perpendicular to the radius through the point of contact)

$\therefore \angle OPB = \angle OQB = 90^\circ$

$\therefore PBQO$ is a square

DS and DR are tangents

$DS = DR = 5 \text{ cm}$ (Tangents from external point are equal)

$AR = AD - DR = 23 - 5$

$= 18 \text{ cm}$

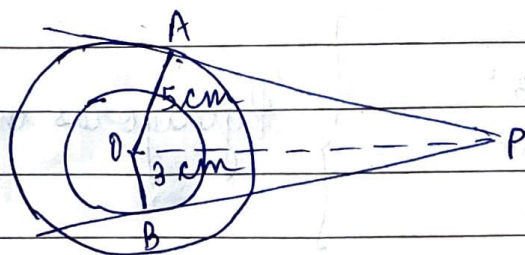
AR & AQ are tangents

$AR = AQ = 18 \text{ cm}$

$QB = AB - AQ = 29 - 18$
 $= 11 \text{ cm}$

As all sides of square are equal;

$\therefore \text{radius} = 11 \text{ cm}$



$AP = 12 \text{ cm}$

$AO = 5 \text{ cm}$, $BO = 3 \text{ cm}$

AP & BP are tangents

$\angle OAP = \angle OBP = 90^\circ$ (Tangents are perpendicular to the radius through the point of contact)

In right $\triangle OAP$,

$$OP^2 = OA^2 + AP^2$$

$$OP^2 = 5^2 + 12^2 = 25 + 144$$

$$OP = \sqrt{169} = 13 \text{ cm}$$

In right $\triangle OBP$,

$$OP^2 = OB^2 + BP^2$$

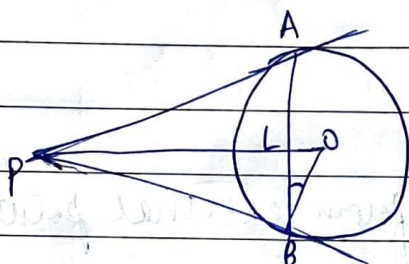
$$13^2 = 5^2 + BP^2$$

$$BP^2 = 169 - 25$$

$$BP = \sqrt{144}$$

$$BP = 12 \text{ cm}$$

Q.27



Given - AB is a chord of a circle with centre O and radius 10 cm. AP & BP are tangents. AB is joined which intersects OP at L. AB = 16 cm

To find - Length of PA

Solution - OP bisects AB at L.

$$\therefore AL = BL = \frac{16}{2} = 8 \text{ cm}$$

In right $\triangle OLB$,

$$OB^2 = OL^2 + LB^2$$

$$10^2 = OL^2 + 8^2$$

$$OL^2 = 100 - 64$$

$$OL = \sqrt{36} = 6 \text{ cm}$$

} Pythagoras theorem

Let PL & PB be x & y respectively.

$$OP = OL + PL = x + 6$$

In right $\triangle PLB$,

$$PB^2 = PL^2 + BL^2$$

$$y^2 = x^2 + 8^2$$

} Pythagoras theorem

$$y^2 = x^2 + 64 \quad \text{--- (1)}$$

In right $\triangle OBP$,

$$OP^2 = OB^2 + PB^2$$

$$(x+6)^2 = 10^2 + y^2$$

$$x^2 + 12x + 36 = 100 + x^2 + 64$$

(Putting ①)

$$12x = 164 - 36$$

$$12x = 128$$

$$x = \frac{128}{12}$$

$$\boxed{x = \frac{32}{3}}$$

Putting x in ①

$$y^2 = x^2 + 64$$

$$y^2 = \left(\frac{32}{3}\right)^2 + 64$$

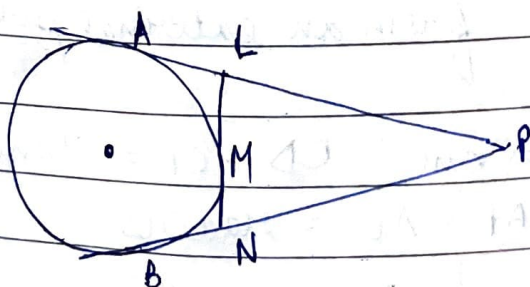
$$y^2 = \frac{1024 + 576}{9}$$

$$y^2 = \left(\frac{40}{3}\right)^2$$

$$\boxed{y = \frac{40}{3}}$$

As tangents from external point are equal,

$$\therefore PA = PB = \boxed{\frac{40}{3} \text{ cm}}$$



Given - PA & PB are tangents.

