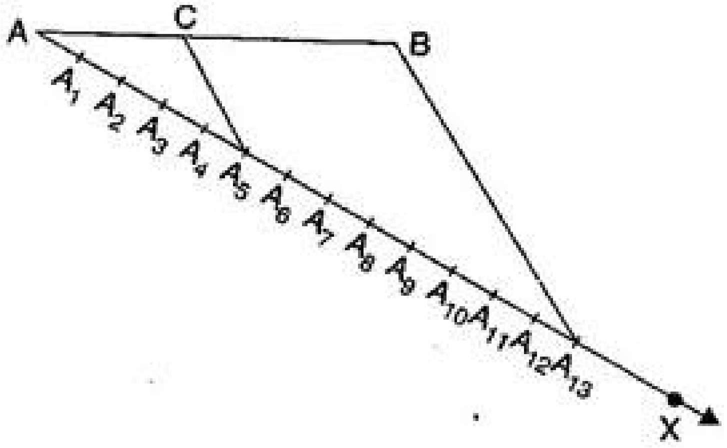
CBSE Class–10 Mathematics
NCERT solution
Chapter - 11
Constructions - Exercise 11.1

In each of the following, give the justification of the construction also:

1. Draw a line segment of length 7.6 cm and divide it in the ratio 5 : 8. Measure the two parts.

Ans. Given: A line segment of length 7.6 cm.

To construct: To divide it in the ratio 5 : 8 and to measure the two parts.



Steps of construction:

(a) From a point A, draw any ray AX, making an acute angle with AB.

(b) Locate 13 (=5 + 8) points $A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8, A_9, A_{10}, A_{11}, A_{12}$ and A_{13} on AX such that

$$AA_1 = A_1A_2 = A_2A_3 = A_3A_4 = A_4A_5 = A_5A_6 = A_6A_7 = A_7A_8 = A_8A_9 = A_9A_{10} = A_{10}A_{11} = A_{11}A_{12} = A_{12}A_{13}$$

(c) Join BA_{13}.

(d) Through the point A_5, draw a line parallel to $A_{13}B$ intersecting AB at the point C.

Then, AC : CB = 5 : 8

On measurement we get, AC = 3.1 cm and CB = 4.5 cm

Justification:

$\because A_5C \parallel A_{13}B$ [By construction]

$$\therefore \frac{AA_5}{A_5A_{13}} = \frac{AC}{CB}$$

[By Basic Proportionality Theorem]

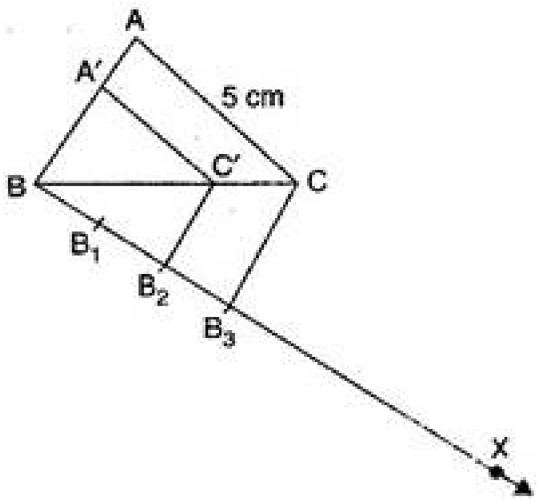
But $\frac{AA_5}{A_5A_{13}} = \frac{5}{8}$ [By construction]

Therefore, $\frac{AC}{CB} = \frac{5}{8}$

$\Rightarrow$ AC : CB = 5 : 8

2. Construct a triangle of sides 4 cm, 5 cm and 6 cm and then a triangle similar to it whose sides are $\frac{2}{3}$ of the corresponding sides of the first triangle.

Ans. To construct: To construct a triangle of sides 4 cm, 5 cm and 6 cm and then a triangle similar to it whose sides are $\frac{2}{3}$ of the corresponding sides of the first triangle.



Steps of construction:

(a) Draw a triangle ABC with sides AB = 4 cm, AC = 5 cm and BC = 6 cm.
(b) From point B, draw any ray BX, making an acute angle with BC on the side opposite to the

vertex A.

(c) Locate 3 points B_1, $B_2 and\ B_3$ on BX such that $BB_1 = B_1B_2 = B_2B_3$.

(d) Join B_3C and draw a line through the point B_2, draw a line parallel to B_3C intersecting BC at the point C'.

