FOCUS ACADEMY

Kg to 12

English&Gujarati Medium

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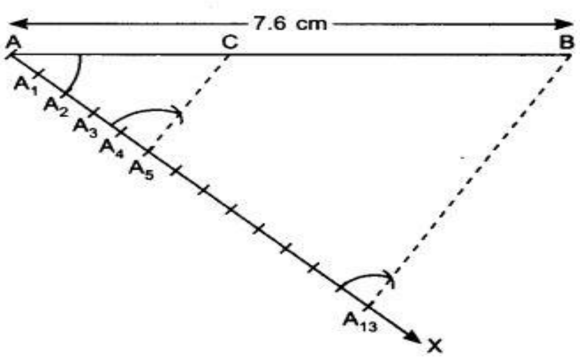
Class 10 Maths Chapter 11 Construction

Ex 11.1 Class 10 Maths Question 1.
Draw a line segment of length 7.6 cm and divide it in the ratio 5:8. Measure the two parts.

Solution:

Steps of Construction:

1. Draw a line segment AB = 7.6 cm.
2. Draw an acute angle BAX on base AB. Mark the ray as AX.
3. Locate 13 points $A_1, A_2, A_3, \ldots\ldots, A_{13}$ on the ray AX so that $AA_1 = A_1A_2 = \ldots\ldots = A_{12}A_{13}$
4. Join A_{13} with B and at A_5 draw a line ‖ to BA_{13}, i.e. A_5C. The line intersects AB at C.
5. On measure AC = 2.9 cm and BC = 4.7 cm.



Justification:

In ΔAA_5C and $\Delta AA_{13}B$,

$A_5C \parallel A_{13}B$

$$\frac{AC}{BC} = \frac{AA_5}{A_5A_{13}} \quad \text{(By the Basic Proportionality Theorem)}$$

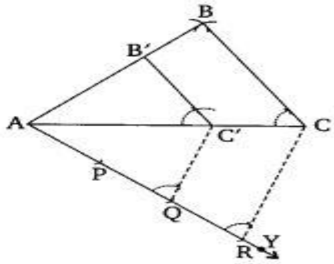
$$\frac{AC}{BC} = \frac{5}{8} \qquad \left[\because \frac{AA_5}{A_5A_{13}} = \frac{5}{8}\right]$$

$\therefore$ AC : BC = 5 : 8

Ex 11.1 Class 10 Maths Question 2.
Construct a triangle of sides 4 cm, 5 cm and 6 cm and then a triangle similar to it whose sides are 23 of the corresponding sides of the first triangle.
Solution:

Steps of Construction:

1. Draw AC – 6 cm (ii) With A and Cas centres and radii 4 cm.
2. 5 cm respectively draw two ares intersecting each other at B. Join BA and BC.
3. Draw a ray AY making an acute angle with AC.
4. Locate three points and Ron AY, such that AP – POQR.
5. Join CR.
6. Through o. draw a line QC' parallel to RC (by making an angle equal to ∠ARC) meeting the line segment AC at C'.



7. Similarly, through C, draw a line B'C parallel to CB

Thus, ABC is the required triangle, which is similar to ΔABC with scale factor $\frac{2}{3}$

Justification:

By construction, we have:

$$\frac{AC'}{C'C} = \frac{2}{1} \text{ or } \frac{C'C}{AC'} = \frac{1}{2}$$

$$\therefore \quad \frac{AC}{AC'} = \frac{AC' + C'C}{AC'} = 1 + \frac{C'C}{AC'}$$

$$\Rightarrow \quad \frac{AC}{AC'} = 1 + \frac{1}{2} = \frac{3}{2} \qquad \Rightarrow \quad \frac{AC'}{AC} = \frac{2}{3}$$

Also C'B' $\parallel$ CB

$$\Rightarrow \quad \Delta B'AC' \sim \Delta BAC \qquad \text{[By AA similarity]}$$

$$\text{So, } \frac{B'A}{BA} = \frac{B'C'}{BC} = \frac{AC'}{AC} = \frac{2}{3}$$

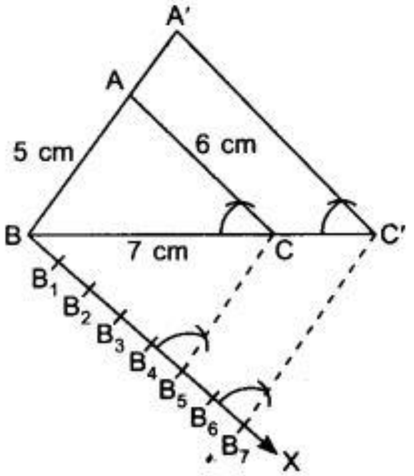
[$\angle C = \angle C'$ (by construction) and $\angle A = \angle A$ (common)]