To prove - $PL + LM = PN + MN$

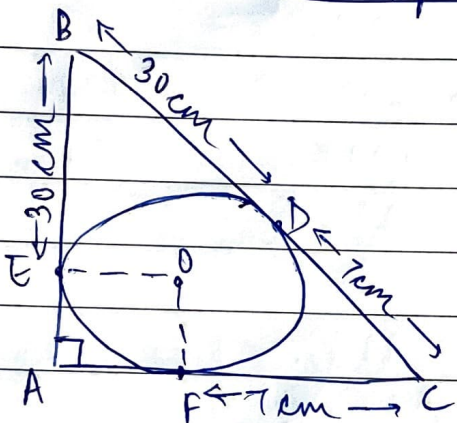
Proof - Since, tangents from an external point are equal.
 $PA = PB$, $LA = LM$, $NB = NM$ — (1)

$$P_A = P_B$$

$$\Rightarrow \underline{PL + LA = PN + NB}$$

$$\Rightarrow \boxed{PL + LM = PN + NM} \quad (LA = LM, NB = NM)$$

Hence, proved



Given - BDC is a tangent to a circle with centre O,
BD = 30 cm, CD = 7 cm. BA & AC are tangents
 ΔBAC is a right Δ .

To find - (i) AF (ii) Radius

Solution - join OE & OF.

$$OE = OF = \text{radius}$$

DE LAB & OF LAC (Tangent is perpendicular to the radius through the point of contact)
 $\therefore$ O EAF is a square

$\therefore$ DEAF is a square

Since, tangents from an external point are equal,

$\therefore BE = BD = 30 \text{ cm}, CD = CF = 7 \text{ cm}$

Also, $OF = OE = AF = AE = \text{radius}$

$$\therefore AB = 30 + x$$

$$BC = 30 + 7$$

$$AC = 7 + q$$

$\approx 37 \text{ cm}$

In right $\triangle ABC$,

$$BC^2 = AB^2 + AC^2$$

$$(37)^2 = (30+x)^2 + (7+x)^2$$

$$1369 = 900 + x^2 + 60x + 49 + x^2 + 14x$$

$$2x^2 + 74x - 1369 + 949 = 0$$

$$2x^2 + 74x - 420 = 0$$

$$x^2 + 37x - 210 = 0$$

$$x^2 + 42x - 5x - 210 = 0$$

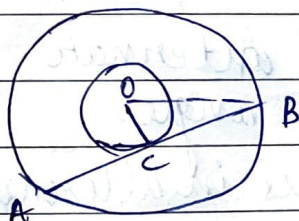
$$x(x+42) - 5(x+42) = 0$$

$$(x+42)(x-5) = 0$$

$$x = -42 \text{ (Neglected)}, \boxed{x = 5}$$

$$\therefore \boxed{x = 5 \text{ cm}} \text{ and } \boxed{AF = x = 5 \text{ cm}}$$

Q.30



Let AB be a chord of a circle which touches the other circle at C.

As AB is a tangent for the other circle,

$\therefore \triangle OCB$ is a right $\triangle$. (Tangent is perpendicular to the radius through the point of contact)

In $\triangle OCB$,

$$OC^2 + CB^2 = OB^2$$

$$\left(\frac{1}{2}d_1\right)^2 + \left(\frac{1}{2}c\right)^2 = \left(\frac{1}{2}d_2\right)^2$$

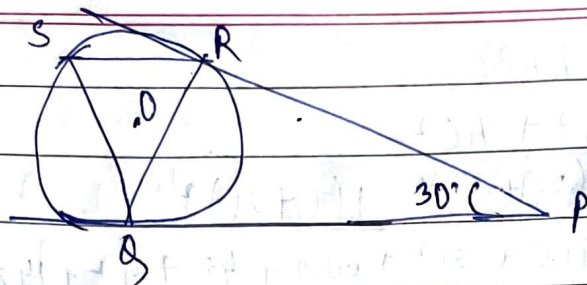
$$\frac{1}{4}d_1^2 + \frac{1}{4}c^2 = \frac{1}{4}d_2^2$$

(Pythagoras theorem)

$$\frac{1}{4}(d_1^2 + c^2) = \frac{1}{4}(d_2^2)$$

$$\therefore \boxed{d_2^2 = d_1^2 + c^2}$$

Q. 31



Given - PQ & PR are tangents. $\angle RPQ = 30^\circ$. Chord $RS \parallel PQ$.