(e) Draw a line through C' parallel to the line CA to intersect BA at A'.

Then, A'BC' is the required triangle.

Justification:

$\because B_3C \parallel B_2C'$ [By construction]

$$\therefore \frac{BB_2}{B_2B_3} = \frac{BC'}{C'C}$$

[By Basic Proportionality Theorem]

But $\dfrac{BB_2}{B_2B_3} = \dfrac{2}{1}$ [By construction]

Therefore, $\dfrac{BC'}{C'C} = \dfrac{2}{1}$

$$\Rightarrow \frac{C'C}{BC'} = \frac{1}{2}$$

$$\Rightarrow \frac{C'C}{BC'} + 1 = \frac{1}{2} + 1$$

$$\Rightarrow \frac{C'C + BC'}{BC'} = \frac{1+2}{2}$$

$$\Rightarrow \frac{BC}{BC'} = \frac{3}{2}$$

$$\Rightarrow \frac{BC'}{BC} = \frac{2}{3} \quad ....(i)$$

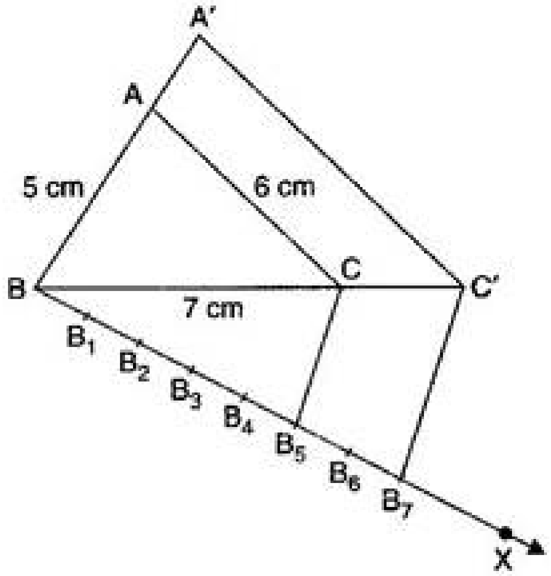
$\because$ CA $\parallel$ C'A' [By construction]

$\therefore$ ΔBC'A' $\sim$ ΔBCA [AA similarity]

$\therefore \frac{AB'}{AB} = \frac{A'C'}{AC} = \frac{BC'}{BC} = \frac{2}{3}$ [From eq. (i)]

3. Construct a triangle with sides 6 cm, 6 cm and 7 cm and then another triangle whose sides are $\frac{7}{5}$ of the corresponding sides of the first triangle.

Ans. To construct: To construct a triangle of sides 5 cm, 6 cm and 7 cm and then a triangle similar to it whose sides are $\frac{7}{5}$ of the corresponding sides of the first triangle.



Steps of construction:

(a) Draw a triangle ABC with sides AB = 5 cm, AC = 6 cm and BC = 7 cm.

(b) From the point B, draw any ray BX, making an acute angle with BC on the side opposite to the vertex A.

(c) Locate 7 points $B_1, B_2, B_3, B_4, B_5, B_6$ and B_7 on BX such that

$BB_1 = B_1B_2 = B_2B_3 = B_3B_4 = B_4B_5 = B_5B_6 = B_6B_7$.

(d) Join B_5C and draw a line through the point B_7, draw a line parallel to B_5C intersecting BC at the point C'.

(e) Draw a line through C’ parallel to the line CA to intersect BA at A’.

Then, A’BC’ is the required triangle.

Justification:

$\because$ C’A’ || CA [By construction]

$\therefore$ $\triangle$ABC ~ $\triangle$A’BC’ [AA similarity]

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

[By Basic Proportionality Theorem]

$\because B_7C' \parallel B_5C$ [By construction]

$\therefore \Delta BB_7C' \sim \Delta BB_5C$ [AA similarity]

But $\frac{BB_5}{BB_7} = \frac{5}{7}$ [By construction]

