CHAPTER

8 CIRCLES

Syllabus

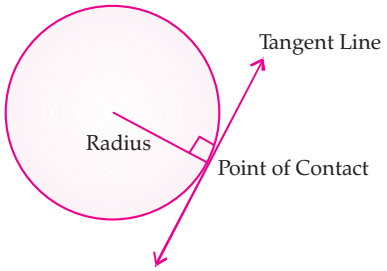
- *Tangent to a circle at point of contact.*
  1. *(Prove) The tangent at any point of a circle is perpendicular to the radius through the point of contact.*
  2. *(Prove) The lengths of tangents drawn from an external point to a circle are equal.*

Chapter Analysis

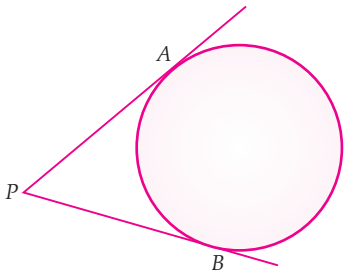
List of Topics	2016			2017			2018
	Delhi	Outside Delhi	Foreign	Delhi	Outside Delhi	Foreign	Delhi & Outside Delhi
Tangent to circle	1 Q (1 M) 2 Q (2 M) 2 Q (4 M)	1 Q (1 M) 2 Q (2 M) 1 Q (4 M)	1 Q (1 M) 2 Q (2 M) 2 Q (4 M)	1 Q (3 M) 2 Q (2 M) 1 Q (4 M)	1 Q (1 M) 2 Q (2 M) 1 Q (4 M)	1 Q (1 M) 1 Q (4 M) 1 Q (2 M)	
Question based on properties of tangent		1 Q (4 M)			1 Q (4 M)	2 Q (3 M)	1 Q (3 M)

Revision Notes

- A tangent to a circle is a line that intersects the circle at one point only.
- The common point of the circle and the tangent is called the point of contact.
- The length of the segment of the tangent from the external point P and the point of contact with the circle is called the length of the tangent.
- A tangent to a circle is a special case of the secant when the two end points of the corresponding chord are coincide.
- There is no tangent to a circle passing through a point lying inside the circle.
- There are exactly two tangents to a circle through a point outside the circle.
- At any point on the circle there can be one and only one tangent.
- The tangent at any point of a circle is perpendicular to the radius through the point of contact.



- The lengths of the tangents drawn from an external point to a circle are equal.



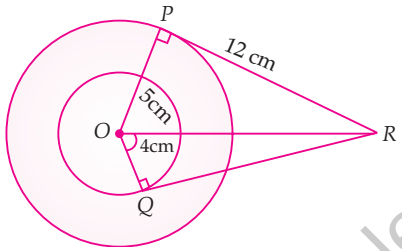
In the figure, $PA = PB$.

Know the Facts

- The word 'tangent' comes from the Latin word 'tangere', which means to touch and was introduced by the Danish mathematician **Thomas Fincke** in 1583.
- The line containing the radius through the point of contact is also called the 'normal' to the circle at that point.
- In two concentric circles, the chord of the larger circle, which touches the smaller circle, is bisected at the point of contact.

How it is done on GREENBOARD ?

Q.



In the given figure if PR = 12 cm, OP = 5 cm and OQ = 4 cm, find RQ.

Sol. Step I : $OP \perp RP$ (as radius is $\perp$ to tangent at point of contact)

In right triangle OPR,

$OR^2 = OP^2 + PR^2$

$OR^2 = 5^2 + 12^2$

$OR^2 = 25 + 144$

$OR^2 = 169$

or, $OR = \sqrt{169} = 13$

Step II : Similarly, in right triangle OQR,

$OR^2 = OQ^2 + QR^2$

$QR^2 = OR^2 - OQ^2$

$QR^2 = 13^2 - 4^2$

or, $(QR)^2 = 169 - 16$

$QR^2 = 153$

or, $QR = \sqrt{153}$ cm. $= 3\sqrt{17}$ cm

Objective Type Questions (1 mark each)

[A] Multiple Choice Questions :

Q. 1. If the radii of two concentric circles are 4 cm and 5 cm, then the length of each chord of one circle which is the tangent to the other circle is :

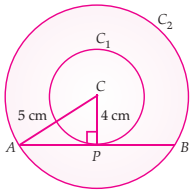
(a) 3 cm **(b) 6 cm**

(c) 9 cm **(d) 1 cm**

C [NCERT Exemp.]

Sol. Correct option : (b)

Explanation : Let C_1, C_2 be two concentric circles with their centre C.



Chord AB of circle C_2 touches C_1 at P

AB is tangent at P and PC is radius

$\therefore$ $CP \perp AB$

Given, $\angle P = 90°$, $CP = 4$ cm and $CA = 5$ cm

$\therefore$ In right angle ΔPAC,

$AP^2 = AC^2 - PC^2$

$= 5^2 - 4^2$

$= 25 - 16$

$= 9$

$\Rightarrow$ $AP = 3$ cm

$\because$ Perpendicular from centre to chord bisects the chord.

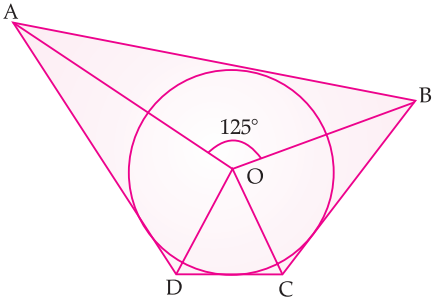
$\therefore$ $AB = 2AP$

$= 2 \times 3$

$= 6$ cm.

Q. 2. In the given figure, if $\angle AOB = 125°$, then $\angle COD$ is equal to :

(a) 62.5° **(b) 45°**
(c) 35° **(d) 55°**



U + R **[NCERT Exemp.]**

Sol. Correct option : (d)

Explanation : Since, quadrilateral circumscribing a circle subtends supplementary angles at the centre of the circle.

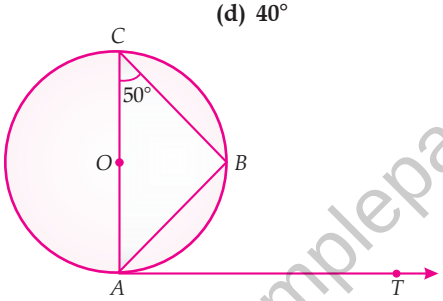
$\therefore \quad \angle AOB + \angle COD = 180°$

$125° + \angle COD = 180°$

$\angle COD = 180° - 125° = 55°$

Q. 3. In the given figure, *AB* is a chord of the circle and *AOC* is its diameter, such that $\angle ACB = 50°$. If *AT* is the tangent to the circle at the point A, then $\angle BAT$ is equal to :

(a) 65° **(b) 60°**
(c) 50° **(d) 40°**



U **[NCERT Exemp.]**

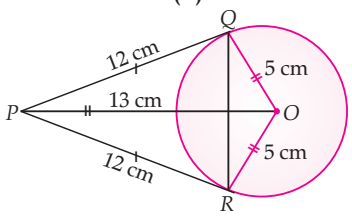
Sol. Correct option : (c)

Explanation : Since, the angle between chord and tangent is equal to the angle subtended by the same chord in alternate segment of circle.

$\Rightarrow \qquad \angle BAT = 50°.$

Q. 4. From a point *P* which is at a distance of 13 cm from the centre *O* of a circle of radius 5 cm, the pair of tangents *PQ* and *PR* to the circle are drawn. Then the area of the quadrilateral *PQOR* is :

(a) 60 cm^2 **(b) 65 cm^2**
(c) 30 cm^2 **(d) 32.5 cm^2**



C + U **[NCERT Exemp.]**

Sol. Correct option : (a)

Explanation : *PQ* is tangent and *QO* is radius at contact point *Q*.

$\therefore \angle PQO = 90°$

$\therefore$ By Pythagoras theorem,

$PQ^2 = OP^2 - OQ^2$

$= 13^2 - 5^2 = 169 - 25 = 144$

$\Rightarrow \quad PQ = 12$ cm

$\therefore \quad \Delta OPQ \cong \Delta OPR$ [*SSS* congruence]

$\therefore$ Area of ΔOPQ = area of ΔOPR

[Since, congruent figures are equal in areas]

Area of quadrilateral $QORP$ = 2 area of ΔOPR

$= 2 \times \frac{1}{2}$ base $\times$ height

$= RP \times OR$

$= 12 \times 5$

$= 60$ cm^2

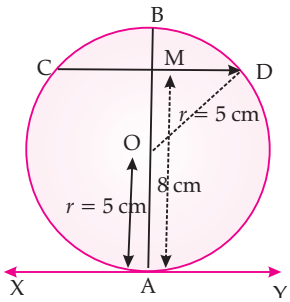
Q. 5. At one end *A* of diameter *AB* of a circle of radius 5 cm, tangent *XAY* is drawn to the circle. The length of the chord *CD* parallel to *XY* and at a distance 8 cm from *A* is :

(a) 4 cm **(b) 5 cm**
(c) 6 cm **(d) 8 cm**

C + U **[NCERT Exemp.]**

Sol. Correct option : (d)

Explanation : *XAY* is tangent and *AO* is radius at contact point *A* of circle.



$AO = 5$ cm

$\therefore \angle OAY = 90°$

CD is another chord at distance (perpendicular) of 8 cm from *A* and *CMD* || *XAY* meets *AB* at *M*.

Join *OD*.

$OD = 5$ cm

$OM = 8 - 5 = 3$ cm

$\angle OMD = \angle OAY = 90°$

Now, in right angled ΔOMD

$MD^2 = OD^2 - MO^2$

$= 5^2 - 3^2$

$= 25 - 9$

$= 16$

$\Rightarrow \quad MD = 4$ cm

We know that, Perpendiculars from centre *O* of circle bisect the chord.

$\therefore \quad CD = 2MD$

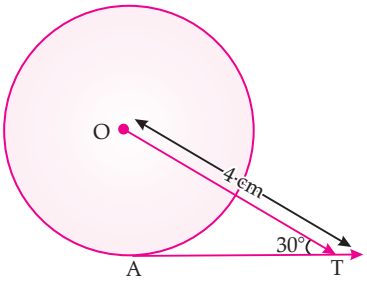
$= 2 \times 4$

$= 8$ cm.

Hence, length of chord, $CD = 8$ cm.

Q. 6. In the given figure, *AT* is a tangent to the circle with centre '*O*' such that *OT* = 4 cm and $\angle OTA = 30°$. Then *AT* is equal to :

(a) 4 cm **(b) 2 cm**
(c) $2\sqrt{3}$ cm **(d) $4\sqrt{3}$ cm**



C [NCERT Exemp.]

Sol. Correct option : (c)

Explanation : Join OA. OA is radius and AT is tangent at contact point A.

$\therefore \quad \angle OAT = 90°$,

Given that, $OT = 4$ cm

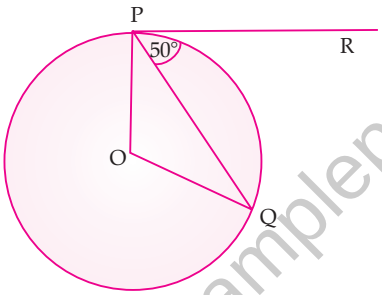
Now, $\dfrac{AT}{4} = \dfrac{\text{base}}{\text{hypotenuse}} = \cos 30°$

$\Rightarrow \quad AT = 4 \times \dfrac{\sqrt{3}}{2} = 2\sqrt{3}$ cm.

Q. 7. In the given figure, '*O*' is the centre of circle, *PQ* is a chord and the tangent *PR* at *P* makes an angle of 50° with *PQ*, then $\angle POQ$ is equal to :

(a) 100° **(b) 80°**

(c) 90° **(d) 75°**



U [NCERT Exemp.]

Sol. Correct option : (a)

Explanation : OP is radius and PR is tangent at P.

So, $\angle OPR = 90°$

$\Rightarrow \angle OPQ + 50° = 90°$

$\Rightarrow \quad \angle OPQ = 90° - 50°$

$\Rightarrow \quad \angle OPQ = 40°$

In ΔOPQ,

$OP = OQ$ [Radii of same circle]

$\therefore \angle Q = \angle OPQ = 40°$

[Angle opposite to equal sides are equal]

But, $\angle POQ = 180° - \angle P - \angle Q$

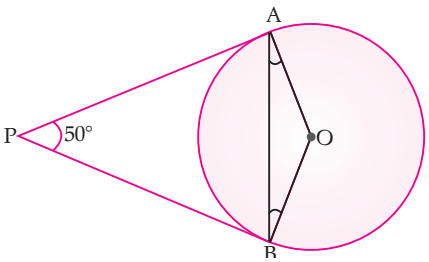
$= 180° - 40° - 40° = 180° - 80° = 100°$

$\Rightarrow \quad \angle POQ = 100°$.

Q. 8. In the given figure, if *PA* and *PB* are tangents to the circle with centre *O* such that $\angle APB = 50°$, then $\angle OAB$ is equal to :

(a) 25° **(b) 30°**

(c) 40° **(d) 50°**



U [NCERT Exemp.]

Sol. Correct option : (a)

Explanation : In ΔOAB, we have

$OA = OB$ [Radii of same circle]

$\therefore \angle OAB = \angle OBA$ [Angle opposite to equal sides are equal]

As OA and PA are radius and tangent respectively at contact point A.

So, $\angle OAP = 90°$.

Similarly, $\angle OBP = 90°$

Now, in quadrilateral $PAOB$,

$\angle P + \angle A + \angle O + \angle B = 360°$

$\Rightarrow 50° + 90° + \angle O + 90° = 360°$

$\Rightarrow \quad \angle O = 360° - 90° - 90° - 50°$

$\Rightarrow \quad \angle O = 130°$

Again, in ΔOAB,

$\angle O + \angle OAB + \angle OBA = 180°$

$\Rightarrow 130° + \angle OAB + \angle OAB = 180°$ [$\because \angle OBA = \angle OAB$]

$\Rightarrow \quad 2\angle OAB = 180° - 130° = 50°$

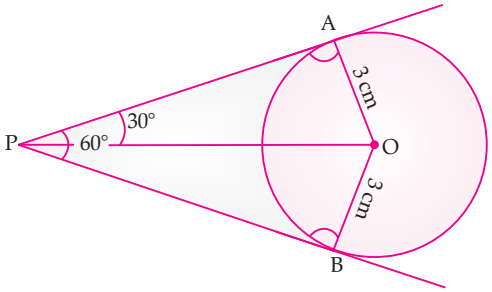
$\Rightarrow \quad \angle OAB = 25°$

Hence, $\angle OAB = 25°$

Q. 9. If two tangents inclined at an angle 60° are drawn to a circle of radius 3 cm, then the length of each tangent is equal to :

(a) $\dfrac{3}{2}\sqrt{3}$ cm **(b) 6 cm**

(c) 3 cm **(d) $3\sqrt{3}$ cm**



U [NCERT Exemp.]

