

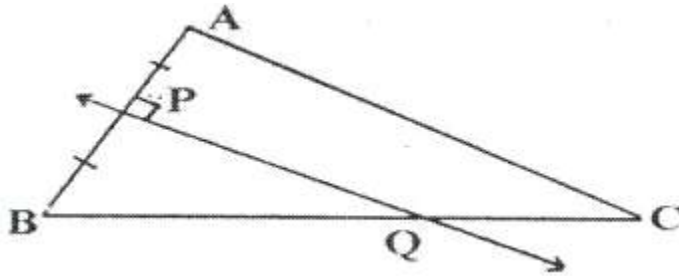
## Loci (Locus & Its Constructions)

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### Exercise 16A

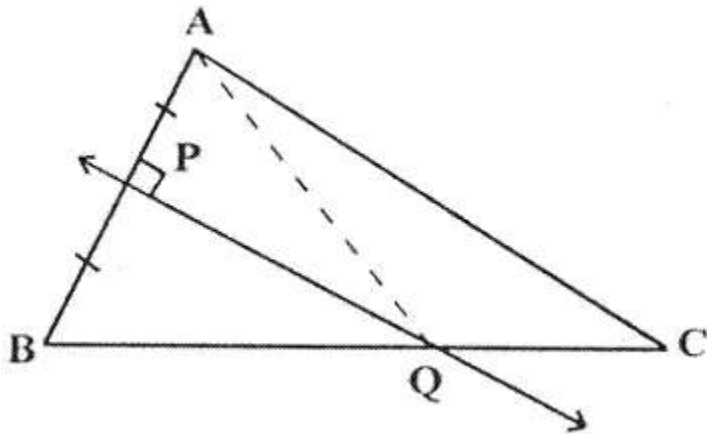
#### Question 1.

Given— PQ is perpendicular bisector of side AB of the triangle ABC.



Prove— Q is equidistant from A and B.

**Solution:**



Construction: Join AQ

Proof: In  $\triangle AQP$  and  $\triangle BQP$ ,  
 $AP = BP$  (given)

$\angle QPA = \angle QPB$  (Each =  $90^\circ$ )

$PQ = PQ$  (Common)

By Side-Angle-Side criterion of congruence, we have  
 $\triangle AQP \cong \triangle BQP$  (SAS postulate)

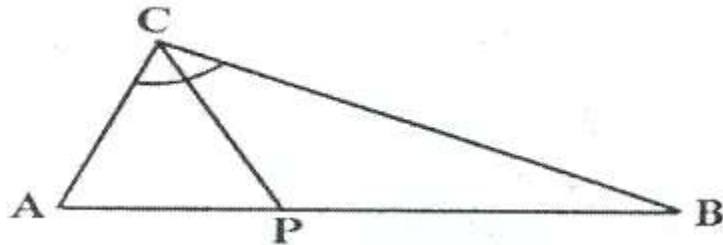
The corresponding parts of the triangle are congruent

$\therefore AQ = BQ$  (CPCT)

Hence Q is equidistant from A and B.

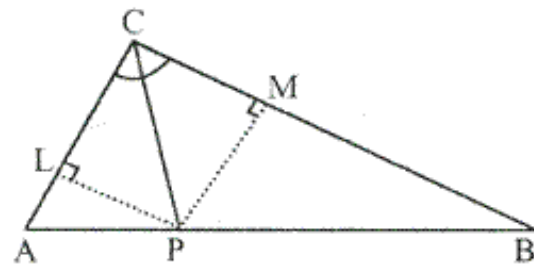
**Question 2.**

Given— CP is bisector of angle C of  $\triangle ABC$ .



Prove— P is equidistant from AC and BC.