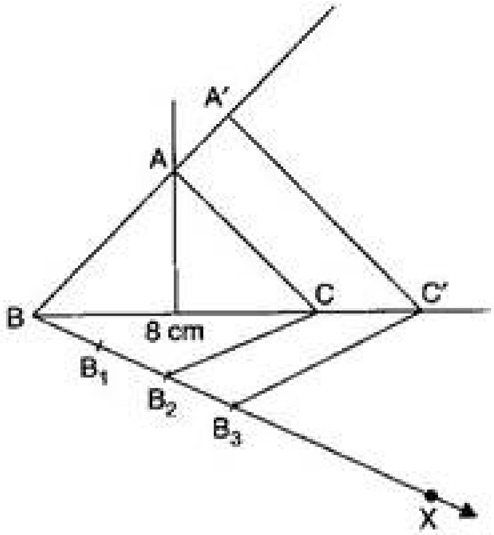
Therefore, $\frac{BC}{BC'} = \frac{5}{7}$

$$\Rightarrow \frac{BC'}{BC} = \frac{7}{5}$$

$$\therefore \frac{A'B}{AB} = \frac{A'C'}{AC} = \frac{BC'}{BC} = \frac{7}{5}$$

4. Construct an isosceles triangle whose base is 8 cm and altitude 4 cm and then another triangle whose sides are $1\frac{1}{2}$ times the corresponding sides of the isosceles triangle.

Ans. To construct: To construct an isosceles triangle whose base is 8 cm and altitude 4 cm and then a triangle similar to it whose sides are $1\frac{1}{2}\left(\text{or } \frac{3}{2}\right)$ of the corresponding sides of the first triangle.



Steps of construction:

(a) Draw BC = 8 cm

(b) Draw perpendicular bisector of BC. Let it meets BC at D.

(c) Mark a point A on the perpendicular bisector such that AD = 4 cm.

(d) Join AB and AC. Thus ΔABC is the required isosceles triangle.

(e) From the point B, draw a ray BX, making an acute angle with BC on the side opposite to the vertex A.

(f) Locate 3 points $B_1, B_2 and\ B_3$ on BX such that $BB_1 = B_1B_2 = B_2B_3$.

(g) Join B_2C and draw a line through the point B_3, draw a line parallel to B_2C intersecting BC at the point C'.

(h) Draw a line through C' parallel to the line CA to intersect BA at A'.

Then, A'BC' is the required triangle.

Justification:

$\because$ C'A' || CA [By construction]

$\therefore$ ΔABC ~ ΔA'BC' [AA similarity]

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

[By Basic Proportionality Theorem]

$\because B_3C' \parallel B_2C$ [By construction]

$\therefore \Delta BB_3C' \sim \Delta BB_2C$ [AA similarity]

But $\frac{BB_3}{BB_2} = \frac{3}{2}$ [By construction]

Therefore,

$\Rightarrow \frac{BC'}{BC} = \frac{3}{2}$

$\therefore \frac{A'B}{AB} = \frac{A'C'}{AC} = \frac{BC'}{BC} = \frac{3}{2}$

Hence, we get the new triangle similar to the given triangle whose sides are equal to $\frac{3}{2}$ i.e., $1\frac{1}{2}$ times of corresponding sides of triangle ABC.

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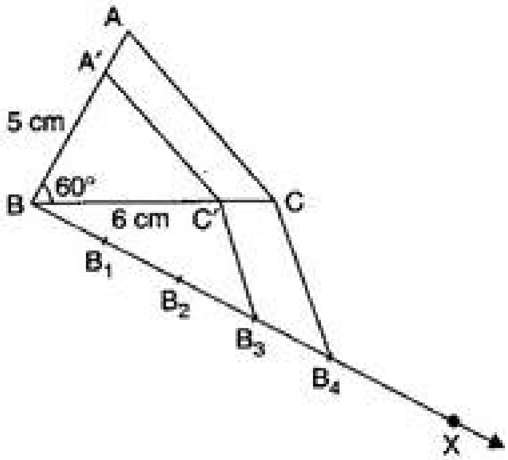
5. Draw a triangle ABC with side BC = 6 cm, AB = 5 cm and $\angle$ ABC = 60°. Then construct a triangle whose sides are $\frac{3}{4}$ of the corresponding sides of triangle ABC.

Ans. To construct: To construct a triangle ABC with side BC = 6 cm, AB = 5 cm and $\angle$ ABC = 60° and then a triangle similar to it whose sides are $\frac{3}{4}$ of the corresponding sides of the first triangle ABC.



Steps of construction:

(a) Draw a triangle ABC with side BC = 6 cm, AB = 5 cm and $\angle$ ABC = 60°.

(b) From the point B, draw a ray BX, making an acute angle with BC on the side opposite to the vertex A.

(c) Locate 4 points $B_1, B_2, B_3 and\ B_4$ on BX such that $BB_1 = B_1B_2 = B_2B_3 = B_3B_4$.