To find - $\angle RQS$

Solution - Since tangents from an external point are equal, $\therefore PR = PQ$

$\Rightarrow \angle PRQ = \angle PQR$ (equal $\angle$ s opp. to equal sides)

$\therefore \angle PRQ + \angle PQR + \angle RPQ = 180^\circ$

$2\angle PRQ = 180^\circ - 30^\circ$

$\angle PRQ = 75^\circ$

} Angle sum prop. of Δ

$\therefore \angle PRQ = \angle PQR = 75^\circ$

$\angle QRS = \angle PQR = 75^\circ$

} Alternate angles

$\angle QSR = \angle QRS$ (Angles in alternate segment)

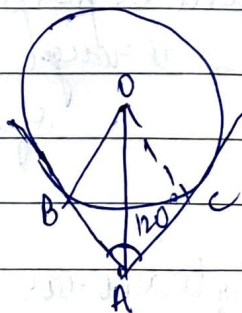
$\therefore \angle QSR + \angle QRS + \angle RQS = 180^\circ$

$\angle RQS = 180^\circ - 150^\circ$

$\angle RQS = 30^\circ$

} Angle sum prop. of Δ

Q. 32



Given - AB & AC are tangents. $\angle BAC = 120^\circ$

To prove - $OA = 2AB$

Proof - In ΔOAB & ΔOAC ,

$\angle OBA = \angle OCA = 90^\circ$ (Tangent is perpendicular to the radius through the point of contact)

$$OA = OA \text{ (Common)}$$

$$OB = OC \text{ (radii)}$$

$$\therefore \triangle OAB \cong \triangle OAC \text{ (RHS congruency)}$$

$$\therefore \angle OAB = \angle OAC = 60^\circ \text{ (C.P.C.T)}$$

In right $\triangle OAB$

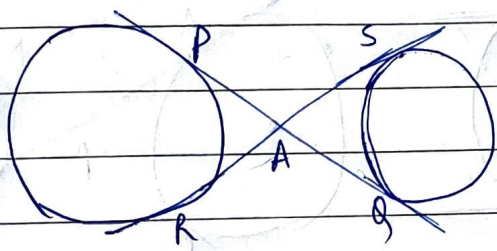
$$\cos 60^\circ = \frac{AB}{OA}$$

$$OA$$

$$\Rightarrow \frac{1}{2} = \frac{AB}{OA}$$

$$\Rightarrow \boxed{OA = 2AB}$$

Hence, proved



Given - Two common tangents PQ & RS intersect at A.

To prove - $PQ = RS$

Proof - Since tangents from external point are equal,

$$\therefore AP = AR \text{ --- (1)}$$

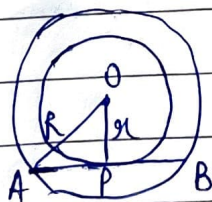
$$AQ = AS \text{ --- (2)}$$

Add (1) & (2),

$$AP + AQ = AR + AS$$

$$\Rightarrow \boxed{PQ = RS}$$

Hence, proved



AB is the ~~the~~ chord of outer circle and tangent to inner circle.

Let R and r be the radius of outer & inner circle respectively.

$OP \perp AB$ (Tangent is perpendicular to radius through the point of contact)

$$OA = R \text{ \& } OP = r$$

$$OA = \frac{30}{2} = 15 \text{ cm}, \quad OP = \frac{18}{2} = 9 \text{ cm}$$

$$\begin{aligned} AP &= \sqrt{OA^2 - OP^2} = \sqrt{15^2 - 9^2} \\ &= \sqrt{225 - 81} = \sqrt{144} \\ &= \boxed{12 \text{ cm}} \end{aligned}$$

$$\therefore AB = 2AP = 12 \times 2 = \boxed{24 \text{ cm}}$$