Sol. Correct option : (d)

Explanation : Let, OA and PA be the radius and the tangent, respectively at contact point A of a circle of radius $OA = 3$ cm.

$\therefore \quad \angle PAO = 90°$

In right angled ΔPOA,

$\tan 30° = \dfrac{\text{Perpendicular}}{\text{Base}} = \dfrac{OA}{PA}$

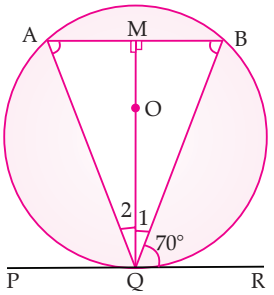
$\Rightarrow \quad \dfrac{1}{\sqrt{3}} = \dfrac{3}{PA}$

$\Rightarrow \quad PA = 3\sqrt{3}$

Q. 10. In the given figure, if *PQR* is the tangent to a circle at *Q*, whose centre is *O*, *AB* is a chord parallel to *PR* and $\angle BQR = 70°$, then $\angle AQB$ is equal to :

(a) 20° **(b) 40°**

(c) 35° **(d) 45°**



A + U **[NCERT Exemp.]**

Sol. Correct option : (b)

Explanation : Given that $AB \parallel PQR$

$\angle B = \angle BQR = 70°$ [Alternate interior angles]

$\angle OQR = \angle AMQ$ [Alternate interior angles]

As PQR and OQ are tangent and radius at contact point Q

$\therefore \quad \angle OQR = 90°$

$\Rightarrow \angle 1 + \angle 70° = 90°$

$\Rightarrow \quad \angle 1 = 90° - 70° = 20°$

$\therefore \quad \angle AMO = 90°$

$\because$ Perpendicular from centre to chord bisect the chord

$\therefore \quad MA = MB$

$\angle QMA = \angle QMB = 90°$

$MQ = MQ$ [Common]

$\therefore \Delta QMA \cong \Delta QMB$ [SAS congruence]

$\Rightarrow \quad \angle A = \angle B$

$\Rightarrow \quad \angle A = 70°$ [$\because \angle B = 70°$]

$\therefore \angle A + \angle AMQ + \angle 2 = 180°$

[Angle sum property of a triangle]

$\Rightarrow 70° + 90° + \angle 2 = 180°$

$\Rightarrow \quad \angle 2 = 180° - 160°$

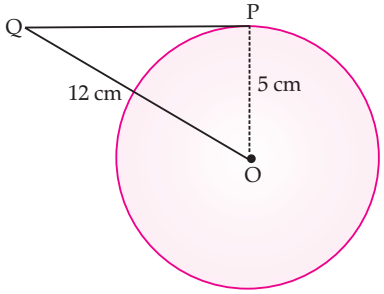
$\Rightarrow \quad \angle 2 = 20°$

$\therefore \quad \angle AQB = \angle 1 + \angle 2 = 20° + 20° = 40°$

Q. 11. A tangent *PQ* at a point *P* of a circle of radius 5 cm meets a line through the centre *O* at a point *Q* so that *OQ* = 12 cm. Length *PQ* is :

(a) 12 cm **(b) 13 cm**

(c) 8.5 cm **(d) $\sqrt{119}$ cm.**



A + U **[NCERT Exemp.]**

Sol. Correct option : (d)

Explanation : We know that the radius is perpendicular to tangent

In ΔOPQ, we have $\angle P = 90°$

By Pythagoras Theorem,

$OQ^2 = PQ^2 + OP^2$

$(12)^2 = PQ^2 + (5)^2$

$\Rightarrow 144 = PQ^2 + 25$

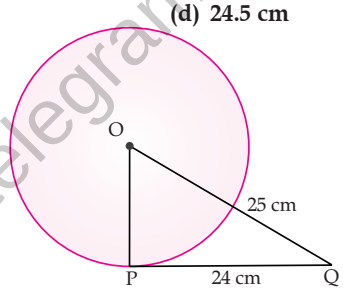
$\Rightarrow PQ^2 = 144 - 25 = 119$

$\Rightarrow PQ = \sqrt{119}$ cm.

Q. 12. From a point *Q*, the length of the tangent to a circle is 24 cm and the distance of *Q* from the centre is 25 cm. The radius of the circle is :

(a) 7 cm **(b) 12 cm**

(c) 15 cm **(d) 24.5 cm**



A + U **[NCERT Exemp.]**

Sol. Correct option : (a)

Explanation : Let O be the centre of the circle.

Given that, $OQ = 25$ cm and $PQ = 24$ cm

We know that the radius is perpendicular to the tangent at the point of contact,

$\therefore OP \perp PQ$

In ΔOPQ, we have

By Pythagoras theorem,

$OP^2 + PQ^2 = OQ^2$

$OP^2 + 24^2 = 25^2$

$OP^2 + 576 = 625$

$OP^2 = 625 - 576$

$OP^2 = 49$

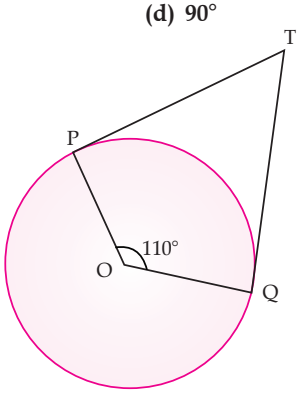
$OP = 7$ cm

Therefore, the radius of the circle is 7 cm.

Q. 13. In the given figure, if *TP* and *TQ* are the two tangents to a circle with centre *O* so that $\angle POQ = 110°$, then $\angle PTQ$ is equal to :

(a) 60° **(b) 70°**

(c) 80° **(d) 90°**



A + U **[NCERT Exemp.]**

Sol. Correct option : (b)

Explanation: Given that, TP and TQ are tangents,

We know that the radius drawn to the tangents will be perpendicular.

$\therefore \quad OP \perp TP$

and $OQ \perp TQ$

$\angle OPT = 90^\circ$

$\angle OQT = 90^\circ$

In quadrilateral $POQT$,

Sum of all interior angles = 360°

$$\angle OPT + \angle POQ + \angle OQT + \angle PTQ = 360^\circ$$

$$90^\circ + 110^\circ + 90^\circ + \angle PTQ = 360^\circ$$

$$\angle PTQ = 70^\circ$$

Q. 14. If tangents PA and PB from a point P to a circle with centre O are inclined to each other at angle of 80°, then $\angle POA$ is equal to :

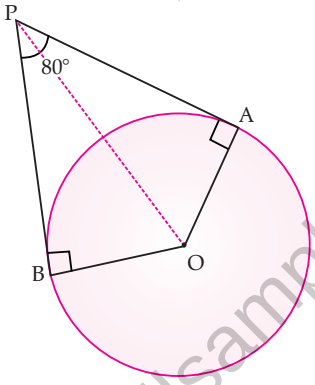
(a) 50° **(b) 60°**

(c) 70° **(d) 80°**

A + U **[NCERT Exemp.]**

Sol. Correct option : (a)

Explanation : Given that, PA and PB are tangents.



We know that the radius drawn to the tangents are perpendicular,

$\therefore \quad OA \perp PA$

and $OB \perp PB$

$\angle OBP = 90^\circ$

$\angle OAP = 90^\circ$

In $AOBP$, we have

Sum of all angles = 360°

$$\angle OAP + \angle APB + \angle PBO + \angle BOA = 360^\circ$$

$$90^\circ + 80^\circ + 90^\circ + \angle PTQ = 360^\circ$$

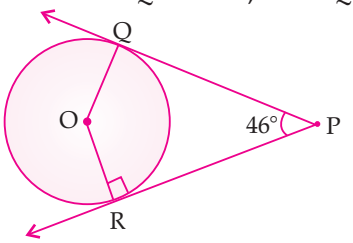
$$\angle BOA = 100^\circ$$

In ΔOPA and ΔOPB we have

$AP = BP$	[Tangents from same point]
$OA = OB$	[Radii]
$OP = OP$	[Common side]
$\Delta OPB \cong \Delta OPA$	[SSS congruency]
$\angle POB = \angle POA$	[$cpct$]

$$\angle POA = \frac{1}{2}\angle AOB = \frac{100}{2} = 50^\circ$$

Q. 15. In figure PQ and PR are two tangents to a circle with centre O. If $\angle QPR = 46^\circ$, then $\angle QOR$ equals :



(a) 67° **(b) 134°**

(c) 44° **(d) 46°**

A + U **[Board Term- 2, Set-I, 2014]**

Sol. Correct option : (b)

Explanation : In Quadrilateral $PQOR$,

$$\angle QPR + \angle PRO + \angle QOR + \angle PQO = 360^\circ$$

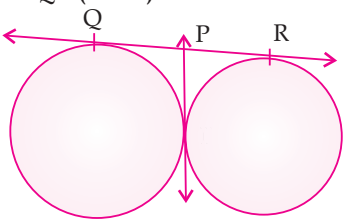
$$46^\circ + 90^\circ + \angle QOR + 90^\circ = 360^\circ$$

$$[\because \angle PRO = \angle PQO = 90^\circ]$$

$$\angle QOR = 360^\circ - 226^\circ$$

$$\angle QOR = 134^\circ.$$

Q. 16. In figure, OR is common tangent to the given circles, touching externally at the point T. The tangent at T meets QR at P. If $PT = 3.8$ cm, then the length of QR (in cm) is :



(a) 3.8 **(b) 7.6**

(c) 5.7 **(d) 1.9**

A + U **[Board term 2, Set- I, 2014]**

Sol. Correct option : (b)

Explanation : Since,

$QP = PT = 3.8$ cm ($\because$ tangents of circle)

and $PR = PT = 3.8$ cm ($\because$ tangents of circle)

$\therefore \quad QP = PR = 3.8$ cm

$QR = QP + PR$

$= 3.8 + 3.8$

$= 7.6$

Q. 17. Two circles touch each other externally at P. AB is a common tangent to the circles touching them at A and B. The value of $\angle APB$ is :

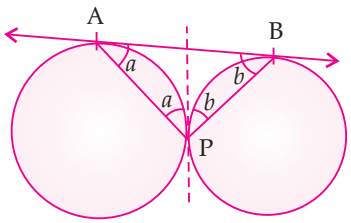
(a) 30° **(b) 45°**

(c) 60° **(d) 90°**

A + U **[Board term-2, Foreign Set- 1, 2014]**

Sol. Correct option : (d)

Explanation :



$\because$ $\angle APB = (a + b)$

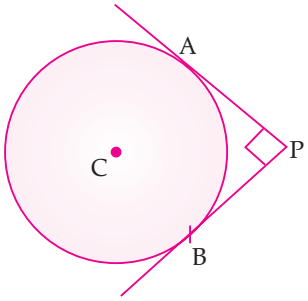
$\angle BAP + \angle APB + \angle BPA = 180°$

$a + (a + b) + b = 180°$

$2(a + b) = 180° \Rightarrow a + b = 90°$

So, $\angle APB = 90°$.

Q. 18. In figure, *PA* and *PB* are two tangents drawn from an external point *P* to a circle with centre *C* and radius 4 cm. If *PA* ⊥ *PB*, then the length of each tangent is :



(a) 3 cm **(b) 4 cm**

(c) 5 cm **(d) 6 cm**

A + U **[Board Term 2 Set I, 2013]**

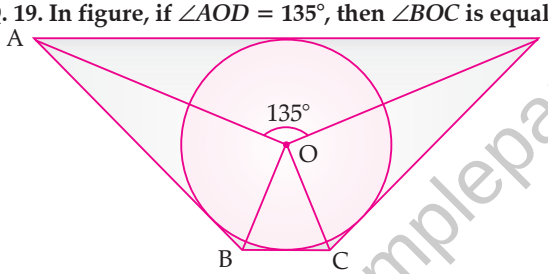
Sol. Correct option : (b)

Explanation : *CAPB* will be a square

$CA = AP = PB = BC = 4$cm

Length of tangent = 4cm

Q. 19. In figure, if ∠*AOD* = 135°, then ∠*BOC* is equal to :



(a) 52.5° **(b) 45°**

(c) 62.5° **(d) 25°**

A + U **[Board comptt., Term-2, Set I, 2013]**

Sol. Correct option : (b)

Explanation :

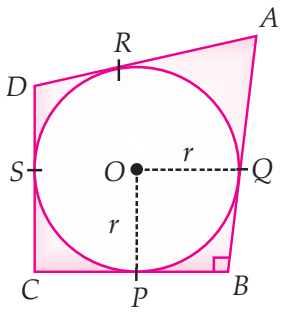
$\angle AOD + \angle BOC = 180°$(vertically opposite angles)

$135° + \angle BOC = 180°$

$\angle BOC = 180° - 135°$

$= 45°$.

Q. 20. In figure, a circle with centre *O* is inscribed in a quadrilateral *ABCD* such that, it touches the sides *BC*, *AB*, *AD* and *CD* at points *P*, *Q*, *R* and *S* respectively. If *AB* = 29 cm, *AD* = 23 cm, ∠*B* = 90° and *DS* = 5 cm, then the radius of the circle (in cm.) is :



(a) 11 **(b) 18**

(c) 6 **(d) 15**

[NCERT Exp.]

Sol. Correct option : (a)

Explanation : Since $DS = DR = 5$ cm

(tangents of a circle from same external point)

Now, $AR = AD - DR$

$= 23 - 5 = 18$ cm

Similarly, $AR = AQ = 18$ cm (tangents)

Now, $QB = AB - AQ$

$= 29 - 18 = 11$ cm

Similarly, $QB = PB = 11$ cm

Given, $\angle B = 90°$

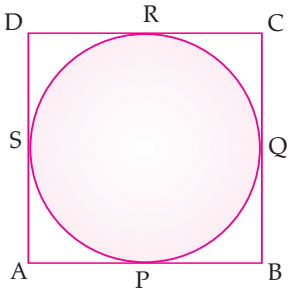
So, $\angle POQ = 90°$

Hence, *OQBP* is square

$\because$ $QB = 11$ cm

$\therefore$ Side of square = 11 cm, so the radius = 11 cm.