(d) Join B_4C and draw a line through the point B_3, draw a line parallel to B_4C intersecting BC at the point C'.

(e) Draw a line through C' parallel to the line CA to intersect BA at A'.

Then, A'BC' is the required triangle.

Justification:

$\because B_4C \parallel B_3C'$ [By construction]

$$\therefore \frac{BB_3}{BB_4} = \frac{BC'}{BC}$$

[By Basic Proportionality Theorem]

But $\frac{BB_3}{BB_4} = \frac{3}{4}$ [By construction]

Therefore, $\frac{BC'}{BC} = \frac{3}{4}$ ....(i)

$\because$ CA $\parallel$ C'A' [By construction]

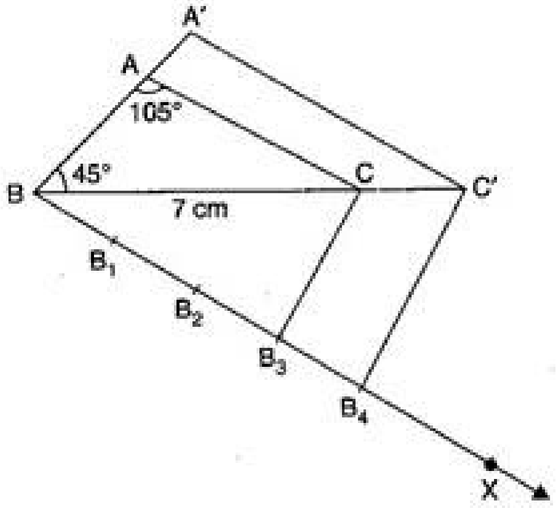
$\therefore$ ΔBC'A' ~ Δ BCA [AA similarity]

$$\therefore \frac{AB'}{AB} = \frac{A'C'}{AC} = \frac{BC'}{BC} = \frac{3}{4}$$ [From eq. (i)]

Hence, we get the new triangle similar to the given triangle whose sides are equal to $\frac{3}{4}$th of corresponding sides of triangle ABC.

6. Draw a triangle ABC with side BC = 7 cm, $\angle$ B = 45°, $\angle$ A = 105°. Then construct a triangle whose sides are $\frac{4}{3}$ times the corresponding sides of Δ ABC.

Ans. To construct: To construct a triangle ABC with side BC = 7 cm, $\angle$ B = 45° and $\angle$ C = 105° and then a triangle similar to it whose sides are $\frac{4}{3}$ of the corresponding sides of the first triangle ABC.



Steps of construction:

(a) Draw a triangle ABC with side BC = 7 cm, $\angle$ B = 45° and $\angle$ C = 105°.
(b) From the point B, draw a ray BX, making an acute angle with BC on the side opposite to the vertex A.
(c) Locate 4 points B_1, B_2, $B_3 and$ B_4 on BX such that $BB_1 = B_1B_2 = B_2B_3 = B_3B_4$.
(d) Join B_3C and draw a line through the point B_4, draw a line parallel to B_3C intersecting BC at the point C'.
(e) Draw a line through C' parallel to the line CA to intersect BA at A'.

Then, A'BC' is the required triangle.

Justification:

$\because B_4C' \parallel B_3C$ [By construction]

$\therefore \Delta BB_4C' \sim \Delta BB_3C$ [AA similarity]

$\therefore \dfrac{BB_4}{BB_3} = \dfrac{BC'}{BC}$

[By Basic Proportionality Theorem]

But $\dfrac{BB_4}{BB_3} = \dfrac{4}{3}$ [By construction]

Therefore, $\dfrac{BC'}{BC} = \dfrac{4}{3}$ ....(i)

$\because$ CA $\|$ C'A' [By construction]

$\therefore$ ΔBC'A' $\sim$ ΔBCA [AA similarity]

$\therefore \dfrac{A'B}{AB} = \dfrac{A'C'}{AC} = \dfrac{BC'}{BC} = \dfrac{4}{3}$ [From eq. (i)]

Hence, we get the new triangle similar to the given triangle whose sides are equal to $\frac{4}{3}$ times of corresponding sides of triangle ABC.