Ex 11.1 Class 10 Maths Question 3.
Construct a triangle with sides 5 cm, 6 cm, and 7 cm and then another triangle whose sides are 75 of the corresponding sides of the first triangle.
Solution:

Steps of Construction:

1. Draw a ΔABC with AB = 5 cm, BC = 7 cm and AC = 6 cm.
2. Draw an acute angle CBX below BC at point B.
3. Mark the ray BX as B_1, B_2, B_3, B_4, B_5, B_6 and B_7 such that $BB_1 = B_1B_2 = B_2B_3 = B_3B_4 = B_4B_5 = B_5B_6 = B_6B_7$.
4. Join B_5 to C.
5. Draw B_7C' parallel to B_5C, where C' is a point on extended line BC.
6. Draw $A'C' \parallel AC$, where A' is a point on extended line BA.

A'BC' is the required triangle.



Justification: In ΔABC and $\Delta A'BC'$,

$$AC \parallel A'C'$$

$$\frac{AB}{A'B} = \frac{BC}{BC'} \quad \text{(By the Basic Proportionality Theorem) ...}(i)$$

In ΔBB_5C and $\Delta BB_7C'$,

$$B_5C \parallel B_7C'$$

$$\frac{BC}{BC'} = \frac{BB_5}{BB_7} = \frac{5}{7} \quad \text{(By the Basic Proportionality Theorem) ...}(ii)$$

Equating (i) and (ii) $\quad \frac{AB}{A'B} = \frac{BB_5}{BB_7} \Rightarrow \frac{AB}{A'B} = \frac{5}{7}$

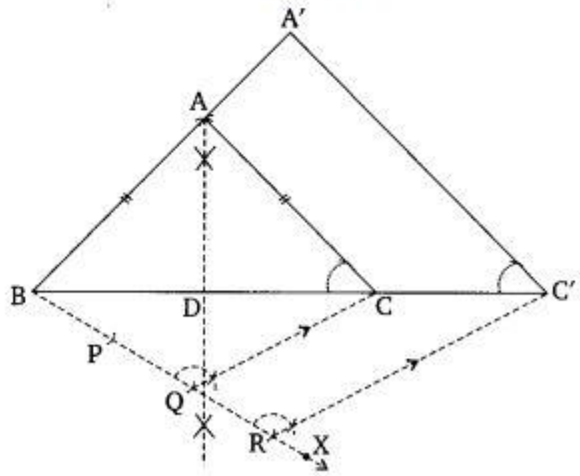
$\therefore \quad A'B = \frac{7}{5}AB$

$\therefore$ Sides of new triangle formed is $\frac{7}{5}$ times the corresponding sides of first triangle.

Ex 11.1 Class 10 Maths Question 4.
Construct an isosceles triangle whose base is 8 cm and altitude 4 cm and then another triangle whose sides are 112 times the corresponding sides of the isosceles triangle.
Solution:

Steps of Construction:

1. Construct an isosceles triangle ABC in which BC – 8 cm and altitude AD is 4 cm.
2. Draw a ray BX, making an acute angle with BC.
3. Locate 3 points on BX, such that BP – PQ = QR.
4. Join QC.
5. Through R, draw a line RC parallel to QC, meeting produced line BC at C'.
6. Through C, draw a line CA parallel to CA, meeting the produced line BA at A'.



Thus, ΔA'BC' is the required isosceles triangle

Justification:

In ΔABC and ΔA'BC', we have:

$\angle ACB = \angle A'C'B$ [Corresponding angles]

$\angle B = \angle B$ [Common]

$\therefore \Delta ABC \sim \Delta A'BC'$ [By AA similarity]

$$\therefore \quad \frac{AB}{A'B} = \frac{AC}{A'C'} = \frac{BC}{BC'}$$

$$\text{But, } \frac{BC}{BC'} = \frac{BQ}{BR} = \frac{2}{3} \quad \therefore \quad \frac{BC}{BC'} = \frac{2}{3} \text{ and}$$

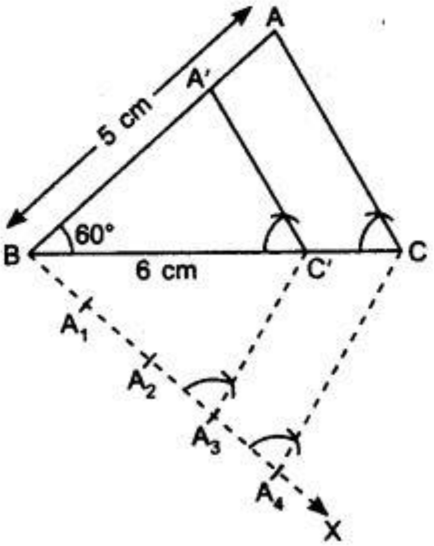
$$\Rightarrow \quad \frac{A'B}{AB} = \frac{A'C'}{AC} = \frac{B'C}{BC} = \frac{3}{2}.$$