**Solution:**



**Construction:** From P, draw  $PL \perp AC$  and  $PM \perp CB$

**Proof:** In  $\triangle LPC$  and  $\triangle MPC$ ,

$$\angle PLC = \angle PMC \quad (\text{Each} = 90^\circ)$$

$$\angle PCL = \angle MCP \quad (\text{Given})$$

$$PC = PC \quad (\text{Common})$$

$\therefore$  By Angle-Side-Angle criterion of congruence,

$$\triangle LPC \cong \triangle MPC \quad (\text{AAS Postulate})$$

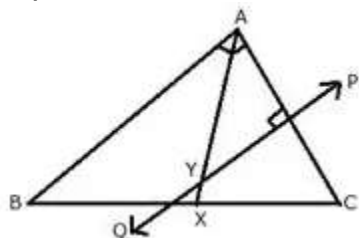
The corresponding parts of the congruent triangles are congruent.

$$\therefore PL = PM \quad (\text{CPCT})$$

Hence, P is equidistant from AC and AB

**Question 3.**

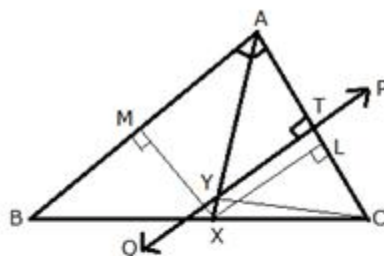
Given— AX bisects angle BAG and PQ is perpendicular bisector of AC which meets AX at point Y.



Prove—

- (i) X is equidistant from AB and AC.
- (ii) Y is equidistant from A and C.

**Solution:**



**Construction:** From X, draw  $XL \perp AC$  and  $XM \perp AB$ . Also join YC.

**Proof:**

i) In  $\triangle AXL$  and  $\triangle AXM$ ,

$$\angle XAL = \angle XAM \quad (\text{Given})$$

$$AX = AX \quad (\text{Common})$$

$$\angle XLA = \angle XMA \quad (\text{Each} = 90^\circ)$$

$\therefore$  By Angle-Side-Angle criterion of congruence,

$$\triangle AXL \cong \triangle AXM \quad (\text{ASA Postulate})$$

The corresponding parts of the congruent triangles are congruent.

$$\therefore XL = XM \quad (\text{CPCT})$$

Hence, X is equidistant from AB and AC.

ii) In  $\triangle YTA$  and  $\triangle YTC$ ,

$$AT = CT \quad (\because PQ \text{ is a perpendicular bisector of } AC)$$

$$\angle YTA = \angle YTC \quad (\text{Each} = 90^\circ)$$

$$YT = YT \quad (\text{Common})$$

∴ By Side-Angle-Side criterion of congruence,

∴  $\triangle YTA \cong \triangle YTC$  (SAS Postulate)

The corresponding parts of the congruent triangles are congruent.

∴  $YA = YC$  (CPCT)

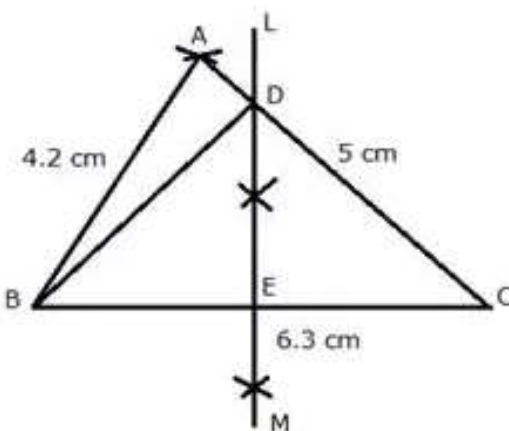
Hence, Y is equidistant from A and C.

#### Question 4.

Construct a triangle ABC, in which  $AB = 4.2$  cm,  $BC = 6.3$  cm and  $AC = 5$  cm. Draw perpendicular bisector of BC which meets AC at point D. Prove that D is equidistant from B and C.