Q. 21. If figure, a quadrilateral *ABCD* is drawn to circumscribe a circle such that its sides *AB*, *BC*, *CD* and *AD* touch the circle at *P*, *Q*, *R* and *S* respectively. If *AB* = *x* cm, *BC* = 7 cm, *CR* = 3 cm and *AS* = 5 cm, find *x* :



(a) 10 **(b) 9**

(c) 8 **(d) 7** A + U

Sol. Correct option : (c)

Explanation :

$AS = AP = 5$ cm

$BP = BQ, BQ + CQ = BC = 7$ cm

$BQ = 7 - 3 = 4$ cm $\Rightarrow BP = 4$ cm

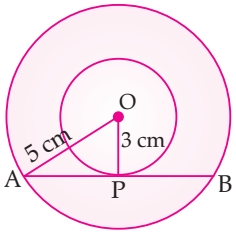
$AB = x, AP + BP = x \Rightarrow 5 + 4 = x \Rightarrow x = 9$.

Q. 22. Two concentric circles are of radii 5 cm and 3 cm. Length of the chord of the larger circle, (in cm), which touches the smaller circle is :

(a) 4 **(b) 5**

(c) 8 **(d) 10** A + U

Sol.



Correct option : (c)

Explanation : In ΔAOP,

Applying Pythagoras Theorem,

$AO^2 = OP^2 + AP^2$

$(5)^2 = (3)^2 + (AP)^2$

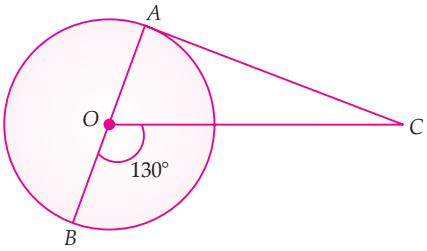
$AP^2 = 25 - 9$

$AP = \sqrt{16} = 4 = PB$

$AB = 4 + 4 = 8$ cm.

[B] Very Short Answer Type Questions :

Q. 1. In the given figure, *AOB* is a diameter of the circle with centre *O* and *AC* is a tangent to the circle at A. If $\angle BOC = 130°$, then find $\angle ACO$.



U [Foreign Set I, II, III, 2016]

Sol. $\angle OAC = 90°$ (as radius $\perp$ tangent)

$\angle BOC = \angle OAC + \angle ACO$

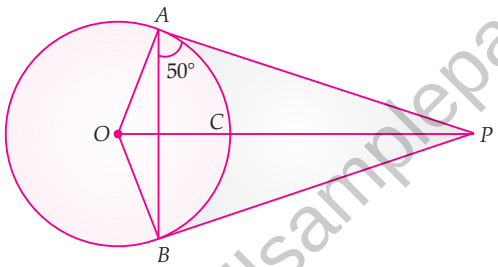
(Exterior angle property)

or, $130° = 90° + \angle ACO$

or, $\angle ACO = 130° - 90° = 40°$ **1**

Q. 2. From an external point *P*, tangents *PA* and *PB* are drawn to a circle with centre *O*. If $\angle PAB = 50°$, then find $\angle AOB$. U [Delhi Set I, II, III, 2016]

Sol.



Here, $\angle OAB = 90° - 50°$

$= 40°$ ($\because$ $PA \perp OA$)

$\angle OAB = \angle OBA = 40°$

($\because$ OA and OB are radii)

$\therefore$ $\angle AOB + 40° + 40° = 180°$

$\angle AOB = 180° - 80° = 100°$

Hence $\angle AOB = 100°$ **1**

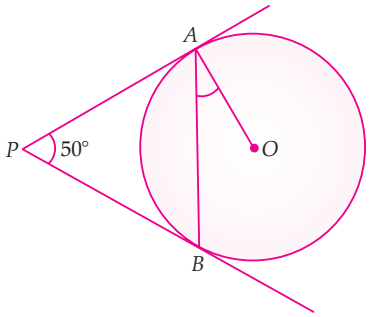
Q. 3. What is the maximum number of parallel tangents a circle can have on a diameter ?

R [Board Term-2, 2012 Set (34)]

Sol. Since, tangent touches a circle on a distinct point. On the diameter of a circle only two parallel tangents can be drawn.

[CBSE Marking Scheme, 2012] **1**

Q. 4. In fig., *PA* and *PB* are tangents to the circle with centre O such that $\angle APB = 50°$. Write the measure of $\angle OAB$. A [Delhi CBSE Board, 2015, Set I, II, III]



Sol. Here, $\angle APB = 50°$

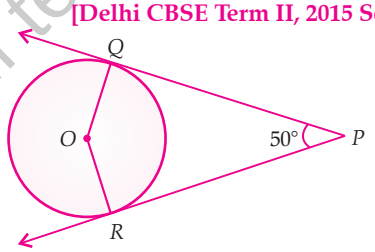
$\angle PAB = \angle PBA = \dfrac{180° - 50°}{2} = 65°$

$\angle OAB = 90° - \angle PAB$

$= 90° - 65° = 25°$

[CBSE Marking Scheme, 2015] **1**

Q. 5. In the given figure, *PQ* and *PR* are tangents to the circle with centre *O* such that $\angle QPR = 50°$, then find $\angle OQR$. A [Board Term-2, 2012 Set (31)] [Delhi CBSE Term II, 2015 Set I, II, III]



Sol. $\angle QPR = \angle 50°$ (Given)

$\angle QOR + \angle QPR = 180°$

(Supplementary angles)

$\therefore$ $\angle QOR = 180° - 50° = 130°$ ½

From ΔOQR

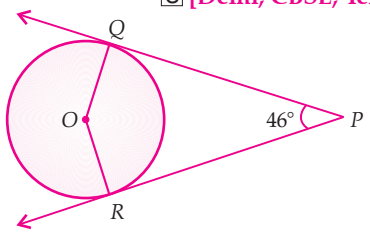
or, $\angle OQR = \angle ORQ = \dfrac{180° - 130°}{2}$

$= \dfrac{50°}{2} = 25°$ ½

[CBSE Marking Scheme, 2015]

Q. 6. If *PQ* and *PR* are two tangents to a circle with centre *O*. If $\angle QPR = 46°$, find $\angle QOR$.

U [Delhi, CBSE, Term-2, 2014]



Sol. Since, $\angle QOR + \angle QPR = 180°$

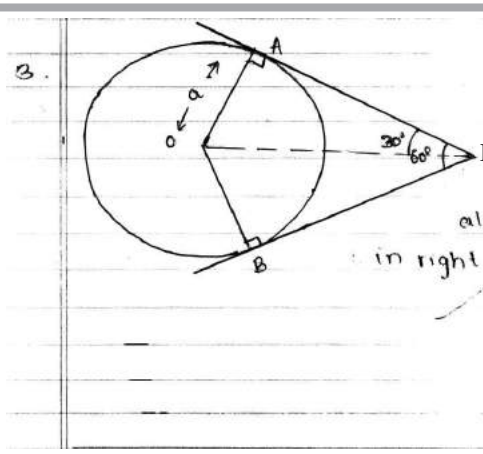
(Supplementary angles)

or, $\angle QOR + 46° = 180°$

or, $\angle QOR = 180° - 46° = 134°$. **1**

Q. 7. If the angle between two tangents drawn from an external point *P* to a circle of radius *a* and centre *O*, is 60°, then find the length of *OP*. [Outside Delhi Set I, II, III, 2017]

Sol.



Tangents are equally inclined to line joining the external point P to centre O.

$\therefore \angle APO = \angle BPO = \frac{60}{2} = 30°$

also radius ⊥ tangent at point of contact.

In right ΔOAP, $\angle APO = 30°$.

Now $\sin 30° = \frac{AO}{OP}$

$\frac{1}{2} = \frac{a}{OP}$ ... radius = a.

$OP = 2a$

[Topper Answer, 2017] **1**

Q. 8. If a circle can be inscribed in a parallelogram how will the parallelogram change ?

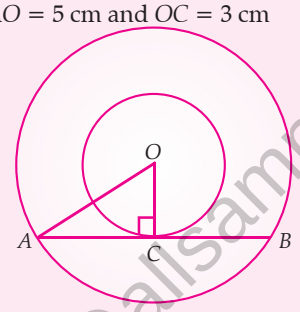
R [Board Term II, 2014]

Sol. It will change into a rhombus or a square. **1**

Q. 9. Two concentric circles are of radii 5 cm and 3 cm. Find the length of the chord of larger circle (in cm) which touches the smaller circle.

U [Foreign Set I, II, III, 2014]

Sol. Here, $AO = 5$ cm and $OC = 3$ cm



$AC = \sqrt{(5)^2 - (3)^2}$

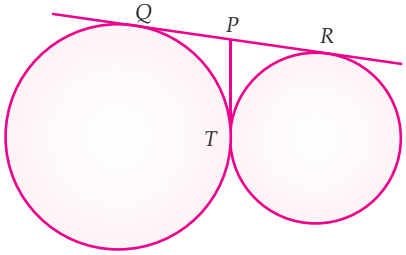
$= \sqrt{25-9} = \sqrt{16} = 4$ cm

Length of chord, $AB = 8$ cm. **1**

[CBSE Marking Scheme, 2012]

Q. 10. In the figure, *QR* is a common tangent to given circle which meet at *T*. Tangent at *T* meets *QR* at *P*. If *QP* = 3.8 cm, then find length of *QR*.

A [Delhi, Set 2014] [Board, Term-2, 2012 Set (44)]



Sol. $QP = 3.8$

$QP = PT$

(Length of tangents from external points are equal)

or, $PT = 3.8$ cm

$PR = PT = 3.8$ cm

or, $QR = QP + PR$

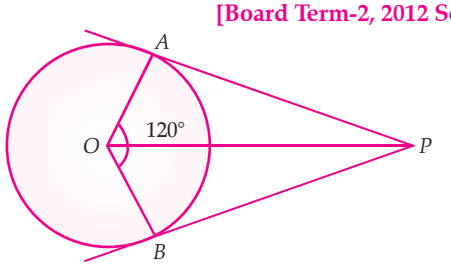
$= 3{\cdot}8 + 3{\cdot}8 = 7.6$ cm. **1**

[CBSE Marking Scheme, 2012]

Q. 11. In the figure, *PA* and *PB* are tangents to a circle with centre O. If $\angle AOB = 120°$, then find $\angle OPA$.

U [Delhi, Set 2014]

[Board Term-2, 2012 Set (44)]



Sol. In ΔAOP

$\angle AOP = \frac{120°}{2} = 60°$

$\angle APB = 90°$ (given)

$AP = BP$ (Tangents)

$\therefore \angle OAP = \angle OBP = 90°$

$\therefore \angle APO + \angle OAP + \angle AOP = 180°$

or, $\angle APO + 90° + 60° = 180°$

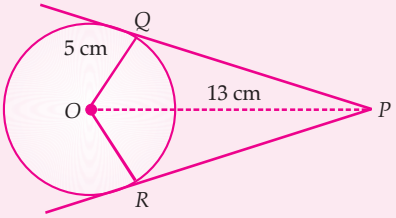
or, $\angle APO = 180° - 150° = 30°$. **1**

[CBSE Marking Scheme, 2012]

Q. 12. From a point *P*, which is at a distance of 13 cm from the centre *O* of a circle of radius 5 cm, the pair of tangents *PQ* and *PR* are drawn to the circle, then find the area of the quadrilateral *PQOR* (in cm^2).

A [Board Term-2, 2012 Set (31)]

Sol.



Length of tangent, $PQ = \sqrt{OP^2 - OQ^2}$

$= \sqrt{(13)^2 - (5)^2}$

$= \sqrt{169 - 25}$

$= \sqrt{144} = 12$ cm ½

Area of quadrilateral $PQOR$

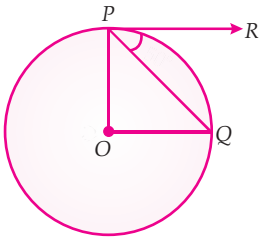
$= 2 \times \Delta POQ$

$=$ base $\times$ height

$= 12 \times 5 = 60$ cm^2. ½

[CBSE Marking Scheme, 2012]

Q. 13. If O is centre of a circle, PQ is a chord and the tangent PR at P makes an angle of 50° with PQ, find $\angle POQ$. U **[Board Term-2, 2012 Set (26)]**



Sol. $\because$ $\angle RPQ = 50°$

$\therefore$ $\angle OPQ = 90° - 50° = 40°$

Since, $OP = OQ$ (radii of circle)

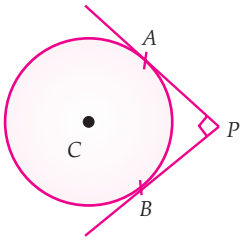
$\because$ $\angle OPQ = \angle OQP = 40°$

$\angle POQ = 180° - (40° + 40°)$

$= 100°$. **1**

[CBSE Marking Scheme, 2012]

Q. 14. In fig., PA and PB are two tangents drawn from an external point P to a circle with centre C and radius 4 cm. If $PA \perp PB$, then find the length of each tangent. U **[Board Term-2, 2013]**



Sol. Here, $CAPB$ will be a square

Then, $CA = AP = PB = BC = 4$ cm

$\therefore$ Length of tangent $= 4$ cm. **1**

Q. 15. What is the length of the tangent drawn from a point 8 cm away from the centre of a circle of radius 6 cm ? U **[Board Term-2, 2012 Set (22)]**

Sol. Length of the tangent $= \sqrt{d^2 - r^2}$

$= \sqrt{(8)^2 - (6)^2}$

$= \sqrt{64 - 36}$

$= \sqrt{28} = 2\sqrt{7}$ cm. **1**

[CBSE Marking Scheme, 2012]

Q. 16. If the angle between two radii of a circle is 130°, then what is the angle between the tangents at the end points of radii at their point of intersection ?

U **[Board Term II, 2012 Set (22)]**

Sol. Since, sum of the angles between radii and between intersection point of tangent is 180°.