Ex 11.1 Class 10 Maths Question 5.
Draw a triangle ABC with side BC = 6 cm, AB = 5 cm and ∠ABC = 60°. Then construct a triangle whose sides are 34 of the corresponding sides of the triangle ABC.
Solution:

Steps of Construction:

1. Draw a line segment BC = 6 cm and at point B draw an $\angle ABC = 60°$.
2. Cut AB = 5 cm. Join AC. We obtain a ΔABC.
3. Draw a ray BX making an acute angle with BC on the side opposite to the vertex A.
4. Locate 4 points A_1, A_2, A_3 and A_4 on the ray BX so that $BA_1 = A_1A_2 = A_2A_3 = A_3A_4$.
5. Join A_4 to C.
6. At A_3, draw $A_3C' \parallel A_4C$, where C' is a point on the line segment BC.
7. At C', draw $C'A' \parallel CA$, where A' is a point on the line segment BA.

$\therefore$ $\Delta A'BC'$ is the required triangle.



Justification: In $\Delta A'BC'$ and ΔABC,

$$A'C' \parallel AC$$

$$\frac{A'B}{AB} = \frac{BC'}{BC} \quad \text{(By the Basic Proportionality Theorem) ...}(i)$$

In $\Delta BA_3C'$ and ΔBA_4C,

$$A_3C' \parallel A_4C$$

$$\frac{BC'}{BC} = \frac{BA_3}{BA_4} = \frac{3}{4} \quad \text{(By the Basic Proportionality Theorem)}$$

$$\therefore \quad \frac{BC'}{BC} = \frac{3}{4} \quad ...(ii)$$

From (*i*) and (*ii*), we get

$$\frac{A'B}{AB} = \frac{3}{4} \Rightarrow A'B = \frac{3}{4}AB$$

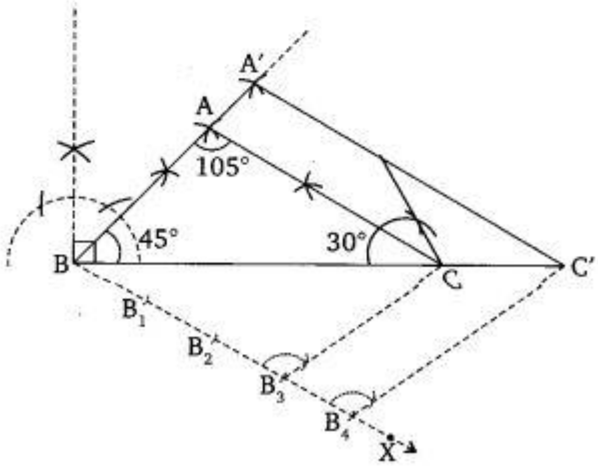
$\therefore$ Sides of new triangle formed are $\frac{3}{4}$ times the corresponding sides of first triangle.

Ex 11.1 Class 10 Maths Question 6.
Draw a triangle ABC with side BC = 7 cm, ∠B = 45°, ∠A = 105°. Then, construct a triangle whose sides are 43 times the corresponding sides of ∆ABC.
Solution:

Steps of Construction:

1. Draw a line segment BC – 7 cm.
2. Draw ∠ABC = 45° and ∠ACB = 30°, i.e., ∠BAC = 105°.
3. We get ΔABC
4. Draw a ray BX making an acute angle with BC
5. Mark four points B_1, B_2, B_3 and B_4 on BX, such that $BB_1 = B_1B_2 = B_2B_3 = B_3B_4$.
6. Join B_3C.
7. Through B_4 draw a line B_4C' parallel to B_3C, intersecting the extended line segment BC at C'.
8. Through C', draw a line A'C' parallel to CA, intersecting the extended line segment BA at A'.

Thus, A'BC' is the required triangle.