#### Solution:

Given: In triangle ABC,  $AB = 4.2$  cm,  $BC = 6.3$  cm and  $AC = 5$  cm



Steps of Construction:

i) Draw a line segment  $BC = 6.3$  cm

ii) With centre B and radius 4.2 cm, draw an arc.

iii) With centre C and radius 5 cm, draw another arc which intersects the first arc at A.

iv) Join AB and AC.

$\triangle ABC$  is the required triangle.

v) Again with centre B and C and radius greater than  $\frac{1}{2}BC$  draw arcs which intersect each other at L and M.

vi) Join LM intersecting AC at D and BC at E.

vii) Join DB.

Proof: In  $\triangle DBE$  and  $\triangle DCE$

$BE = EC$  (LM is bisector of  $BC$ )

$\angle DEB = \angle DEC$  (Each =  $90^\circ$ )

$DE = DE$  (Common)

$\therefore$  By Side-Angle-Side criterion of congruence, we have

$\triangle DBE \cong \triangle DCE$  (SAS Postulate)

The corresponding parts of the congruent triangles are congruent.

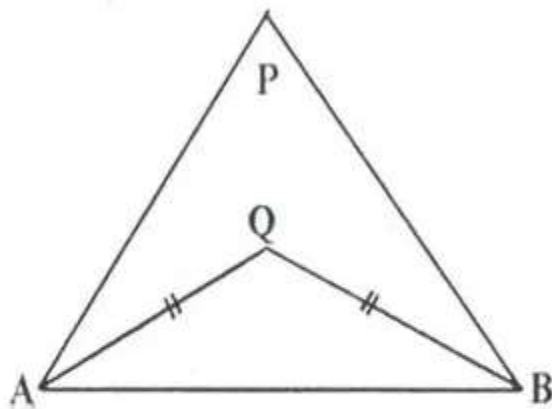
$\therefore DB = DC$  (CPCT)

Hence,  $D$  is equidistant from  $B$  and  $C$ .

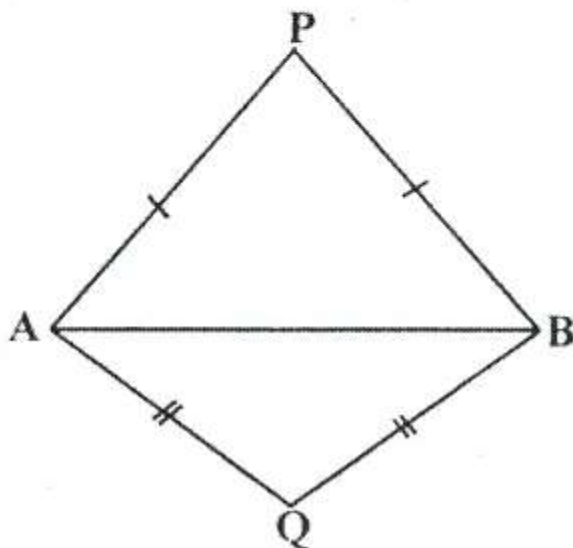
**Question 5.**

In each of the given figures:  $PA = PH$  and  $QA = QB$ .

i)