Angle at the point of intersection of tangents

$= 180° - 130° = 50°$. **1**

[CBSE Marking Scheme, 2012]

Q. 17. To draw a pair of tangents to a circle which are inclined to each other at an angle of 30°, it is required to draw tangents at end points of two radii of the circle, what will be the angle between them ? R **[Board Term II, 2012 Set (31)]**

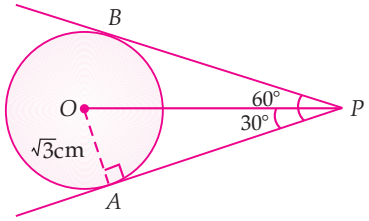
Sol. Angle between the radii $= 180° - 30° = 150°$

(Since the sum of opposite angles = 180°). **1**

[CBSE Marking Scheme, 2012]

Q. 18. Two tangents making an angle of 60° between them are drawn to a circle of radius $\sqrt{3}$ cm, then find the length of each tangent.

U **[Board, Term-2, 2013]**



Sol. Since, $\tan\theta = \dfrac{\text{Altitude}}{\text{Base}}$

So. $\tan 30° = \dfrac{OA}{AP}$

or, $\dfrac{1}{\sqrt{3}} = \dfrac{\sqrt{3}}{AP}$

or, $AP = \sqrt{3} \times \sqrt{3} = 3$ cm. **1**

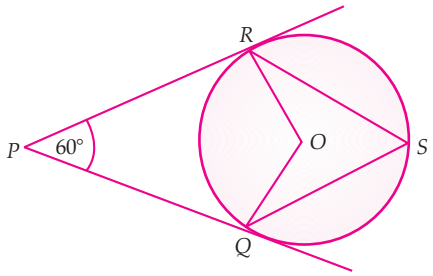
Q. 19. If a line intersects a circle in two distinct points, what is it called ? R **[Board Term-2, 2012 Set (17)]**

Sol. The line which intersects a circle in two distinct points is called secant. **1**

[CBSE Marking Scheme, 2012]

Q. 20. In the given figure, find $\angle QSR$.

U **[Board Term-2, 2012 Set (5)]**



Sol. $\angle ROQ = 180° - 60° = 120°$

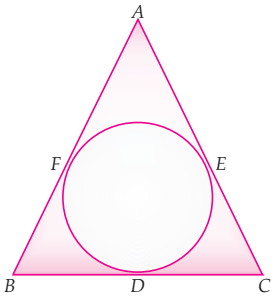
$\angle QSR = \frac{1}{2}\angle ROQ = \frac{1}{2} \times 120°$

(Angle subtended on the centre of a circle)

$= 60°$. **1**

[CBSE Marking Scheme, 2012]

Q. 21. A triangle *ABC* is drawn to circumscribe a circle. If *AB* = 13 cm, *BC* = 14 cm and *AE* = 7 cm, then find *AC*. U **[Board Term-2, 2012 Set (26)]**



Sol. $AF = AE = 7$ cm

(Tangents of the circle)

$\therefore$ $BF = AB - AF = 13 - 7 = 6$ cm

$BD = BF = 6$ cm

(Tangents of the circle)

$CD = BC - BD = 14 - 6 = 8$ cm

$CE = CD = 8$ cm

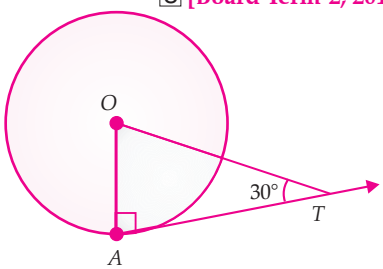
$\therefore$ $AC = AE + EC$

$= 7 + 8 = 15$ cm. **1**

[CBSE Marking Scheme, 2012]

Q. 22. In given figure, if *AT* is a tangent to the circle with centre *O*, such that *OT* = 4 cm and $\angle OTA = 30°$, then find the length of *AT* (in cm).

U **[Board Term-2, 2012 Set (13)]**



Sol. $\cos\theta = \frac{\text{Base}}{\text{Hypotenuse}}$

$\frac{AT}{OT} = \cos 30°$

$\therefore$ $AT = OT \cos 30°$

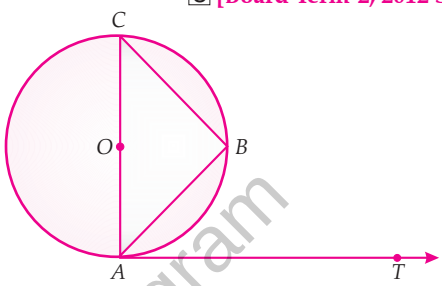
or, $AT = 4 \times \frac{\sqrt{3}}{2}$

$= 2\sqrt{3}$ cm. **1**

[CBSE Marking Scheme, 2012]

Q. 23. In the given figure, *AB* is a chord of the circle and *AOC* is its diameter such that $\angle ACB = 50°$. If AT is the tangent to the circle at the point A, find $\angle BAT$.

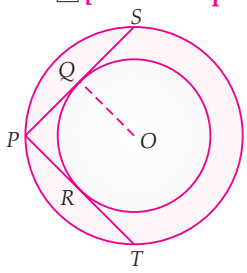
U **[Board Term-2, 2012 Set (32)]**



Sol. Try yourself, Similar to Q.No. 3 in MCQs.

Q. 24. In the fig. there are two concentric circles with centre *O*. *PRT* and *PQS* are tangents to the inner circle from a point *P* lying on the outer circle. If *PR* = 5 cm, find the length of *PS*.

U **[Delhi Compt. Set I, II, III 2017]**



Sol. $PQ = PR = 5$ cm ½

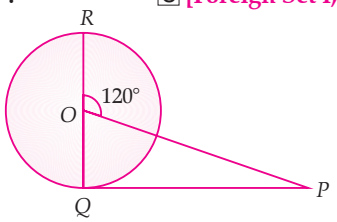
and $PQ = QS$ ½

$\therefore$ $PS = 2PQ$

$= 2 \times 5 = 10$ cm.

[CBSE Marking Scheme, 2012]

Q. 25. *PQ* is a tangent drawn from an external point *P* to a circle with centre *O* and *QOR* is the diameter of the circle. If $\angle POR = 120°$, What is the measure of $\angle OPQ$? U **[Foreign Set I, II, III, 2017]**



Sol. In ΔOQP $\angle POR = \angle OQP + \angle OPQ$

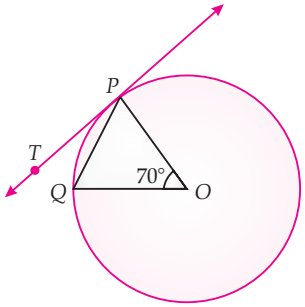
(Exterior angle) ½

$\therefore$ $\angle OPQ = \angle POR - \angle OQP$

$= 120° - 90$

$= 30°$ ½

Q. 26. In given figure, *O* is the centre of the circle, *PQ* is a chord and *PT* is tangent to the circle at *P*. Find $\angle TPQ$.



U [Outside Delhi Set I, II, III 2017]

Sol. $\angle OPQ = \angle OQP$ (radius of circle)

$= \frac{180° - 70°}{2} = 55°$ ½

$\therefore \quad \angle TPQ = 90° - 55°$

$= 35°$ ½

[CBSE Marking Scheme, 2017]

Commonly Made Error

- In circle problems, whenever diameter is given, students may think it as radius.
- They have to familiar with diagram so that they may not make mistakes while drawing diagrams.

Answering Tips

- Students may name to angles as $\angle 1$, $\angle 2$ etc. instead of writing full forms like $\angle AOB$, $\angle BOC$, etc.
- They should understand the concept of Reflex angles as (360°–angle).

[C] Fill in the blanks :

(i) A tangent to a circle intersects it in _____ point (s).

(ii) A line intersecting a circle in two points is called a _____.

(iii) A circle can have _____ parallel tangents at the most.

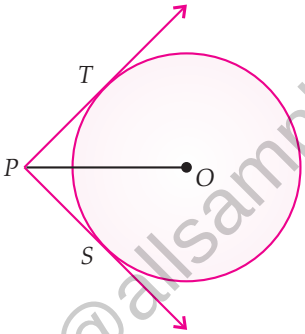
(iv) The common point of a tangent to a circle and the circle is called _____.

[NCERT Exemp.]

Ans. (i) One, (ii) Secant, (iii) Two, (iv) Point of contact

Short Answer Type Questions-I (2 marks each)

Q. 1. In the given figure, from a point *P*, two tangents *PT* and *PS* are drawn to a circle with centre *O* such that $\angle SPT = 120°$, prove that $OP = 2PS$.



U [Foreign Set I, II, III, 2016]

Sol. Given that $\angle SPT = 120°$

or, $\angle OPS = \frac{120°}{2} = 60°$

(as *OP* bisects $\angle SPT$) ½

Also, $\angle PTO = 90°$

(as radius ⊥ tangent) ½

$\therefore$ In right triangle *POS*,

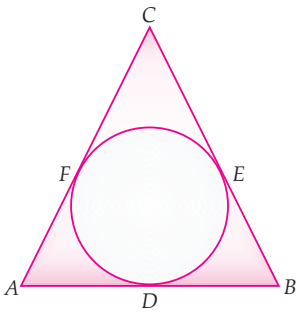
$\cos \angle OPS = \frac{PS}{OP}$

or, $\frac{1}{2} = \frac{PS}{OP}$

or, $OP = 2PS$. **1**

Hence proved.

Q. 2. In the given figure, a circle is inscribed in a ΔABC, such that it touches the sides *AB*, *BC* and *CA* at points *D*, *E* and *F* respectively. If the lengths of sides *AB*, *BC* and *CA* are 12 cm, 8 cm and 10 cm respectively, find the lengths of *AD*, *BE* and *CF*.



U [Delhi Set I, II, III, 2016]

Sol. Let $AD = AF = x$

or, $DB = BE = 12 - x$

and $CF = CE = 10 - x$

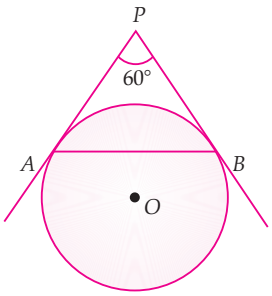
$BC = BE + EC$

or, $8 = 12 - x + 10 - x$

or, $x = 7$ **1**

$\therefore AD = 7$ cm, $BE = 5$ cm and $CF = 3$ cm **1**

Q. 3. In Fig., *AP* and *BP* are tangents to a circle with centre *O*, such that $AP = 5$ cm and $\angle APB = 60°$. Find the length of chord *AB*.



U [Delhi Set I, II, III, 2016]

Sol. $PA = PB$ ½

or, $\angle PAB = \angle PBA = 60°$ ½

$\therefore$ ΔPAB is an equilateral triangle. ½

Hence, $AB = PA = 5$ cm. ½

[CBSE Marking Scheme, 2016]

Q. 4. Prove that in two concentric circles, the chord of the larger circle, which touches the smaller circle is bisected at the point of contact.

A [Board Term-2, 2012 Set (17, 40)]

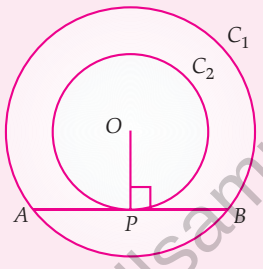
Sol. Let OP is radius and APB is tangent.

or, $OP \perp AB$ **1**

Now, for bigger circle, O is centre and AB is ½

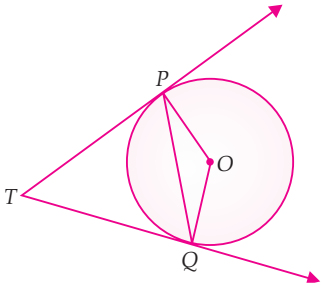
chord such that $OP \perp AB$. ½

Thus, OP bisects AB.



[CBSE Marking Scheme, 2012]

Q. 5. In the given figure PQ is chord of length 6 cm of the circle of radius 6 cm. TP and TQ are tangents to the circle at points P and Q respectively. Find $\angle PTQ$.



U [CBSE S.A.2 2016 Set HODM4OL]

Sol. Here, $PQ = 6$ cm, $OP = OQ = 6$ cm

$\therefore$ $PQ = OP = OQ$

$\therefore$ $\angle POQ = 60°$

(angle of equilateral Δ.) ½

$\angle P = \angle Q = 90°$

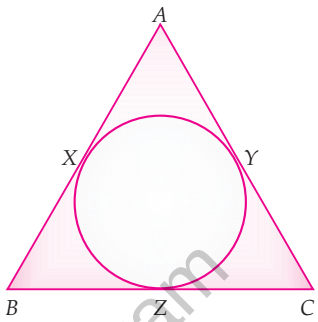
(radius $\perp$ tangent)

$\therefore$ $\angle PTQ + 90° + 90° + 60° = 360°$

(angle sum property) ½

$\angle PTQ = 120°$ **1**

Q. 6. ABC is an isosceles triangle in which $AB = AC$ which is circumscribed about a circle as shown in the figure. Show that BC is bisected at the point of contact.



A [Board Term-2, 2012 Set (22)]

Sol. $AX = AY$ $\rightarrow$ (1)

$BX = BZ$ $\rightarrow$ (2)

$CZ = CY$ $\rightarrow$ (3)

(Tangents from an external point to a circle are equal) ½

$AB = AC$, (Given)

or, $AX + XB = AY + YC$ ½

or, $XB = YC$

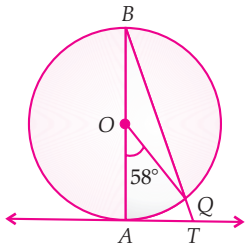
or, $BZ = CZ$ ½

$\therefore$ Z is the mid-point of BC and Z is the point of contact.