Justification:

In ΔABC and ΔA'BC',

$\angle ABC = \angle A'BC'$ [Common]

$\angle ACB = \angle A'C'B$ [Corresponding angles]

$\therefore \Delta ABC \sim \Delta A'BC'$ [By AA similarity]

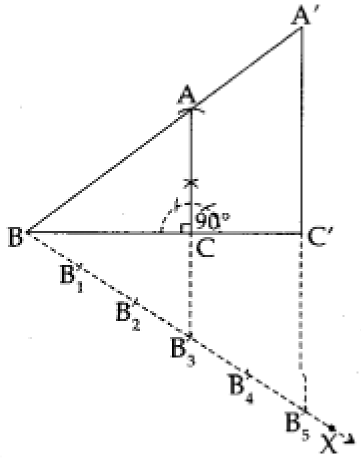
$$\therefore \quad \frac{AB}{A'B} = \frac{AC}{A'C'} = \frac{BC}{BC'}$$

$$\text{But,} \quad \frac{BC}{BC'} = \frac{BB_3}{BB_4} = \frac{3}{4}$$

$$\therefore \quad \frac{BC'}{BC} = \frac{4}{3}$$

$$\Rightarrow \quad \frac{A'B}{AB} = \frac{A'C'}{AC} = \frac{BC'}{BC} = \frac{4}{3}.$$

Ex 11.1 Class 10 Maths Question 7.
Draw a right triangle in which the sides (other than hypotenuse) are of lengths 4 cm and 3 cm. Then construct another triangle whose sides are 53F times the corresponding sides of the given triangle.
Solution:
Steps of Construction:
1. Construct a $\triangle ABC$, such that BC = 4 cm, CA = 3 cm and $\angle BCA = 90°$
2. Draw a ray BX making an acute angle with BC.
3. Mark five points B_1, B_2, B_3, B_4 and B_5 on BX, such that $BB_1 = B_1B_2 = B_2B_3 = B_3B_4 = B_4B_5$.
4. Join B_3C.
5. Through B_5, draw B_5C' parallel to B_3C intersecting BC produced at C'.
6. Through C', draw C'A' parallel to CA intersecting AB produced at A'.
Thus, $\triangle A'BC'$ is the required right triangle.



Justification:

In ΔABC and $\Delta A'BC'$, we have:

$\angle ABC = \angle A'BC'$ [Common]

$\angle ACB = \angle A'C'B$ [Corresponding angles]

$\therefore \Delta ABC \sim \Delta A'BC'$ [By AA similarity]

$$\therefore \frac{AB}{A'B} = \frac{AC}{A'C'} = \frac{BC}{BC'}$$

$$\text{But, } \frac{BC}{BC'} = \frac{BB_3}{BB_5} = \frac{3}{5}$$

$$\therefore \frac{BC'}{BC} = \frac{5}{3}$$

$$\Rightarrow \frac{A'B}{AB} = \frac{A'C'}{AC} = \frac{BC'}{BC} = \frac{5}{3}.$$

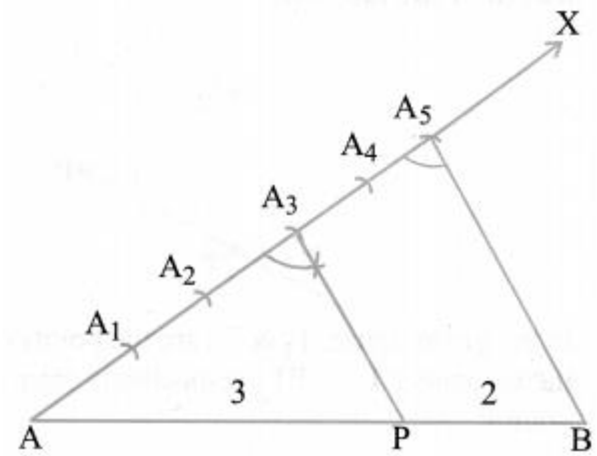
Class 10 Maths Constructions Mind Maps

Construction

Construction implies drawing geometrical figures accurately such that triangles, quadrilateral and circles with the help of ruler and compass.

Division of a Line Segment

A line segment can be divided in a given ratio (both internally and externally)
Example:
Divide a line segment of length 12 cm internally in the ratio 3:2.
Solution :
Steps of construction :
(i) Draw a line segment AB = 12 cm. by using a ruler.
(ii) Draw a ray making a suitable acute angle ∠BAX with AB.