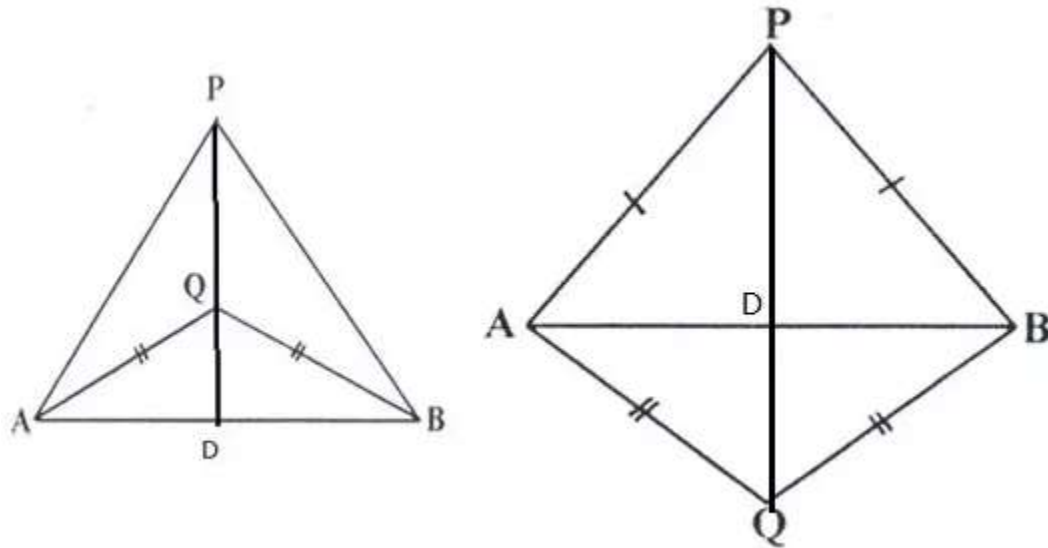
ii)



Prove, in each case, that PQ (produce, if required) is perpendicular bisector of AB.  
Hence, state the locus of points equidistant from two given fixed points.

**Solution:**

Construction: Join PQ which meets AB in D.



Proof: P is equidistant from A and B.

$\therefore$  P lies on the perpendicular bisector of AB.

Similarly, Q is equidistant from A and B.

$\therefore$  Q lies on perpendicular bisector of AB.

$\therefore$  P and Q both lie on the perpendicular bisector of AB.

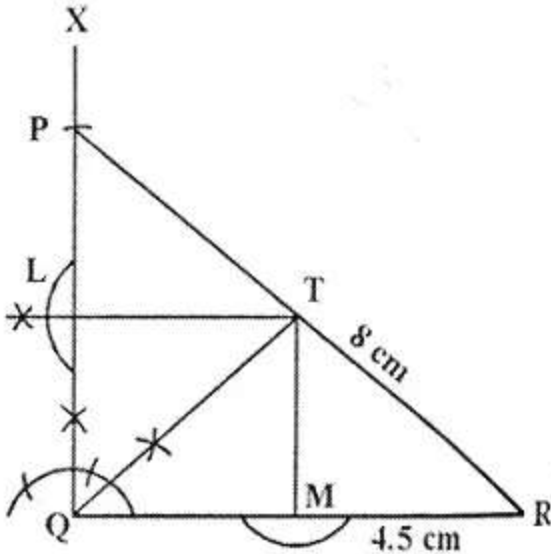
$\therefore$  PQ is perpendicular bisector of AB.

Hence, locus of the points which are equidistant from two fixed points, is a perpendicular bisector of the line joining the fixed points.

**Question 6.**

Construct a right angled triangle PQR, in which  $\angle Q = 90^\circ$ , hypotenuse PR = 8 cm and QR = 4.5 cm. Draw bisector of angle PQR and let it meet PR at point T. Prove that T is equidistant from PQ and QR.

**Solution:**



Steps of Construction:

- i) Draw a line segment  $QR = 4.5$  cm
  - ii) At Q, draw a ray QX making an angle of  $90^\circ$
  - iii) With centre R and radius 8 cm, draw an arc which intersects QX at P.
  - iv) Join RP.
- $\triangle PQR$  is the required triangle.
- v) Draw the bisector of  $\angle PQR$  which meets PR in T.
  - vi) From T, draw perpendicular PL and PM respectively on PQ and QR.