Hence, BC is bisected at the point of contact. ½

[CBSE Marking Scheme, 2012]

Q. 7. In given figure, AB is the diameter of a circle with center O and AT is a tangent. If $\angle AOQ = 58°$, find $\angle ATQ$. U [Board Term-2, 2015 Set I, II, III]



Sol. $\angle AOQ = 58°$ (Given)

$\angle ABQ = \frac{1}{2} \angle AOQ$

(Angle on the circumference of the circle by the same arc)

$= \frac{1}{2} \times 58°$

$= 29°$ **1**

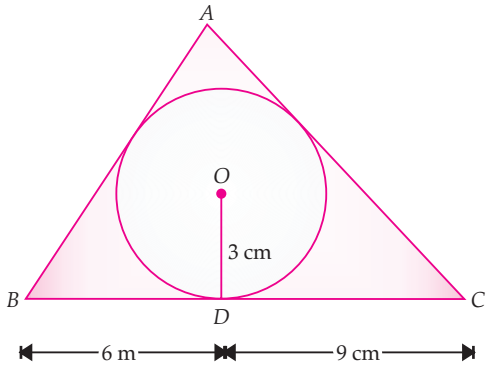
$\angle BAT = 90°$ ($\because OA \perp AT$)

$\therefore$ $\angle ATQ = 90° - 29°$

$= 61°$ **1**

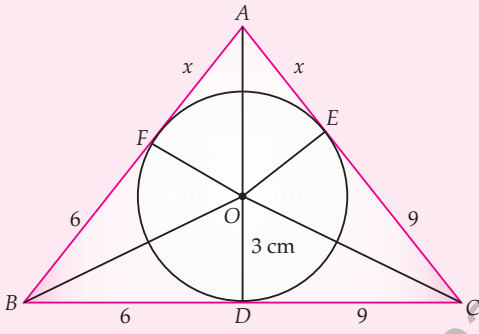
[CBSE Marking Scheme, 2015]

Q. 8. In figure, a triangle *ABC* is drawn to circumscribe a circle of radius 3 cm, such that the segments *BD* and *DC* are respectively of lengths 6 cm and 9 cm. If the area of ΔABC is 54 cm^2, then find the lengths of sides *AB* and *AC*.



A [Outside Delhi CBSE, 2015, Set I, II, III]

Sol.



Let $AF = AE = x$.

$\therefore$ $AB = 6 + x$, $AC = 9 + x$ and $BC = 15$ ½

$\frac{1}{2}[15 + 6 + x + 9 + x].3 = 54$

$45 + 3x = 54$ **1**

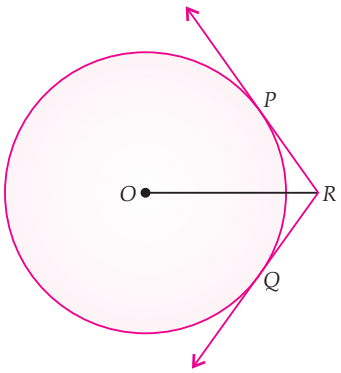
or, $x = 3$

$\therefore$ $AB = 9$ cm, $AC = 12$ cm ½

and $BC = 15$ cm.

[CBSE Marking Scheme, 2015]

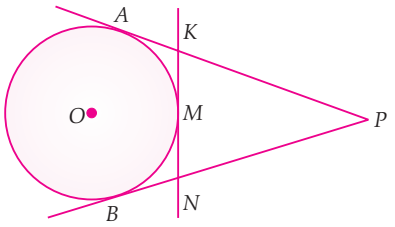
Q. 9. In figure, two tangents *RQ* and *RP* are drawn from an external point *R* to the circle with centre *O*. If $\angle PRQ = 120°$, then prove that *OR* = *PR* + *RQ*.



A [Outside Delhi CBSE Board, 2015, Set I, II, III]

Sol. Try yourself, Similar to Q. No. 1 in SATQ-I.

Q. 10. *PA* and *PB* are tangents from point *P* to the circle with centre *O* as shown in figure. At point *M*, a tangent is drawn cutting *PA* at *K* and *PB* at *N*. Prove that *KN* = *AK* + *BN*.



U [Board Term-2, 2012 Set (28)]

Sol. $PA = PB$, $KA = KM$, $NB = NM$,

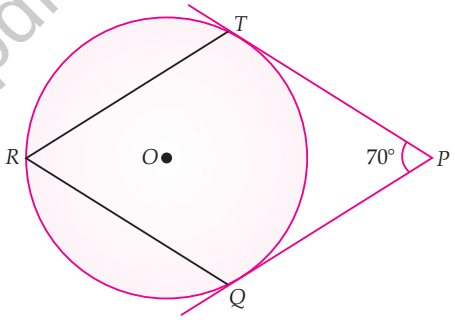
(Length of tangents from an external point are equal)

$\therefore$ $KA + NB = KM + NM$ **1**

or $AK + BN = KN$. **1**

[CBSE Marking Scheme, 2012]

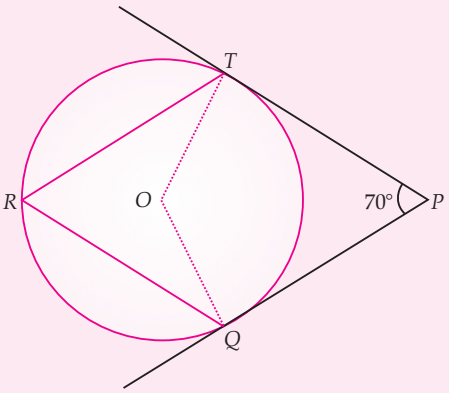
Q. 11. In figure, *O* is the centre of a circle. *PT* and *PQ* are tangents to the circle from an external point *P*. If $\angle TPQ = 70°$, find $\angle TRQ$.



U [Foreign Set I, II, III, 2015]

Sol. $\angle TOQ = 180° - 70° = 110°$ **1**

(angle of supplementary)



Then, $\angle TRQ = \frac{1}{2}\angle TOQ$

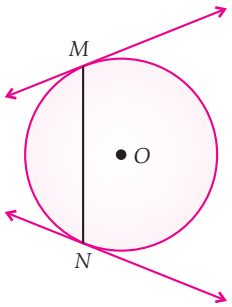
(angle at the circumference of the circle by same arc)

$= \frac{1}{2} \times 110° = 55°$. **1**

[CBSE Marking Scheme, 2015]

Q. 12. Prove that tangents drawn at the ends of a chord of a circle make equal angles with the chord.

Sol.



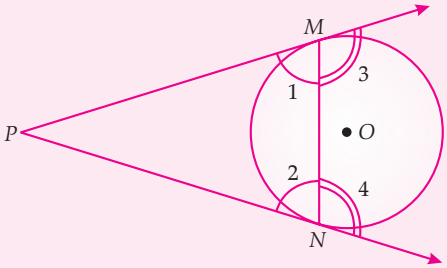
A [Delhi Term-2, 2015]

$\because$ PM = PN (length of tangents are equal)

$\angle 1 = \angle 2$ (angles opp. to equal sides are equal) **1**

$\because$ $180° - \angle 1 = 180° - \angle 2$ (linear pair)

$\angle 3 = \angle 4$ **1**



[CBSE Marking Scheme, 2015]

Q. 13. Two tangents PA and PB are drawn from an external point P to a circle inclined to each other at an angle of 70°, then what is the value of $\angle PAB$?

U [Board Term-2, 2012 Set (26, 34)]

Sol. Here, $\angle OPA = \frac{1}{2}\angle APB$

$= \frac{1}{2} \times 70° = 35°$ ½

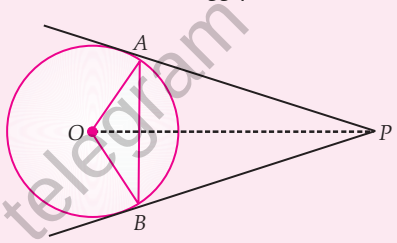
$\angle OAP = 90°$

$\therefore$ $\angle AOP = 180° - (90° + 35°) = 55°$ ½

$\therefore$ $\angle OAB = 35°$

$\angle PAB = 90° - 35°$

$= 55°$.



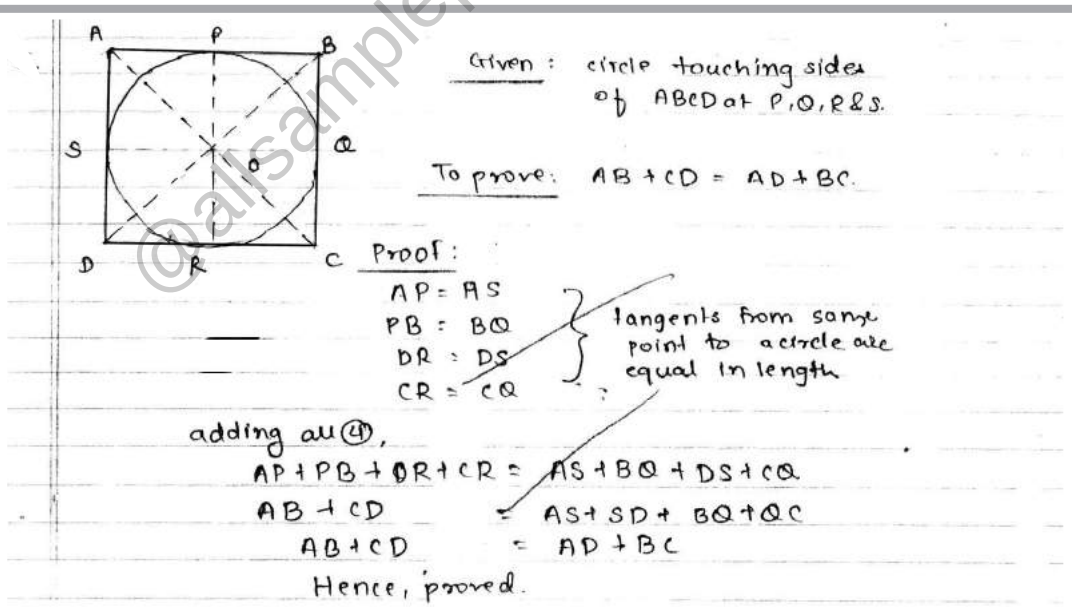
1

[CBSE Marking Scheme, 2012]

Q. 14. A circle touches all the four sides of a quadrilateral $ABCD$. Prove that $AB + CD = BC + DA$.

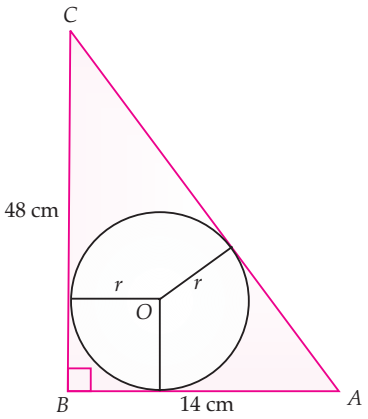
A [Outside Delhi Set, I, II, III, 2016]

Sol.



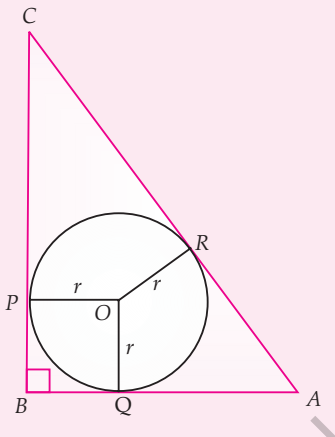
[Topper Answer, 2017] **2**

Q. 15. In Fig, ABC is a triangle in which $\angle B = 90°$, $BC = 48$ cm and $AB = 14$ cm. A circle is inscribed in the triangle, whose centre is O. Find radius of incircle.



A [CBSE Comptt. Set I, II, III, 2018]
[Board Term-II, 2012 Set(44)]

Sol. $AC = \sqrt{AB^2 + BC^2}$



$= \sqrt{14^2 + 48^2} = \sqrt{2500} = 50$ cm ½

$\angle OQB = 90° \Rightarrow OPBQ$ is a square

$BQ = r, QA = 14 - r = AR$ ½

Again, $PB = r,$

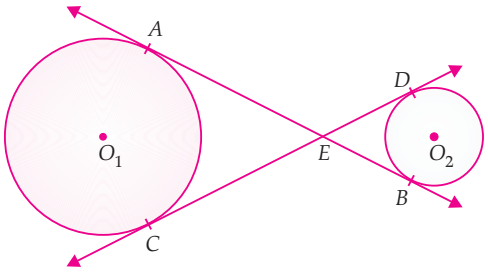
$PC = 48 - r \Rightarrow RC = 48 - r$ ½

$AR + RC = AC \Rightarrow 14 - r + 48 - r = 50$

$r = 6$ cm ½

[CBSE Marking Scheme, 2018]

Q. 16. In Figure, common tangents *AB* and *CD* to the two circles with centres O_1 and O_2 intersect at *E*. Prove that *AB* = *CD*. A [CBSE O.D. 2014]



Sol. *EA* and *EC* are tangents from point *E* to the circle with centre O_1.

$EA = EC$ ...(i) ½

EB and *ED* are tangents from point *E* to circle with centre O_2.

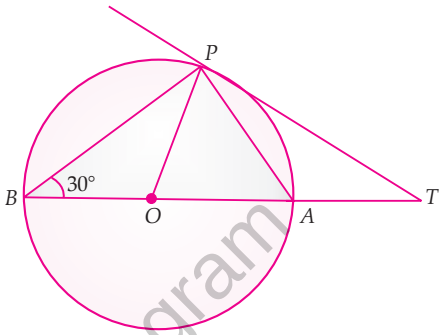
$EB = ED$ ...(ii) ½

Adding Eqs. (i) and (ii),

or, $EA + EB = EC + ED$

or, $AB = CD$ **Hence proved. 1**

Q. 17. In the given figure, *BOA* is a diameter of a circle and the tangent at a point *P* meets *BA* when produced at *T*. If $\angle PBO = 30°$, what is the measure of $\angle PTA$?



U [Board Term-2, 2012 Set (21)]

Sol. Given, *BOA* is a diameter.

or, $\angle BPA = 90°$ (angle in semicircle)

and $\angle OPT = 90°$ ½

Tangents from right angle at end point of radius.

or, $\angle BPO = 30°$ ($\because OB = OP$) ½

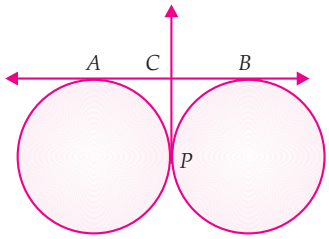
or, $\angle OPA = 60°$ and $APT = 30°$ ½

or, $\angle PTA = 60° - 30°$

$= 30°$ (exterior angle). ½

[CBSE Marking Scheme, 2012]

Q. 18. In the given figure, if *BC* = 4.5 cm, find the length of *AB*. U [Board Term-2, 2012 Set (59)]



Sol. Given, $BC = 4.5$ cm

$BC = CP$

(length of tangents from external point are equal) **1**

or, $CP = 4.5$ cm

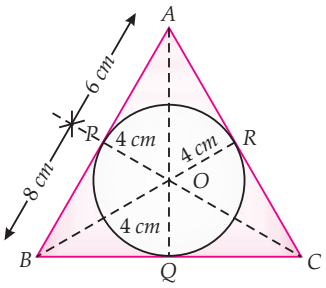
$AC = CP = 4.5$ cm

or, $AB = AC + CB$

$= 4{\cdot}5 + 4{\cdot}5 = 9$ cm. ½+½

[CBSE Marking Scheme, 2012]

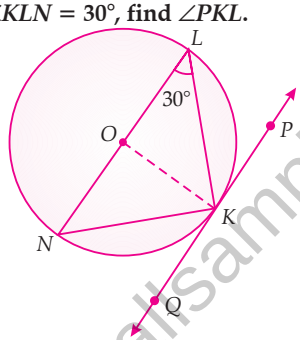
Q. 19. In fig. the radius of incircle of ΔABC of area 84 cm^2 and the lengths of the segments *AP* and BP into which side *AB* is divided by the point of contact are 6 cm and 8 cm. Find the lengths of the sides *AC* and *BC*.