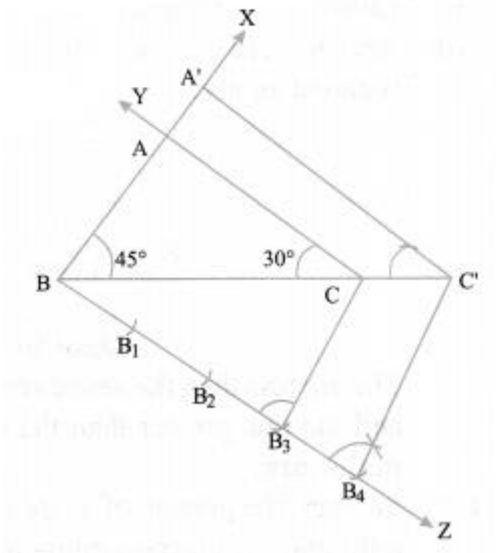


(iii) Along AX, draw 5 (= 3 + 2) arcs intersecting the ray AX at A_1? A_2, A_3, A_4 and A_5 such that
$AA_1 = A_1A_2 = A_2A_3 = A_3A_4 = A_4A_5$
(iv) Join BA_5.
(v) Through A_3 draw a line A_3P parallel to A_5B making $\angle AA_3P = \angle AA_5B$, intersecting AB at point P.
The point P so obtained is the required point, which divides AB internally in the ratio 3 : 2.

Similar Triangles

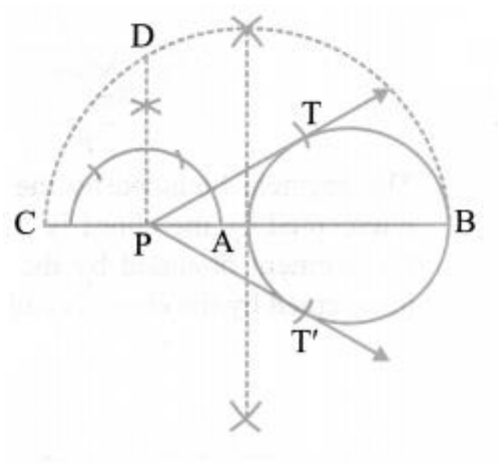
(i) This Construction involves two different situation.
(a) Construction of a similar triangle smaller than the given triangle.

(b) Construction of a similar triangle greater than the given triangle.
(ii) The ratio of sides of the triangle to be constructed with the corresponding sides of the given triangle is called scale factor.
Example:
Draw a triangle ABC with side BC = 7 cm. ∠B = 45°, ∠A = 105°. Construct a triangle whose sides are (4/3) times the corresponding side of ∆ABC.



Solution :
Steps of construction :
(i) Draw BC = 7 cm.
(ii) Draw a ray BX and CY such that ∠CBX= 45° and
∠BCY = 180° – (45° + 105°) = 30°
Suppose BX and CY intersect each other at A.
∆ABC so obtained is the given triangle.
(iii) Draw a ray BZ making a suitable acute angle with BC on opposite side of vertex A with respect to BC.
(iv) Draw four (greater of 4 and 3 in 4/3) arcs intersecting the ray BZ at B_1, B_2, B_3, B_4 such that $BB_1 = B_1B_2 = B_2B_3 = B_3B_4$.
(v) Join B_3 to C and draw a line through B_4 parallel to B_3C, intersecting the extended line segment BC at C'.
(vi) Draw a line through C' parallel to CA intersecting the extended line segment BA at A'. Triangle A'BC' so obtained is the required triangle.
Tangents to a Circle

Two tangents can be drawn to a given circle from a point outside it.
Example:
Draw a circle of radius 4 cm. Take a point P outside the circle. Without using the centre of the circle, draw two tangents to the circle from point P.
Solution :

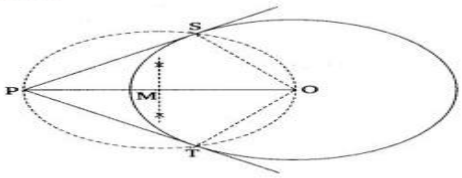


Steps of construction :
(i) Draw a circle of radius 4 cm.
(ii) Take a point P outside the circle and draw a secant PAB, intersecting the circle at A and B.
(iii) Produce AP to C such that AP = CP.
(iv) Draw a semi-circle with CB as diameter.
(v) Draw PD ⊥ CB, intersecting the semi-circle at D.
(vi) With P as centre and PD as radius draw arcs to intersect the given circle at T and T'
(vii) Join PT and PT'. Then, PT and PT' are the required tangents.
Note:
If centre of a circle is not given, then it can be located by finding point of intersection of perpendicular bisector, of any two nonparallel chords of a circle.

Ex 11.2 Class 10 Maths Question 1.
Draw a circle of radius 6 cm. From a point 10 cm away from its centre, construct the pair of tangents to the circle and measure their lengths.
Solution:

Steps of Construction:
1. Draw a circle with centre and radices = 6 cm.
2. Take a point P such that OP = 10 cm.
3. Draw the perpendicular bisector of OP. Let M is the mid-point of OP.
4. With centre M and radius PM = MO, draw a circle which cuts the given circle at S and T.
5. Join PS and PT.