Proof: In  $\triangle LTQ$  and  $\triangle MTQ$

$$\angle TLQ = \angle TMQ \quad (\text{Each} = 90^\circ)$$

$$\angle LQT = \angle TQM \quad (QT \text{ is angle bisector})$$

$$QT = QT \quad (\text{Common})$$

$\therefore$  By Angle-Angle-Side criterion of congruence,

$$\therefore \triangle LTQ \cong \triangle MTQ \quad (\text{AAS Postulate})$$

The corresponding parts of the congruent triangles are congruent.

$$\therefore TL = TM \quad (\text{CPCT})$$

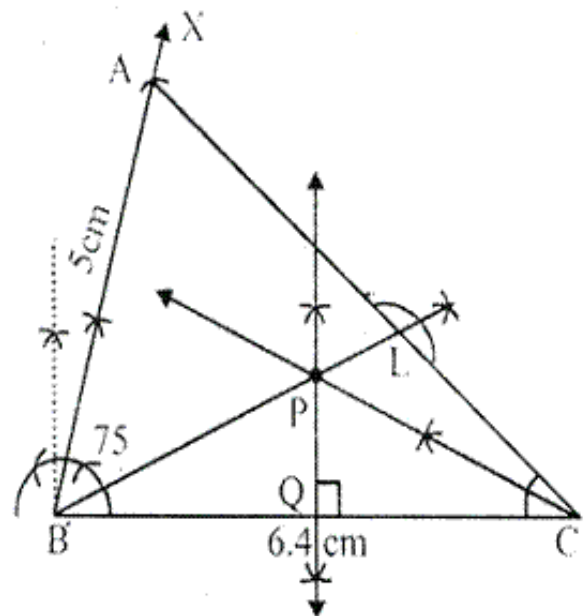
Hence, T is equidistant from PQ and QR.

### Question 7.

Construct a triangle ABC in which angle  $ABC = 75^\circ$ .  $AB = 5$  cm and  $BC = 6.4$  cm. Draw perpendicular bisector of side BC and also the bisector of angle ACB. If these bisectors intersect each other at point P ; prove that P is equidistant from B and C ; and also from AC and BC.

Hence P is equidistant from AC and BC.

**Solution:**



Steps of Construction:

- i) Draw a line segment  $BC = 6.4$  cm
  - ii) At B, draw a ray BX making an angle of  $75^\circ$  with BC and cut off  $BA = 5$  cm.
  - iii) Join AC.
- $\triangle ABC$  is the required triangle.
- iv) Draw the perpendicular bisector of BC.
  - v) Draw the angle bisector of angle ACB which intersects the perpendicular bisector of BC at P.
  - vi) Join PB and draw  $PL \perp AC$ .

Proof: In  $\triangle PBQ$  and  $\triangle PCQ$



$PQ = PQ$  (common)

$\angle AQB = \angle PQC$  (Each =  $90^\circ$ )

$BQ = QC$  ( $PQ$  is the perpendicular bisector of  $BC$ )

$\therefore$  By Side-Angle-Side criterion of congruence

$\triangle PBQ \cong \triangle PCQ$  (SAS Postulate)

The corresponding parts of the congruent triangles are congruent.

$\therefore PB = PC$  (CPCT)

Hence,  $P$  is equidistant from  $B$  and  $C$ .

$\angle PQC = \angle PLC$  (Each =  $90^\circ$ )

$\angle PCQ = \angle PCL$  (Given)

$PC = PC$  (common)

Again in  $\triangle PQC$  and  $\triangle PLC$   $\therefore$  By Angle-Angle-Side criterion of congruence,

$\triangle PQC \cong \triangle PLC$  (AAS Postulate)

The corresponding parts of the congruent triangles are congruent.

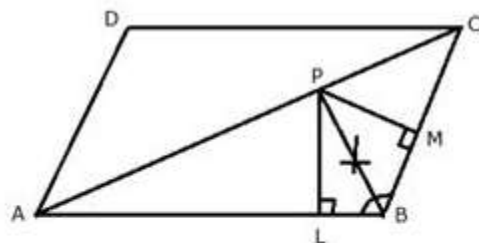
$\therefore PQ = PL$  (CPCT)

Hence,  $P$  is equidistant from  $AC$  and  $BC$ .