U **[Board Term-2, 2012(34); Delhi CBSE Term II 2014]**

Sol. Given, $BP = BQ = 8$ cm
$AP = AR = 6$ cm
Tangents from external points A, B and C
Let $CQ = CR$ be x cm. ½
Perimeter of $\Delta ABC = 2 \times 8 + 2 \times 6 + 2x$
$= (28 + 2x)$ cm
$\therefore$ Area of $\Delta ABC = \frac{1}{2}(28 + 2x) \times 4$ ½
$= 84$ cm^2
$2x = 42 - 28$
$x = 7$ ½
$\therefore$ $AC = 6 + 7 = 13$ cm
$BC = 8 + 7 = 15$ cm ½
[CBSE Marking Scheme, 2017]

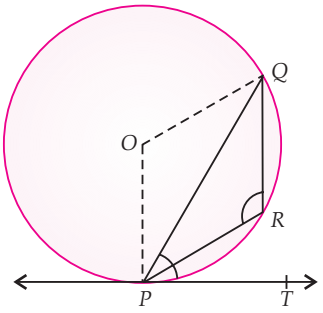
Q. 20. In given figure 2, *O* is the centre of the circle and *LN* is a diameter. If *PQ* is a tangent to the circle at *K* and $\angle KLN = 30°$, find $\angle PKL$.



U **[Outside Delhi Compt. Set I, II, III 2017]**

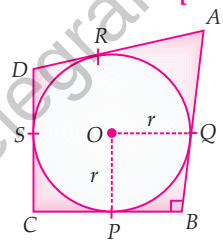
Sol. Here, $OK = OL$ (radii)
$\angle OKL = \angle OLK = 30°$
(Opposite angles of equal sides) **1**
Since $\angle OKP = 90°$ (Tangent)
$\therefore$ $\angle PKL = 90° - 30° = 60°$ **1**
[CBSE Marking Scheme, 2017]

Q. 21. In figure, *PQ* is a chord of a circle centre *O* and *PT* is a tangent. If $\angle QPT = 60°$, find $\angle PRQ$.
[Outside Delhi CBSE Board, 2015 Set I, II, III]



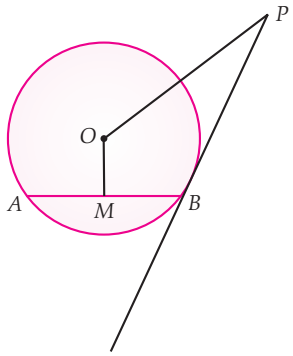
Sol. Given, $\angle QPT = 60°$
$\angle OPQ = \angle OQP = 90° - 60° = 30°$
$\angle POQ = 180° - (30° + 30°)$
$= 180° - 60° = 120°$
$\angle PRQ = \frac{1}{2}$ Reflex $\angle POQ$ **1**
$[\because$ Reflex $\angle POQ = 360° - 120° = 240°]$
$= \frac{1}{2} \times 240° = 120°$
[CBSE Marking Scheme, 2015] 1

Q. 22. In fig., a circle with centre *O* is inscribed in a quadrilateral *ABCD* such that, it touches the sides *BC*, *AB*, *AD* and *CD* at points *P*, *Q*, *R* and *S* respectively. If $AB = 29$ cm, $AD = 23$ cm, $\angle B = 90°$ and $DS = 5$ cm, then find the radius of the circle (in cm.). **[Board Term-2, 2013] 2**



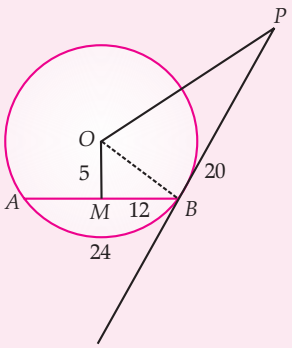
Sol. $\because$ $DS = 5$ cm
$\therefore$ $DR = DS = 5$ cm **1**
(length of tangents are equal)
$AR = 23 - 5 = 18$ cm
$AQ = AR = 18$ cm
$QB = 29 - 18 = 11$ cm $= PB$
$\angle OQB = \angle OPB = 90°$
$\therefore$ $OP = OQ = PB = BQ$
So, $POQB$ is a square.
Hence, $r = OP = PB = 11$ cm. **1**

Q. 23. *PB* is a tangent to the circle with centre *O* to *B*. *AB* is a chord of length 24 cm at a distance of 5 cm from the centre. If the tangent is of length 20 cm, find the length of *PO*.



[Delhi Board Term-2, 2015]

Sol. Construction : Join OB.
In rt. ΔOMB,
$OB^2 = 5^2 + 12^2 = 13^2$
$\therefore$ $OB = 13$ cm **1**
Since $OB \perp PB$ (radius $\perp$ tangent)



$\therefore$ In rt. ΔOBP,

$$OP^2 = OB^2 + BP^2$$
$$= 13^2 + 20^2$$
$$= 569$$

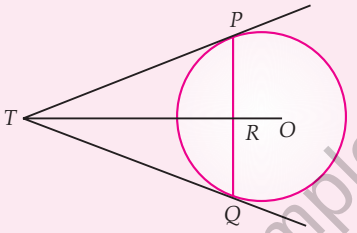
or, $OP = \sqrt{569} = 23.85$ cm. **1**

[CBSE Marking Scheme, 2015]

Q. 24. From a point *T* outside a circle of centre *O*, tangents *TP* and *TQ* are drawn to the circle. Prove that *OT* is the right bisector of line segment *PQ*.

[Delhi CBSE Term-2, 2015 Set I, II, III

Sol. Given : *A* circle with centre *O*. Tangents *TP* and *TQ* are drawn from a point *T* outside a circle.



To Prove : *OT* is the right bisector of line segment *PQ*.

Proof : In ΔPTR and ΔQTR

$TP = TQ$ (Tangents of the circle)

$TR = TR$ (Common)

$\angle TPR = \angle TQR$ (opposite angle of equal sides)

$\therefore$ $\Delta PTR \cong \Delta QTR$ **1** (SAS Congruency)

$\therefore$ $PR = QR$

and $\angle PRT = \angle QRT$

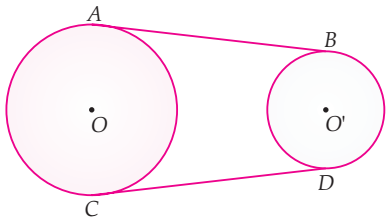
But $\angle PRT + \angle QRT = 180°$ (as *PQ* is line segment)

$\therefore$ $\angle PRT = \angle QRT = 90°$

Therefore *TR* or *OT* is the right bisector of line segment *PQ*. **Hence proved. 1**

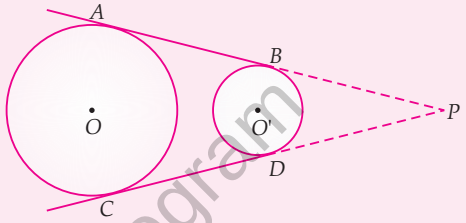
[CBSE Marking Scheme, 2015]

Q. 25. In the fig, *AB* and *CD* are common tangents to two circles of unequal radii. Prove that *AB* = *CD*.



[Delhi Compt. Set III 2017]

Sol. Construction : Produce *AB* and *CD* to meet at *P*.



Now, $PA = PC$

and $PB = PD$ ½

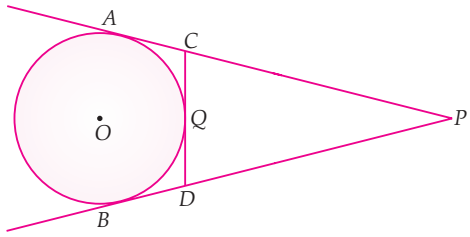
Tangents to a circle from external point ½

Now, $PA - PB = PC - PD$ ½

$\Rightarrow$ $AB = CD$ ½

[CBSE Marking Scheme, 2017]

Q. 26. In the given figure, *PA* and *PB* are tangents to the circle from an external point *P*. *CD* is another tangent touching the circle at *Q*. If *PA* = 12 cm, *QC* = *DQ* = 3 cm, then find *PC* + *PD*.



[Delhi Compt. Set I, II, III 2017]

Sol. Here, $AC = CQ$

(Tangents from external point to a circle)

$PA = PC + CA = PC + CQ$

($\because$ $CA = CQ$)

$\Rightarrow$ $12 = PC + 3$

$\Rightarrow$ $PC = 12 - 3 = 9$ cm **1**

$PC = PD = 9$ cm

$\therefore$ $PC + PD = 9 + 9 = 18$ cm **1**

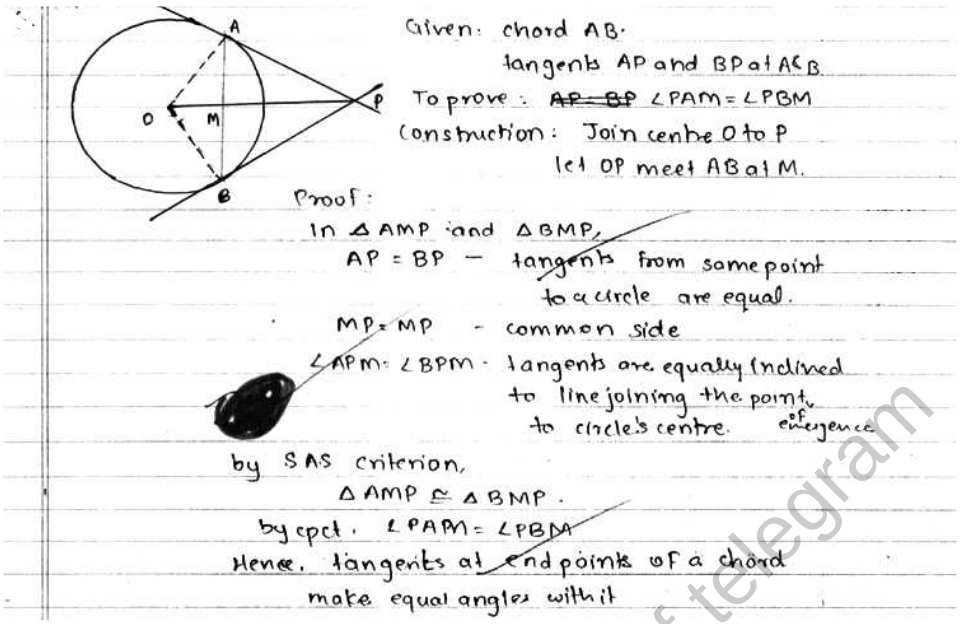
[CBSE Marking Scheme, 2017]

Q. 27. In a right angle ΔABC, *BC* = 12 cm and *AB* = 5 cm. Find the radius of the circle inscribed in this triangle. **[Delhi CBSE Term-2, 2014]**

Sol. Try yourself, similar to Q. No. 15 in SATQ-I,

Q. 28. Prove that the tangents drawn at the end points of a chord of a circle make equal angles with the chord.
[Outside Delhi Set, I, II, III, 2017]

Sol.



[Topper Answer, 2017] 2

Short Answer Type Questions-II

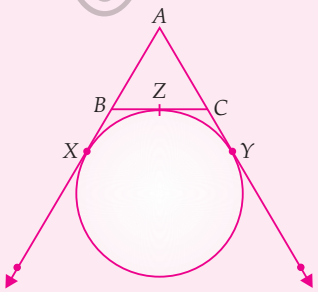
(3 marks each)

Q. 1. ***ABC*** **is a triangle.** ***A*** **circle touches sides** ***AB*** **and** ***AC*** **produced and side** ***BC*** **at** ***X***, ***Y*** **and** ***Z*** **respectively. Show that** $AX = \frac{1}{2}$ **perimeter of** ΔABC.

A **[Board Term-2, 2016, Set-HODM4OL]**

Sol. Perimeter of $\Delta ABC = AB + AC + BC$
$= (AX - BX) + (AY - CY) + (BZ + ZC)$. **1**
$= AX + AY - BX + BZ + ZC - CY$

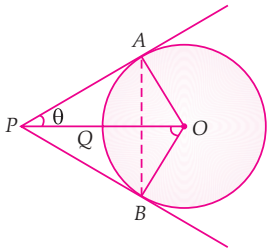
The tangents of a circle, from an external point are equal.



or, From point $B \rightarrow BX = BZ$ From $A \rightarrow AX = AY$
and from point $C \rightarrow CZ = CY$
$\therefore \quad P = AX + AY = 2AX$ **1**
or $AX = \frac{1}{2}$ Perimeter of ΔABC. **1**

[CBSE Marking Scheme, 2016]

Q. 2. In the given figure, ***OP*** **is equal to the diameter of a circle with centre** ***O*** **and** ***PA*** **and** ***PB*** **are tangents. Prove that** ***ABP*** **is an equilateral triangle.**



A **[Board Term-2, 2014]**

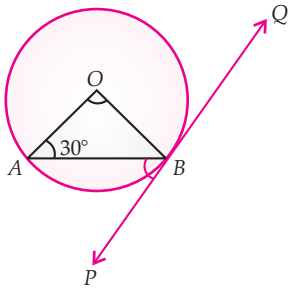
Sol. Construction : Join A to B.
We have,
OP = diameter
$\Rightarrow \quad OQ + QP$ = diameter
$\Rightarrow \quad$ Radius + QP = diameter **1**
$\Rightarrow \quad OQ = PQ$ = radius
Thus, OP is the hypotenuse of right angled ΔAOP.

So, In ΔAOP, $\sin\theta = \frac{AO}{OP} = \frac{1}{2}$

$\theta = 30°$ **1**
Hence, $\angle APB = 60°$
Now, in ΔABP,
$AP = PB$
So, $\angle PAB = \angle PBA = 60°$
$\therefore \Delta APB$ is an equilateral triangle. **1**

[CBSE Marking Scheme, 2014]

Q. 3. In the figure, ***PQ*** **is a tangent to a circle with centre** ***O***. **If** $\angle OAB = 30°$, **find** $\angle ABP$ **and** $\angle AOB$.