Thus, PS and PT are the required tangents.
The length of tangents Ps= PT = 8 cm.

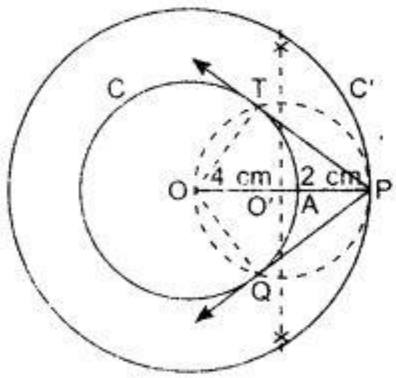


Justification:
Join OS.
Now in triangle PSO,
$\angle PSO = 90°$
$\therefore PS = \sqrt{OP^2 - OS^2}$ [By Pythagoras' Theorem]
$= \sqrt{(10)^2 - (6)^2} = \sqrt{100 - 36} = \sqrt{64}$
$= 8$ cm.

Ex 11.2 Class 10 Maths Question 2.
Construct a tangent to a circle of radius 4 cm from a point on the concentric circle of radius 6 cm and measure its length. Also verify the measurement by actual calculation.
Solution:

Steps of Construction:

1. Draw concentric circles of radius OA = 4 cm and OP = 6 cm having same centre O.
2. Mark these circles as C and C'.
3. Points O, A and P lie on the same line.
4. Draw perpendicular bisector of OP, which intersects OP at O'.
5. Take O' as centre, draw a circle of radius OO' which intersects the circle C at points T and Q.
6. Join PT and PQ, these are the required tangents.
7. Length of these tangents are approx. 4.5 cm.



Justification: Join OT and OQ.

$OT \perp PT$ [Radius $\perp$ to tangent]

In right angled ΔOTP, $OP^2 = OT^2 + PT^2 \Rightarrow (6)^2 = (4)^2 + PT^2$

$\Rightarrow 36 = 16 + PT^2 \Rightarrow 20 = PT^2$

$\Rightarrow PT = \sqrt{20} \Rightarrow PT = 2\sqrt{5}$ cm

Similarly, $PQ = 2\sqrt{5}$ cm

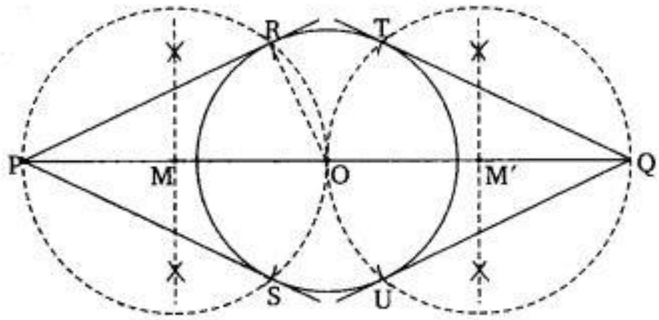
A pair of tangents can be drawn to a circle from an external point outside the circle. These two tangents are equal in lengths.

$\therefore PT = PQ.$

Ex 11.2 Class 10 Maths Question 3.
Draw a circle of radius 3 cm. Take two points P and Q on one of its extended diameter each at a distance of 7 cm from its centre. Draw tangents to the circle from these two points P and Q.
Solution:

Steps of Construction:

1. With centre and radius 3 cm, draw a circle.
2. Produce the diameter of circle to both the ends up to P and such that OP = OQ = 7 cm
3. Mark the mid-points M and M' of OP and OQ respectively
4. With centres M and M' and radii MP and MO respectively, draw two circles.



5. Circle with centre M intersects the given circle at Rand S. The circle with centre M intersects the given circle at T and U.
6. Join PR, PS, QT and QU.

Thus, we have PR and PS as a pair of tangents from P and OT and QU as another pair of tangents from Q drawn to the given circle.

Justification:

Join OR. Now in ΔPRO,

∠PRO = 90° [Angle in a semicircle]

Also OR is the radius of the circle with centre O.

∴ Line PR⊥ OR.

We know that a line drawn through the end of a radius and perpendicular to it, is a tangent to the circle.

Hence, PR is the tangent to the point R similarly, PS, QT and QU are the tangents at the points S, T and U respectively.

Ex 11.2 Class 10 Maths Question 4.
Draw a pair of tangents to a circle of radius 5 cm which are inclined to each

other at an angle of 60°.