### Question 8.

In parallelogram  $ABCD$ , side  $AB$  is greater than side  $BC$  and  $P$  is a point in  $AC$  such that  $PB$  bisects angle  $B$ . Prove that  $P$  is equidistant from  $AB$  and  $BC$ .

**Solution:**



Construction: From  $P$ , draw  $PL \perp AB$  and  $PM \perp BC$

Proof: In  $\triangle PLB$  and  $\triangle PMB$

$\angle PLB = \angle PMB$  (Each =  $90^\circ$ )

$\angle PBL = \angle PBM$  (Given)

$PB = PB$  (common)

∴ By Angle-Angle-Side criterion of congruence,

$\triangle PLB \cong \triangle PMB$  (AAS Postulate)

The corresponding parts of the congruent triangles are congruent.

∴  $PL = PM$  (CPCT)

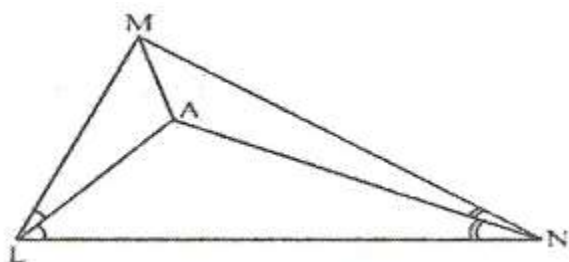
Hence, P is equidistant from AB and BC.

### Question 9.

In triangle LMN, bisectors of interior angles at L and N intersect each other at point A. Prove that –

- (i) point A is equidistant from all the three sides of the triangle.
- (ii) AM bisects angle LMN.

**Solution:**



Construction: Join AM

Proof:

∵ A lies on bisector of  $\angle N$

∴ A is equidistant from MN and LN.

Again, A lies on bisector of  $\angle L$

∴ A is equidistant from LN and LM.

Hence, A is equidistant from all sides of the triangle LMN.

∴ A lies on the bisector of  $\angle M$

### Question 10.

Use ruler and compasses only for this question:

(i) construct  $\triangle ABC$ , where  $AB = 3.5$  cm,  $BC = 6$  cm and  $\angle ABC = 60^\circ$ .

(ii) Construct the locus of points inside the triangle which are equidistant from BA and BC.

(iii) Construct the locus of points inside the triangle which are equidistant from B and C.

(iv) Mark the point P which is equidistant from AB, BC and also equidistant from B and C. Measure and record the length of PB.

**Solution:**

Steps of construction:

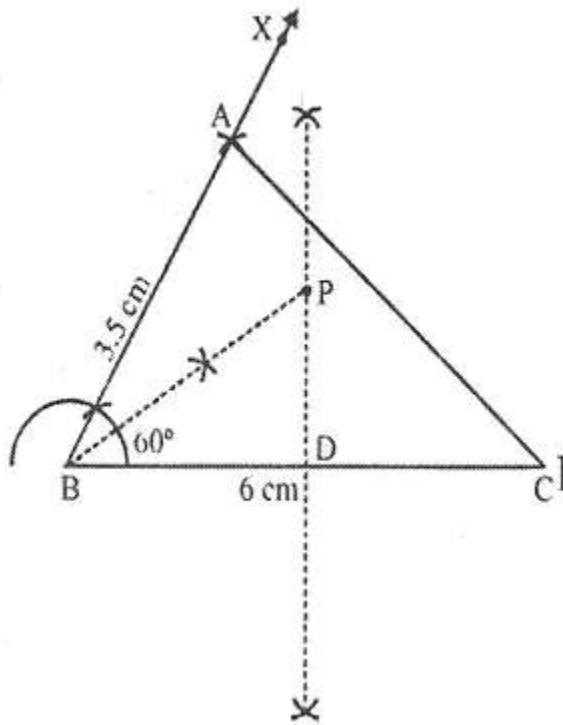
(i) Draw line  $BC = 6\text{ cm}$  and an angle  $CBX = 60^\circ$ . Cut off  $AB = 3.5$ . Join  $AC$ , triangle  $ABC$  is the required triangle.