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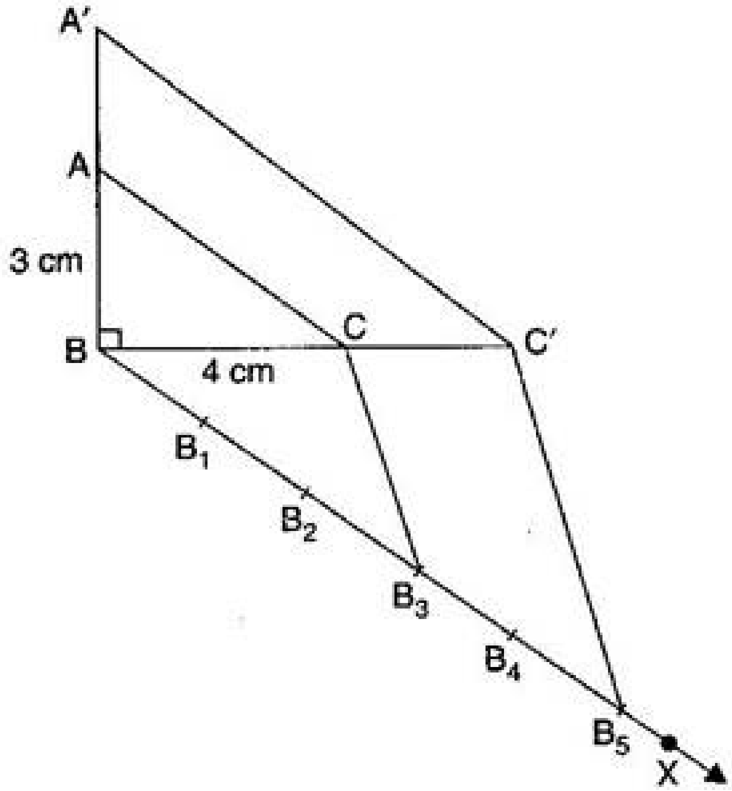
7. Draw a right triangle in which the sides (other than hypotenuse) are of lengths 4 cm and 3 cm. Then construct another triangle whose sides are $\frac{5}{3}$ times the corresponding sides of the given triangle.

Ans. To construct: To construct a right triangle in which sides (other than hypotenuse) are of lengths 4 cm and 3 cm and then a triangle similar to it whose sides are $\frac{5}{3}$ of the corresponding sides of the first triangle ABC.



Steps of construction:

(a) Draw a right triangle in which sides (other than hypotenuse) are of lengths 4 cm and 3 cm, right angled at B.

(b) From the point B, draw a ray BX, making an acute angle with BC on the side opposite to the vertex A.

(c) Locate 5 points $B_1, B_2, B_3, B_4 and\ B_5$ on BX such that

$BB_1 = B_1B_2 = B_2B_3 = B_3B_4 = B_4B_5$.

(d) Join B_3C and draw a line through the point B_5, draw a line parallel to B_3C intersecting BC at the point C'.

(e) Draw a line through C' parallel to the line CA to intersect BA at A'.

Then, A'BC' is the required triangle.

Justification:

$\because B_5C' \parallel B_3C$ [By construction]

$\therefore \Delta BB_5C' \sim \Delta BB_3C$ [AA similarity]

$\therefore \frac{BB_5}{BB_3} = \frac{BC'}{BC}$

[By Basic Proportionality Theorem]

But $\frac{BB_5}{BB_3} = \frac{5}{3}$ [By construction]

Therefore, $\frac{BC'}{BC} = \frac{5}{3}$ ....(i)

$\because$ CA $\parallel$ C'A' [By construction]

$\therefore$ $\triangle$BC'A' $\sim$ $\triangle$BCA [AA similarity]

$\therefore \frac{A'B}{AB} = \frac{A'C'}{AC} = \frac{BC'}{BC} = \frac{5}{3}$ [From eq. (i)]

Hence, we get the new triangle similar to the given triangle whose sides are equal to $\frac{5}{3}$ times of corresponding sides of triangle ABC.

CBSE Class–10 Mathematics

NCERT solution

Chapter - 11

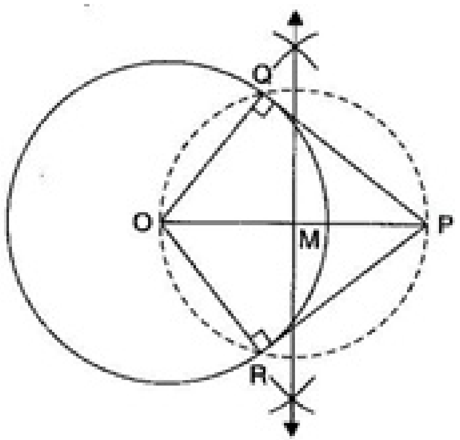
Constructions - Exercise 11.2

In each of the following, give the justification of the construction also:

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.