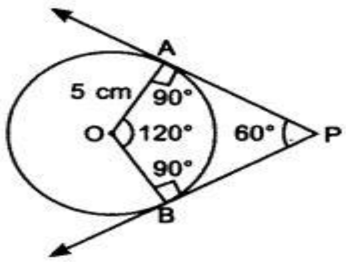
Solution:

Steps of Construction:

1. Draw a circle of radius 5 cm.
2. As tangents are inclined to each other at an angle of 60°.

∴ Angle between the radii of circle is 120°. (Use quadrilateral property)

3. Draw radii OA and OB inclined to each other at an angle 120°.
4. At points A and B, draw 90° angles. The arms of these angles intersect at point P.
5. PA and PB are the required tangents.

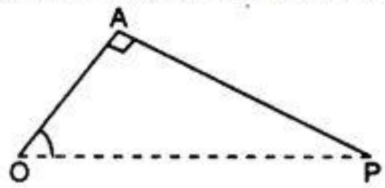


Justification: In quadrilateral AOBP,

AP and BP are the tangents to the circle.

Join OP.

In right angled ΔOAP, OA ⊥ PA [Radius is ⊥ to tangent]



OAPB forms a quadrilateral

$$\therefore \quad \angle AOB = 120^\circ$$

$$\angle AOP = 60^\circ$$

OP bisects ∠AOB

$$OA = 5 \text{ cm}$$

$$\therefore \quad \tan 60^\circ = \frac{AP}{OA} = \frac{AP}{5}$$

$$\Rightarrow \quad \sqrt{3} = \frac{AP}{5} \Rightarrow AP = 5\sqrt{3} \text{ cm.}$$

Similarly, $BP = 5\sqrt{3}$ **cm.**

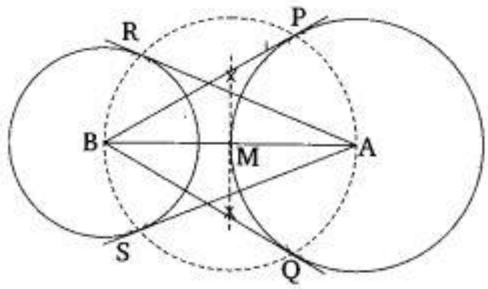
A pair of tangents can be drawn to a circle from an external point outside the circle. These two tangents a equal in lengths.

∴ PA = PB.

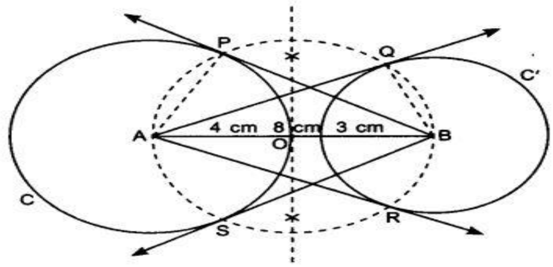
Ex 11.2 Class 10 Maths Question 5.
Draw a line segment AB of length 8 cm. Taking A as centre, draw a circle of radius 4 cm and taking B as centre, draw another circle of radius 3 cm. Construct tangents to each circle from the centre of the other circle.
Solution:

Steps of Construction:

1. Draw a line segment AB = 8 cm.
2. With centres A and B and radil 4 cm and 3 cm respectively draw two circles.
3. Mark the mid-point M of AB,
4. With centre M and radius AM = BM, draw a circle intersecting the two circles at P, Q and R, S.
5. Join AP, AQ, BR and BS.



Thus, AR and AS are a pair of tangents drawn from A to the given circle, and BP and BO are a pair of tangents drawn from B to the given circle.



Justification: Join AP

In ΔABP, $AP \perp BP$ **[Radius ⊥ to tangent]**

$AP = 4$ cm and $AB = 8$ cm

$AB^2 = AP^2 + BP^2$

$\Rightarrow (8)^2 = (4)^2 + BP^2 \Rightarrow 64 = 16 + BP^2$

$\Rightarrow 64 - 16 = BP^2 \Rightarrow 48 = BP^2$

$\Rightarrow BP = \sqrt{16 \times 3} \Rightarrow BP = 4\sqrt{3}$ cm

Similarly, $BS = 4\sqrt{3}$ cm

Join BQ.

In ΔABQ, $BQ \perp AQ$ **[Radius ⊥ to tangent]**

$BQ = 3$ cm

$AB^2 = BQ^2 + AQ^2 \Rightarrow (8)^2 = (3)^2 + AQ^2$

$\Rightarrow 64 = 9 + AO^2 \Rightarrow 64 - 9 = AQ^2$

$\Rightarrow 55 = AQ^2 \Rightarrow AQ = \sqrt{55}$ cm

Similarly, $AR = \sqrt{55}$ cm

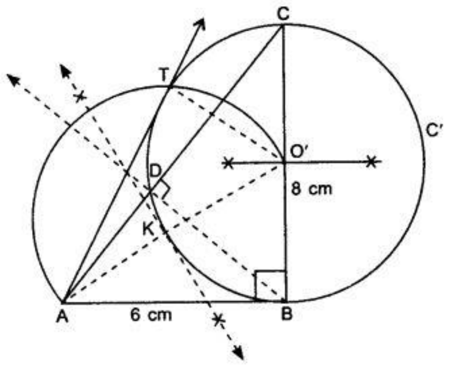
A pair of tangents can be drawn to a circle from an external point outside the circle. These two tangents arc equal in lengths.