(ii) Draw perpendicular bisector of  $BC$  and bisector of angle  $B$

(iii) Bisector of angle  $B$  meets bisector of  $BC$  at  $P$ .

$\Rightarrow BP$  is the required length, where,  $PB = 3.5\text{ cm}$

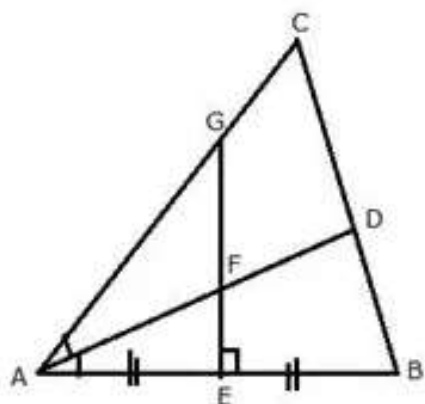
(iv)  $P$  is the point which is equidistant from  $BA$  and  $BC$ , also equidistant from  $B$  and  $C$ .



$PB = 3.5\text{ cm}$

**Question 11.**

The given figure shows a triangle  $ABC$  in which  $AD$  bisects angle  $BAC$ .  $EG$  is perpendicular bisector of side  $AB$  which intersects  $AD$  at point  $E$

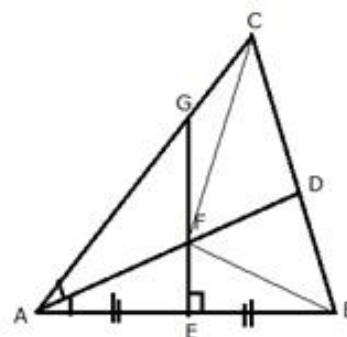


Prove that:

- (i) F is equidistant from A and B.
- (ii) F is equidistant from AB and AC.

**Solution:**

i)



**Construction:** Join FB and FC

**Proof:** In  $\triangle AFE$  and  $\triangle BFE$ ,

$AE = EB$  (E is the mid-point of AB)

$\angle FEA = \angle FEB$  (Each =  $90^\circ$ )

$FE = FE$  (Common)

$\therefore$  By Side-Angle-Side criterion of congruence,

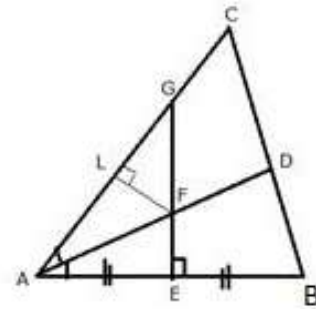
$\triangle AFE \cong \triangle BFE$  (SAS Postulate)

The corresponding parts of the congruent triangles are congruent.

$\therefore AF = FB$  (CPCT)

Hence, F is equidistant from A and B.

ii)



**Construction:** Draw  $LF \perp AC$

**Proof:** In  $\triangle AFL$  and  $\triangle AFE$ ,

$$\angle FEA = \angle FLA \quad (\text{Each} = 90^\circ)$$

$$\angle LAF = \angle FAE \quad (\text{AD bisects } \angle BAC)$$

$$AF = AF \quad (\text{Common})$$

$\therefore$  By Angle-Angle-Side criterion of congruence,

$$\triangle AFL \cong \triangle AFE \quad (\text{AAS Postulate})$$

The corresponding parts of the congruent triangles are congruent.