Ans. Given: A circle whose centre is O and radius is 6 cm and a point P is 10 cm away from its centre.

To construct: To construct the pair of tangents to the circle and measure their lengths.



Steps of Construction:

(a) Join PO and bisect it. Let M be the mid-point of PO.
(b) Taking M as centre and MO as radius, draw a circle. Let it intersects the given circle at the points Q and R.
(c) Join PQ and PR.

Then PQ and PR are the required two tangents.
By measurement, PQ = PR = 8 cm

Justification: Join OQ and OR.

Since $\angle$ OQP and $\angle$ ORP are the angles in semicircles.

$\therefore \angle OQP = 90^\circ = \angle ORP$

Also, since OQ, OR are radii of the circle, PQ and PR will be the tangents to the circle at Q and R respectively.

$\therefore$ We may see that the circle with OP as diameter increases the given circle in two points. Therefore, only two tangents can be draw.

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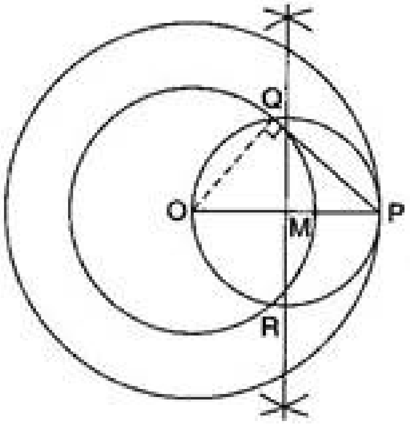
2. Construct a tangent to a circle of radius 4 cm from a point on the concentric circle of radius 6 cm and measure its length. Also verify the measurement by actual calculation.

Ans. To construct: To construct a tangent to a circle of radius 4 cm from a point on the concentric circle of radius 6 cm and measure its lengths. Also to verify the measurements by actual calculation.



Steps of Construction:
(a) Join PO and bisect it. Let M be the mid-point of PO.
(b) Taking M as centre and MO as radius, draw a circle. Let it intersects the given circle at the point Q and R.
(c) Join PQ.

Then PQ is the required tangent.

By measurement, PQ = 4.5 cm
By actual calculation,

PQ = $\sqrt{(OP)^2 + (OQ)^2}$

$= \sqrt{6^2 - 4^2} = \sqrt{36-16}$

$= \sqrt{20} = 4.47$ cm = 4.5 cm

Justification: Join OQ. Then $\angle$ PQO is an angle in the semicircle and therefore,

$\angle PQO = 90^\circ$

$\Rightarrow PQ \perp OQ$

Since, OQ is a radius of the given circle, PQ has to be a tangent to the circle.

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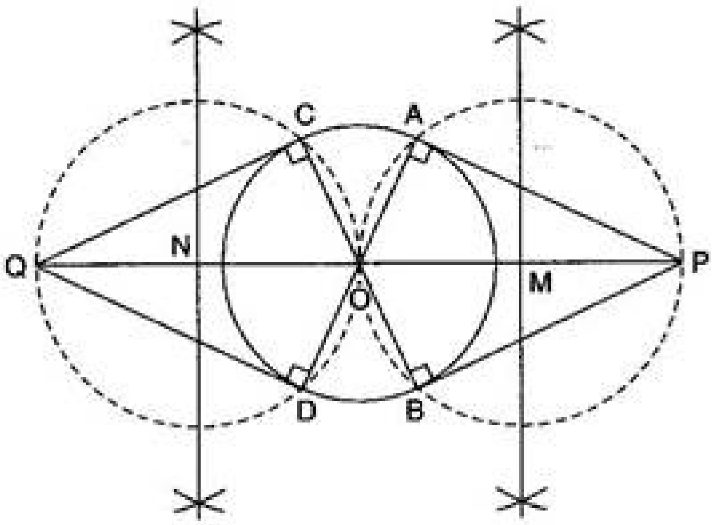
3. Draw a circle of radius 3 cm. Take two points P and Q on one of its extended diameter each at a distance of 7 cm from its centre. Draw tangents to the circle from these two points P and Q.

Ans. To construct: A circle of radius 3 cm and take two points P and Q on one of its extended diameter each at a distance of 7 cm from its centre and then draw tangents to the circle from these two points P and Q.