∴ AQ = AR and BP=BS.

Ex 11.2 Class 10 Maths Question 6.
Let ABC be a right triangle in which AB = 6 cm, BC = 8 cm and ∠B = 90°. BD is the perpendicular Burn B on AC. The circle through B, C, D is drawn. Construct the tangents from A to this circle.
Solution:

Steps of Construction:

1. Draw a right triangle ABC with AB = 6 cm, BC = 8 cm and ∠B = 90°.
2. From B, draw BD perpendicular to AC.
3. Draw perpendicular bisector of BC which intersect BC at point O'.
4. Take O' as centre and O'B as radius, draw a circle C' passes through points B, C and D.
5. Join O'A and draw perpendicular bisector of O'A which intersect O'A at point K.
6. Take K as centre, draw an arc of radius KO' intersect the previous circle C' at T.
7. Join AT, AT is required tangent.



Justification:

∠ BDC = 90°

∴ BC acts as diameter.

AB is tangent to circle having centre O'

Join O'T.

In ΔAO'T, $AO'^2 = AT^2 + O'T^2$

BC is diameter $O'B = \frac{1}{2}BC = \frac{1}{2}(8) = 4$ cm

$O'B = 4$ cm

$O'B = O'T = 4$ cm

$AO'^2 = AB^2 + O'B^2 \Rightarrow AO'^2 = (6)^2 + (4)^2$

$\Rightarrow AO'^2 = 36 + 16 = 52\text{ cm}^2$

$\therefore AT^2 + O'T^2 = AO'^2 \Rightarrow AT^2 + (4)^2 = 52$

$\Rightarrow AT^2 = 52 - 16 = 36 \Rightarrow AT = 6$ cm

$\Rightarrow AT = AB = 6$ cm

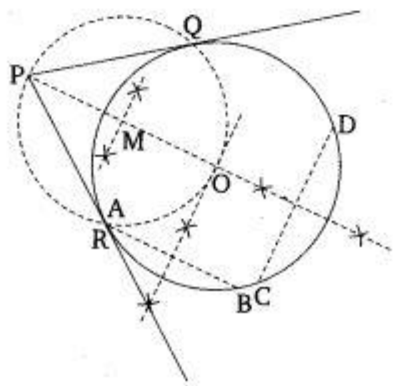
A pair of tangents can be drawn to a circle from an external point outside the circle. These two tangents are equal in lengths.

∴ AB = AT.

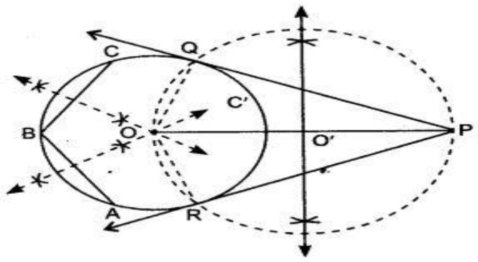
Ex 11.2 Class 10 Maths Question 7.
Draw a circle with the help of a bangle. Take a point outside the circle. Construct the pair of tangents from this point to the circle.
Solution:

Steps of Construction:

1. Draw a circle with bangle.
2. Take two non-parallel chords AB and CD of the circle
3. Draw perpendicular bisectors of these chords intersecting each other at O, which is the centre of the circle.
4. Take a pomt P outside the circle.
5. Join OP.
6. Mark the mid-point M of OP.
7. With M as centre and radius equal to MP = OM, draw a circle intersecting the first circle at and R.
8. Join PQ and PR.



Thus, PQ and PR are the required tangents.



Justification: Join OQ and OR.

In ΔOQP and ΔOPR,	$OQ = OR$	[Radii of the circle]
	$OP = OP$	[Common]
	$\angle Q = \angle R = 90°$	[Radius is $\perp$ to tangent]
	$\Delta OQP \cong \Delta ORP$	[by RHS]
$\therefore$	$PQ = PR$	[By C.P.C.T]

A pair of tangents can be drawn to a circle from an external point laying outside the circle. These two tangents are equal in lengths.
$\therefore PQ = QR$