U [Board Term-2, 2014]

Sol. Since, the tangent is perpendicular to the end point of radius.

Then, $\angle OAB = \angle OBA$ ($\because OA = OB$)

$\angle OBA = 30°$ **1**

$\therefore$ $\angle AOB = 180° - (30° + 30°)$

$\therefore$ $\angle AOB = 120°$ **1**

$\angle ABP = \angle OBP - \angle OBA$

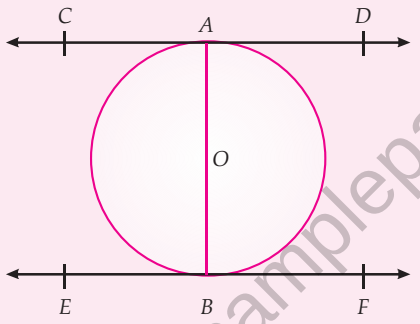
$= 90° - 30° = 60°$ **1**

[CBSE Marking Scheme, 2014]

Q. 4. Prove that the tangents drawn at the ends of a diameter of a circle are parallel.

A **[Foreign set I, II, III, Delhi CBSE, Term-2, 2014]**
[Board Term-2, 2012 Set (12)]
[Delhi Set I, II, III 2017]

Sol.



Let AB be the diameter of a given circle and let CD and EF be the tangents drawn to the circle at A and B respectively.

$AB \perp CD$ and $AB \perp EF$ **1**

$\therefore$ $\angle CAB = 90°$ and $\angle ABF = 90°$ ½

$\angle CAB = \angle ABF$

and $\angle ABE = \angle BAD$ ½

$\angle CAB$ and $\angle ABF$ also $\angle ABE$ and $\angle BAD$ are alternate interior angles. **1**

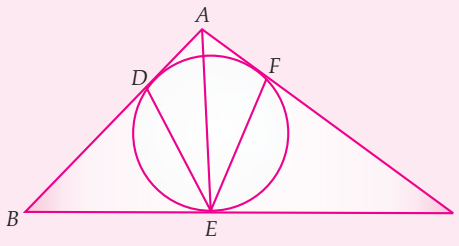
$\therefore$ $CD \parallel EF$ **Hence proved**

[CBSE Marking Scheme, 2012]

Q. 5. In ΔABC, $AB = AC$. If the interior circle of ΔABC touches the sides AB, BC and CA at D, E and F respectively. Prove that E bisects BC.

A **[Board Term-2, 2014 Delhi Set, 2012 Set (40)]**

Sol.



½

Here, $AF = AD$

and $BE = BD$,

(tangents from external points) **1½**

$CE = CE$

$AB = AC$

Then, $AD + BD = AF + FC$

or, $BD = FC$ ($\because AD = AF$)

$BE = EC$ ($\because BD = BE, CE = CF$)

$\therefore$ E bisects BC. **1**

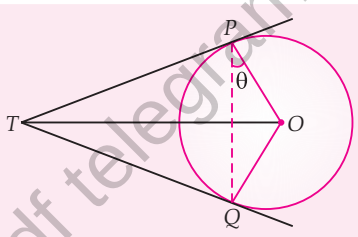
[CBSE Marking Scheme, 2012]

Q. 6. Two tangents TP and TQ are drawn to a circle with centre O from an external point T. Prove that

$\angle PTO = 2\angle OPQ$

U **[Delhi Set I, II, III 2017;**
Delhi Compt Set I, II, III 2017]

Sol.



Let $\angle OPQ$ be θ.

$\therefore$ $\angle TPQ = (90° - \theta)$

Since $TP = TQ$ (Tangents)

$\therefore$ $\angle TQP = (90° - \theta)$

(Opposite angles of equal sides) **1**

Now, $\angle TPQ + \angle TQP + \angle PTQ = 180°$

$\Rightarrow 90° - \theta + 90° - \theta + \angle PTQ = 180°$

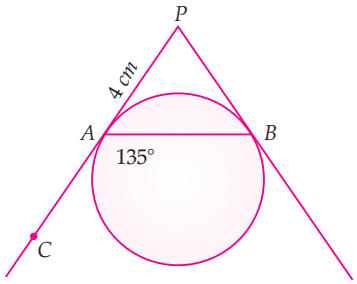
$\Rightarrow$ $\angle PTQ = 180° - 180° + 2\theta$ **1½**

$\Rightarrow$ $\angle PTQ = 2\theta$

$\Rightarrow$ $\angle PTQ = 2\angle OPQ$. ½

[CBSE Marking Scheme, 2017]

Q. 7. In the given figure, PA and PB are tangents to a circle from an external point P such that PA = 4 cm and $\angle BAC = 135°$. Find the length of chord AB.



U **[Outside Delhi Set I, II, III, 2017]**

Sol. $PA = PB = 4$ cm

(Tangents from external point) ½

$\angle PAB = 180° - 135° = 45°$

(Supplementary angles)

$\angle ABP = \angle PAB = 45°$

(Opposite angles of equal sides) ½

$\therefore$ $\angle APB = 180° - 45° - 45°$

$= 90°$ ½

So, ΔABP is an isosceles right angled triangle.

$\Rightarrow \quad AB^2 = 2AP^2$ **1**

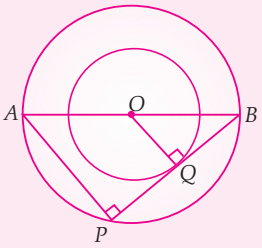
$\Rightarrow \quad AB^2 = 32$ **1**

Hence, $AB = \sqrt{32} = 4\sqrt{2}$ cm

[CBSE Marking Scheme, 2017]

Q. 8. The radii of two concentric circles are 13 cm and 8 cm. *AB* is a diameter of the bigger circle and *BD* is a tangent to the smaller circle touching it at *D* and intersecting the larger circle at *P* on producing. Find the length of *AP*. U **[SQP, 2018-19]**

Sol.



1

$\angle APB = 90°$ (angle in semi-circle)

and $\angle ODB = 90°$ (radius is perpendicular to tangent)

$\Delta ABP \sim \Delta OBD$

$\Rightarrow \quad \frac{AB}{OB} = \frac{AP}{OD}$ **1**

$\Rightarrow \quad \frac{26}{13} = \frac{AP}{8}$

Hence, $AP = 16$ cm **1**

[CBSE Marking Scheme, 2018-19]

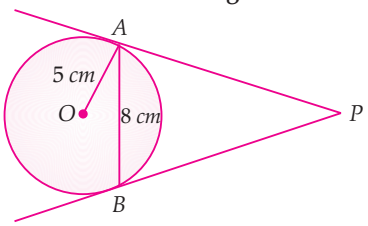
Commonly Made Error

- Some candidates are not versed with the circle properties, e.g., could not well identify $\angle APB = 90°$ by using angle at a semi-circle.

Answering Tips

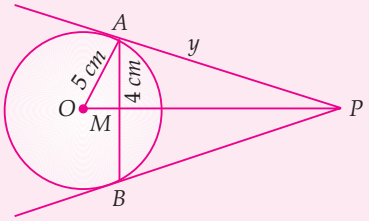
- Candidates should be familiar with the circle properties.

Q. 9. In figure *AB* is a chord of length 8 cm of a circle of radius 5 cm. The tangents to the circle at *A* and *B* intersect at *P*. Find the length of *AP*.



A **[CBSE Compt. Set I, II, III 2018]**

Sol.



AB = 8 cm $\Rightarrow$ AM = 4 cm.

$\therefore \quad OM = \sqrt{5^2 - 4^2} = 3$ cm.

Let $AP = y$ cm, $PM = x$ cm.

$\therefore \Delta OAP$ is a right angle triangle.

$\therefore \quad OP^2 = OA^2 + AP^2$

$(x + 3)^2 = y^2 + 25$

$\Rightarrow \quad x^2 + 9 + 6x = y^2 + 25$ ...(i) ½

Also, $x^2 + 4^2 = y^2$ ...(ii) ½

$x^2 + 6x + 9 = x^2 + 16 + 25$

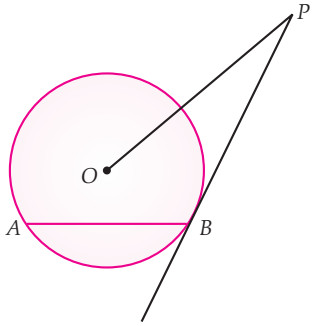
$6x = 32 \Rightarrow x = \frac{32}{6}$ *i.e.* $\frac{16}{3}$ cm

$y^2 = x^2 + 16 = \frac{256}{9} + 16 = \frac{400}{9}$ **1**

$y = \frac{20}{3}$ cm or $6\frac{2}{3}$ cm **1**

[CBSE Marking Scheme, 2018]

Q. 10. *AB* is a chord of circle with centre *O*. At *B*, a tangent *PB* is drawn such that its length is 24 cm. The distance of *P* from the centre is 26 cm. If the chord *AB* is 16 cm, find its distance from the centre.

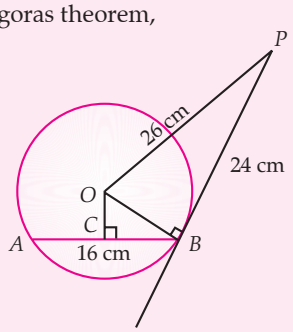


C **[Board Term-2, 2012 Set (40), 2014]**

Sol. Given, *AB* is a chord of circle with centre *O* and tangent *PB* = 24 cm, *OP* = 26 cm.

Construction : Join *O* to *B* and draw $OC \perp AB$.

By Pythagoras theorem,



1

$OB = \sqrt{(26)^2 - (24)^2}$

$= \sqrt{676 - 576} = \sqrt{100}$

$= 10$ cm **1**

Now, in ΔOBC, $BC = \frac{1}{2}AB = \frac{16}{2} = 8$ cm

(Perpendicular drawn from the centre to a chord bisects it.)

$OB = 10$ cm

$OC^2 = OB^2 - BC^2$

$= 10^2 - 8^2$

$OC^2 = 36$

$OC = 6$ cm **1**

$\therefore$ Distance of the chord from the centre = 6 cm.

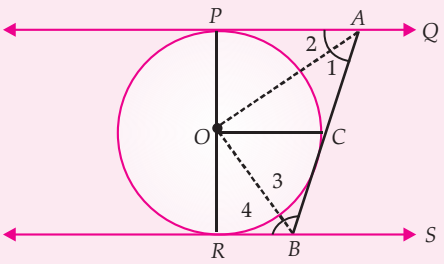
[CBSE Marking Scheme, 2014]

Q. 11. Prove that the intercept of a tangent between a pair of parallel tangents to a circle subtend a right angle at the centre of the circle.

[Delhi CBSE, Term-2, 2014]

[Board Term-2, 2012 Set (22, 5)]

Sol.



½

PQ and RS are two parallel tangents to a circle with centre O.

AB is tangent to a circle at C, intersecting PQ and RS at A and B respectively.

Since, $PA \parallel RB$ and AB is transversal.

$\angle 1 + \angle 2 + \angle 3 + \angle 4 = 180°$

[$\angle 1 = \angle 2$, $\angle 3 = \angle 4$ (by congruency)]

$2\angle 1 + 2\angle 3 = 180°$ **1+½**

$\angle 1 + \angle 3 = 90°$ ½

In ΔAOB, by angle sum property of a triangle,

$\angle AOB = 180° - (\angle 1 + \angle 3)$

$= 180° - 90°$

$\therefore$ $\angle AOB = 90°$. ½

[CBSE Marking Scheme, 2012]

Q. 12. Prove that the parallelogram circumscribing a circle is a rhombus. **[Delhi CBSE, Term-2, 2014]**

[Board Term-2, 2012 Set (1); Delhi 2013]

AE

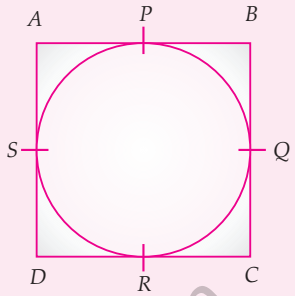
Sol. Let $ABCD$ be the || gm.

$\therefore$ $AB = CD$ and $AD = BC$ ...(i) ½

$AP + PB + DR + CR = AS + BQ + DS + CQ$ **1**

or, $AB + CD = AD + BC$ ½

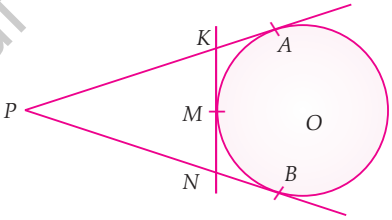
From (i), $2AB = 2AD$ or $AB = AD$



or, $ABCD$ is a rhombus. **1**

[CBSE Marking Scheme, 11, 2012]

Q. 13. In given figure, *PA* and *PB* are tangents from a point *P* to the circle with centre *O*. At the point *M*, another tangent to the circle is drawn cutting *PA* and *PB* at *K* and *N*. Prove that the perimeter of $\Delta PNK = 2PB$. **[Board Term-2, 2012 Set (1, 25)]**



Sol. Here, $KN = KM + MN$

But $KM = KA$ and $MN = BN$, ($\because$ tangents drawn from an external point to a circle are equal) **1**

$\therefore$ $KN = KA + BN$

$\therefore$ Perimeter of $\Delta PNK = PN + KN + PK$

$= PN + BN + KA + PK$

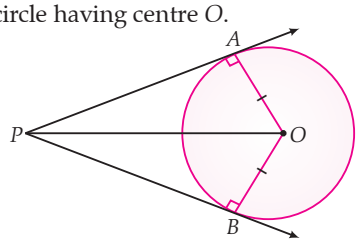
$= PB + PA = 2PB$,

($\because$ $PA = PB$) **2**

Q. 14. Prove that the lengths of two tangents drawn from an external point to a circle are equal.

A **[Outside Delhi Set, I, II, III 2017]**

Sol. Given : AP and BP are tangents of circle having centre O. ½



½

To Prove : $AP = BP$ ½

Construction : Join OP, AO and BO ½

Proof : ΔOAP and ΔOBP

$OA = OB$ (Radius of circle)

$OP = OP$ (Common side)

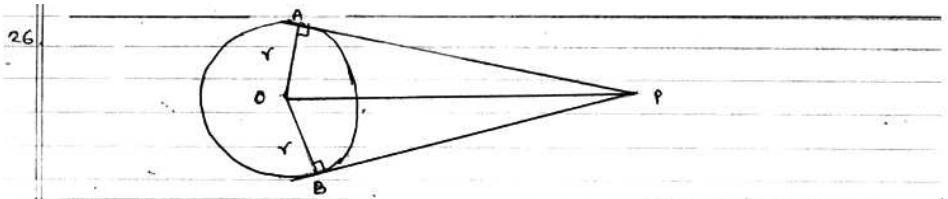
$OAP = OBP = 90°$ (Radius – tangent angle)

$OAP = OBP$ (RHS congruency rule)

$AP = BP$ (CPCT) **1**

Hence Proved.