Steps of Construction:
(a) Bisect PO. Let M be the mid-point of PO.
(b) Taking M as centre and MO as radius, draw a circle. Let it intersects the given circle at the points A and B.
(c) Join PA and PB. Then PA and PB are the required two tangents.
(d) Bisect QO. Let N be the mid-point of QO.

(e) Taking N as centre and NO as radius, draw a circle. Let it intersects the given circle at the points C and D.
(f) Join QC and QD.

Then QC and QD are the required two tangents.

Justification: Join OA and OB.

Then $\angle$ PAO is an angle in the semicircle and therefore $\angle$ PAO = 90°.

$\Rightarrow$ PA $\perp$ OA

Since OA is a radius of the given circle, PA has to be a tangent to the circle. Similarly, PB is also a tangent to the circle.

Again join OC and OD.

Then $\angle$ QCO is an angle in the semicircle and therefore $\angle$ QCO = 90°.

Since OC is a radius of the given circle, QC has to be a tangent to the circle. Similarly, QD is also a tangent to the circle.

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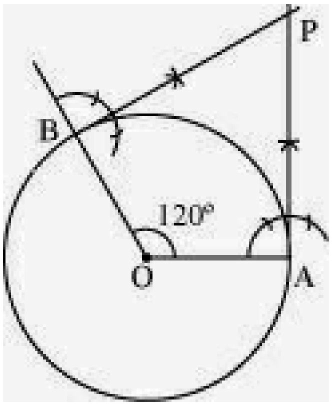
4. Draw a pair of tangents to a circle of radius 5 cm which are inclined to each other at an angle of 60°.

Ans. To construct: A pair of tangents to a circle of radius 5 cm which are inclined to each other at an angle of 60°.



Steps of Construction:

(a) Draw a circle of radius 5 cm and with centre as O.

(b) Take a point A on the circumference of the circle and join OA. Draw a perpendicular to OA at point A with the help of compass.

(c) Draw a radius OB, making an angle of 120° (180° − 60°) with OA.

(d) Draw a perpendicular to OB at point B with the help of compass. Let both the perpendiculars intersect at point P. PA and PB are the required tangents at an angle of 60°.

Justification: The construction can be justified by proving that ∠APB = 60°

By our construction

∠OAP = 90°

∠OBP = 90°

And ∠AOB = 120°

We know that the sum of all interior angles of a quadrilateral = 360°

∠OAP + ∠AOB + ∠OBP + ∠APB = 360°

90° + 120° + 90° + ∠APB = 360°

∠APB = 60°

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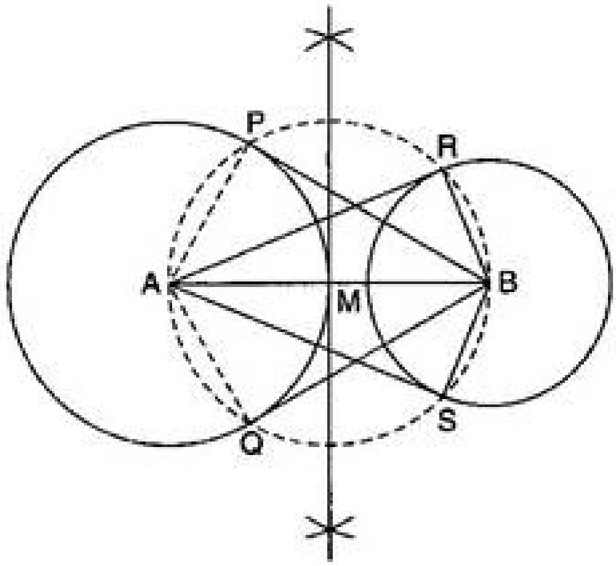
5. Draw a line segment AB of length 8 cm. Taking A as centre, draw a circle of radius 4 cm and taking B as centre, draw another circle of radius 3 cm. Construct tangents to each circle from the centre of the other circle.

Ans. To construct: A line segment of length 8 cm and taking A as centre, to draw a circle of radius 4 cm and taking B as centre, draw another circle of radius 3 cm. Also, to construct tangents to each circle from the centre to the other circle.



Steps of Construction:

(a) Bisect BA. Let M be the mid-point of BA.
(b) Taking M as centre and MA as radius, draw a circle. Let it intersects the given circle at the points P and Q.
(c) Join BP and BQ. Then, BP and BQ are the required two tangents from B to the circle with centre A.
(d) Again, Let M be the mid-point of AB.
(e) Taking M as centre and MB as radius, draw a circle. Let it intersects the given circle at the points R and S.
(f) Join AR and AS.

Then, AR and AS are the required two tangents from A to the circle with centre B.

Justification: Join BP and BQ.

Then $\angle$ APB being an angle in the semicircle is 90°.

$\Rightarrow$ BP $\perp$ AP

Since AP is a radius of the circle with centre A, BP has to be a tangent to a circle with centre A. Similarly, BQ is also a tangent to the circle with centre A.

Again join AR and AS.

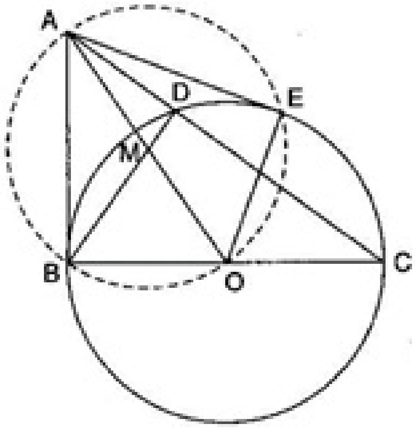
Then $\angle$ ARB being an angle in the semicircle is 90°.

$\Rightarrow AR \perp BR$

Since BR is a radius of the circle with centre B, AR has to be a tangent to a circle with centre B. Similarly, AS is also a tangent to the circle with centre B.

6. Let ABC be a right triangle in which AB = 6 cm, BC = 8 cm and $\angle$B = 90°. BD is the perpendicular from B on AC. The circle through B, C, D is drawn. Construct the tangents from A to this circle.

Ans. To construct: A right triangle ABC with AB = 6 cm, BC = 8 cm and $\angle$B = 90°. BD is the perpendicular from B on AC and the tangents from A to this circle.



Steps of Construction:
(a) Draw a right triangle ABC with AB = 6 cm, BC = 8 cm and $\angle$B = 90°. Also, draw perpendicular BD on AC.
(b) Join AO and bisect it at M (here O is the centre of circle through B, C, D).
(c) Taking M as centre and MA as radius, draw a circle. Let it intersects the given circle at the points B and E.
(d) Join AB and AE.

Then AB and AE are the required two tangents.

Justification: Join OE.

Then, $\angle$AEO is an angle in the semicircle.

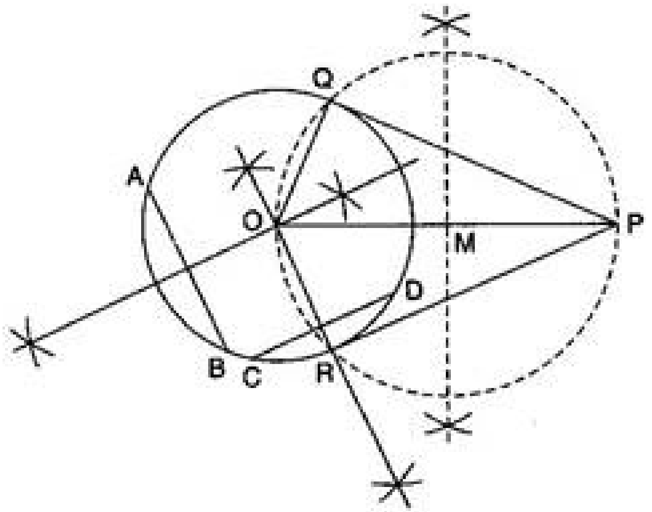
$\Rightarrow \angle AEO = 90^\circ$

$\Rightarrow AE \perp OE$

Since OE is a radius of the given circle, AE has to be a tangent to the circle. Similarly, AB is also a tangent to the circle.

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.

Ans. To construct: 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.



Steps of Construction:
(a) Draw a circle with the help of a bangle.
(b) Take two non-parallel chords AB and CD of this circle.
(c) Draw the perpendicular bisectors of AB and CD. Let these intersect at O. Then O is the centre of the circle draw.
(d) Take a point P outside the circle.
(e) Join PO and bisect it. Let M be the mid-point of PO.
(f) Taking M as centre and MO as radius, draw a circle. Let it intersects the given circle at the points Q and R.
(g) Join PQ and PR.

Then PQ and PR are the required two tangents.

Justification: Join OQ and OR.

Then, $\angle$ PQO is an angle in the semicircle.

$\Rightarrow \angle PQO = 90^\circ$

$\Rightarrow PQ \perp OQ$

Since OQ is a radius of the given circle, PQ has to be a tangent to the circle. Similarly, PR is also a tangent to the circle.