Sol. 26



Given: Circle with C(O, r)
2 tangents from P at A and B
To prove: AP = BP
Construction: Join OA, OB and OP
Proof:
In ΔAPO and ΔBPO,
OA = OB – radii of same circle
OP = OP – common side.
∠OAP = ∠OBP = 90° – radius is ⊥ tangent at point of contact
by RHS criterion,
ΔAPO ≅ ΔBPO
and hence, AP = BP – by cpct
∴ lengths of 2 tangents drawn from an external point to a circle are equal.

[Topper Answer, 2017] 3

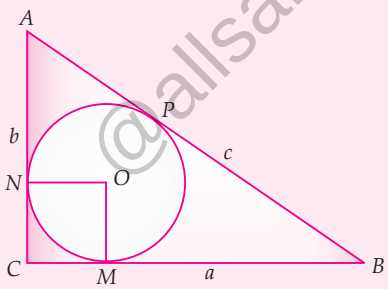
Long Answer Type Questions

(4 marks each)

Q. 1. *a*, *b* and *c* are the sides of a right triangle, where *c* is the hypotenuse. A circle, of radius *r*, touches the sides of the triangle. Prove that $r = \frac{a+b-c}{2}$.

A **[CBSE S.A.2 2016 Set HODM4OL]**

Sol.



1

Let circle touches *CB* at *M*, *CA* at *N* and *AB* at *P*.

Now $OM \perp CB$ and $ON \perp AC$
(radius ⊥ tangent)

$OM = ON$ (radii)

$CM = CN$ (Tangents)

∴ *OMCN* is a square.

Let $OM = r = CM = CN$ **1**

$AN = AP$, $CN = CM$ and $BM = BP$
(tangent from external point)

$AN = AP$

$\Rightarrow \quad AC - CN = AB - BP$ **1**

$b - r = c - BM$

$b - r = c - (a - r)$

$b - r = c - a + r$

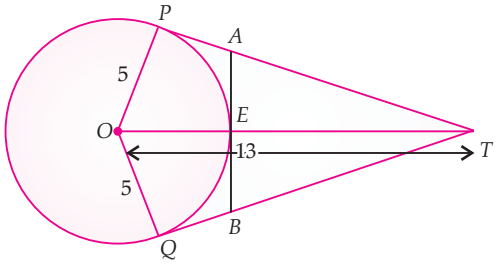
$\therefore \quad 2r = a + b - c$

$r = \frac{a+b-c}{2}$. **1**

Hence Proved.

[CBSE Marking Scheme, 2016]

Q. 2. In Fig. *O* is the centre of a circle of radius 5 cm. *T* is a point such that *OT* = 13 cm and *OT* intersects circle at *E*. If *AB* is a tangent to the circle at *E*, find the length of *AB*, where *TP* and *TQ* are two tangents to the circle.



U **[Delhi Set I, II, III, 2016]**

Sol.

$PT = \sqrt{169 - 25} = 12$ cm

and $TE = OT - OE = 13 - 5$

$= 8$ cm ½ + ½

Let $PA = AE = x$. (Tangents)

Then, $TA^2 = TE^2 + EA^2$ **1**

or, $(12 - x)^2 = 8^2 + x^2$

$24x = 80$

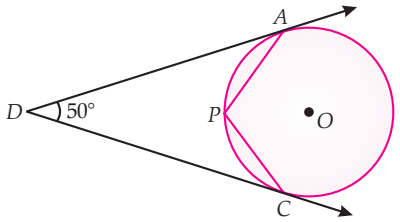
or, $x = 3.3$ cm. **1**

Thus $AB = 2 \times x = 2 \times 3{\cdot}3$

$= 6.6$ cm. **1**

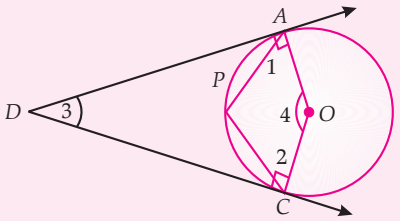
[CBSE Marking Scheme, 2016]

Q. 3. In the given figure, *O* is the centre of the circle. Determine $\angle APC$, if *DA* and *DC* are tangents and $\angle ADC = 50°$.



A **[Board Term-2, 2015]**

Sol.



1

Given *DA* and *DC* are tangents from point *D* to a circle with centre *O*.

$\angle 1 = \angle 2 = 90°$

(radius $\perp$ tangent)

$\angle 1 + \angle 2 + \angle 3 + \angle 4 = 360°$ **1**

or, $90° + 90° + 50° + \angle 4 = 360°$

or, $\angle 4 = 130°$

$\therefore$ Reflex $\angle 4 = 360° - 130° = 230°$ **1**

$\angle APC = \frac{1}{2}$ reflex $\angle 4$

(angle subtended at centre)

$\angle APC = \frac{1}{2} \times 230° = 115°$ **1**

[CBSE Marking Scheme, 2015]

Q. 4. Prove that opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle.

A **[Foreign Set I, II, III 2017][CBSE O.D. 2014]**

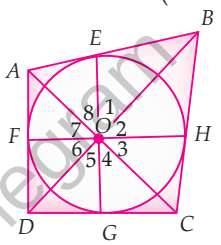
Sol. Given : A circle with centre *O* is inscribed in a quadrilateral *ABCD*.

In ΔAEO and ΔAFO,

$OE = OF$ (radii of circle)

$\angle OEA = \angle OFA = 90°$

(radius is $\perp^r$ to tangent)



The point of contact is perpendicular to the tangent.

$OA = OA$ (common side)

$\Delta AEO \cong \Delta AFO$ (SAS congruency)

$\angle 7 = \angle 8$ ... (i) (*CPCT*)

Similarly,

$\angle 1 = \angle 2$ ...(ii)

$\angle 3 = \angle 4$ ...(iii)

$\angle 5 = \angle 6$ ...(iv)

$\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 + \angle 6 + \angle 7 + \angle 8 = 360°$

(angle around a point is 360°)

$2\angle 1 + 2\angle 8 + 2\angle 4 + 2\angle 5 = 360°$

$\angle 1 + \angle 8 + \angle 4 + \angle 5 = 180°$

$(\angle 1 + \angle 8) + (\angle 4 + \angle 5) = 180°$ **4**

$\angle AOB + \angle COD = 180°$

Hence Proved.

Q. 5. Prove that tangent drawn at any point of a circle is perpendicular to the radius through the point of contact.

[Outside Delhi Set II, 2016]

Sol.

Given – A circle C(O, OP) and tangent at P.

To prove – $OP \perp PQ$

Const^n – Extend OR to Q, at AB

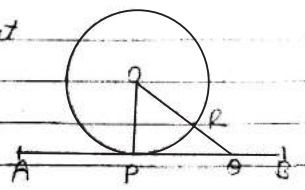
Proof – We have –

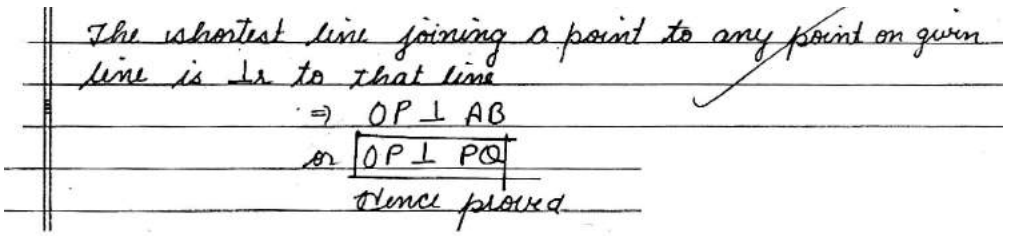
$OP = OR$ (radius)

$OQ = OR + RQ$

Clearly $OQ > OR$

$\therefore$ $OQ > OP$





[Topper Answer, 2016]

Q. 6. In figure, *PQ* is a chord of length 16 cm, of a circle of radius 10 cm. The tangents at *P* and *Q* intersect at a point *T*. Find the length of *TP*.

A [Delhi CBSE, Term-2, 2014]

Sol. Given, $OM \perp PQ$, bisects PQ.

$\therefore$ $PM = 8$ cm (as $PQ = 16$ cm.) **1**

In rt. ΔOMP, $OM = \sqrt{10^2 - 8^2}$

$= \sqrt{100 - 64}$

$= \sqrt{36}$

$= 6$ cm **1**

$\angle TPM + \angle MPO = 90°$

Also, $\angle TPM + \angle PTM = 90°$

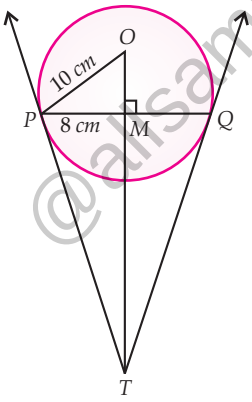
$\angle MPO = \angle PTM$

$\angle TMP = \angle OMP = 90°$

$\Delta TMP \sim \Delta PMO$ (AA) **1**

or, $\frac{TP}{PO} = \frac{MP}{MO}$

$\frac{TP}{10} = \frac{8}{6}$



or, $TP = \frac{80}{6}$

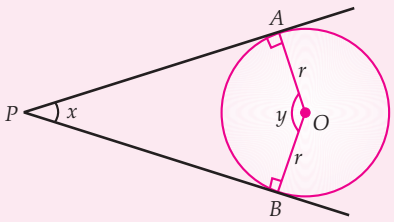
or, $TP = \frac{40}{3}$

Hence length of $TP = \frac{40}{3}$ cm. **1**

Q. 7. Two tangents *PA* and *PB* are drawn from an external point *P* to a circle with centre *O*, such that $\angle APB = \angle x$ and $\angle AOB = y$. Prove that opposite angles are supplementary.

A [Board Term-2, 2011 (B1)]

Sol. Since, *AOBP* is a quadrilateral



1

So, $\angle A + \angle B + x + y = 360°$

$90° + 90° + x + y = 360°$ **1**

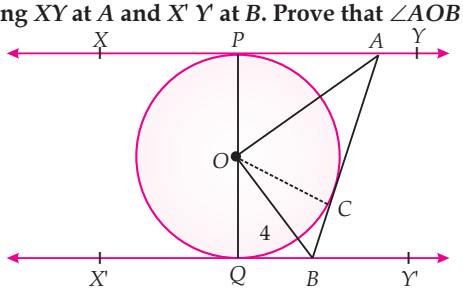
$180° + x + y = 360°$

$x + y = 180°$ **1**

Hence, Opposite angle are supplementary **1**

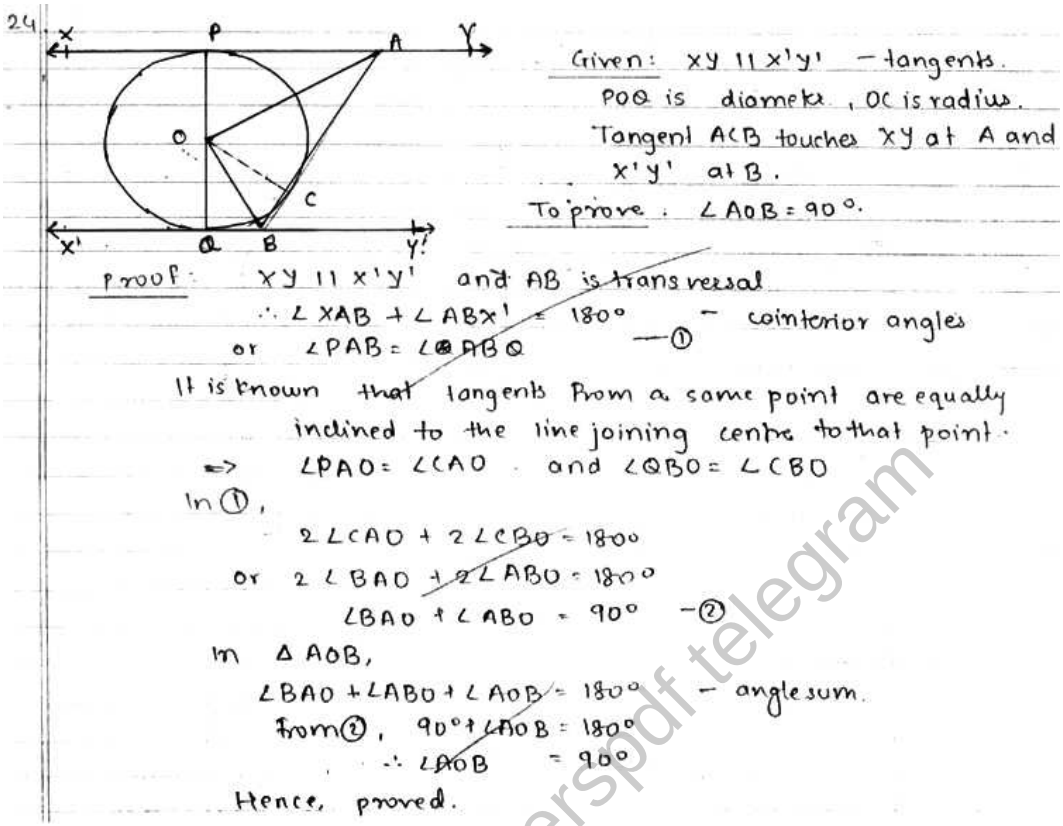
[CBSE Marking Scheme, 2011]

Q. 8. In the given figure, *XY* and *X'Y'* are two parallel tangents to a circle with centre *O* and another tangent *AB* with point of contact *C*, is intersecting *XY* at *A* and *X' Y'* at *B*. Prove that $\angle AOB = 90°$.



A [Outside Delhi Set, I, II, III 2017]

Sol.



[Topper Answer, 2017] 3

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