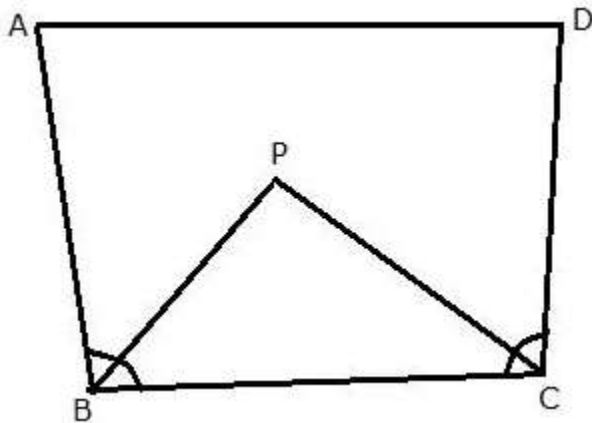
$$\therefore FE = FL \quad (\text{CPCT})$$

Hence, F is equidistant from AB and AC.

### Question 12.

The bisectors of  $\angle B$  and  $\angle C$  of a quadrilateral ABCD intersect each other at point P. Show that P is equidistant from the opposite sides AB and CD.

**Solution:**



Since P lies on the bisector of angle B,

therefore, P is equidistant from AB and BC .... (1)  
Similarly, P lies on the bisector of angle C,

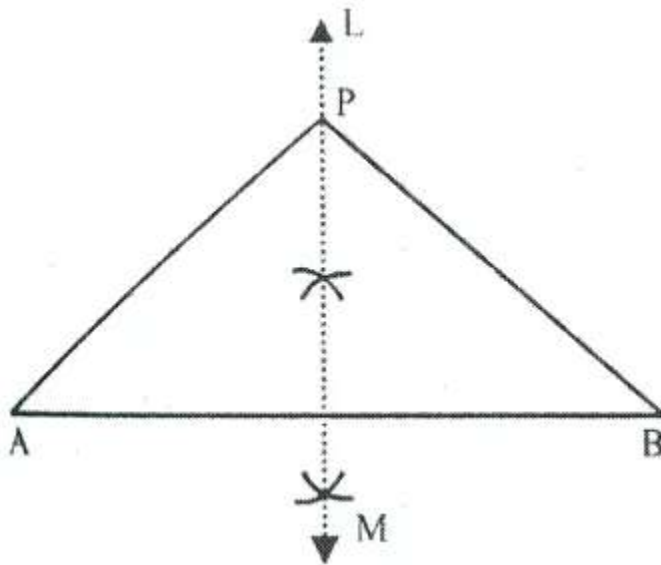
therefore, P is equidistant from BC and CD .... (2)  
From (1) and (2),

Hence, P is equidistant from AB and CD.

**Question 13.**

Draw a line AB = 6 cm. Draw the locus of all the points which are equidistant from A and B.

**Solution:**



Steps of construction:

- (i) Draw a line segment AB of 6 cm.
- (ii) Draw perpendicular bisector LM of AB. LM is the required locus.
- (iii) Take any point on LM say P.
- (iv) Join PA and PB.

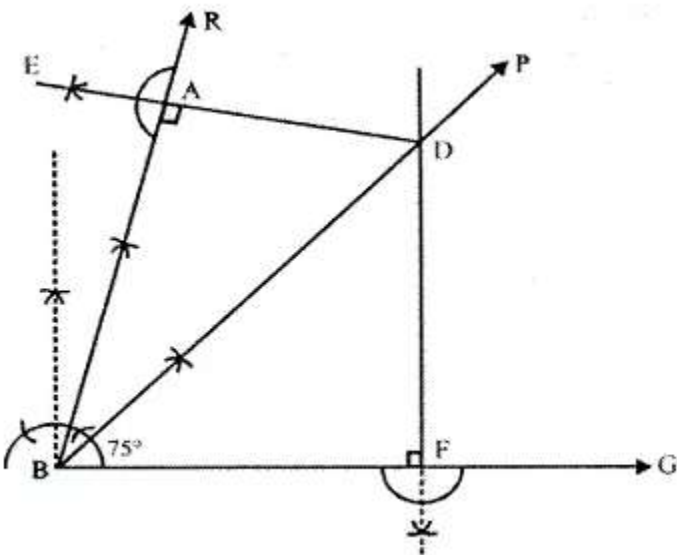
Since, P lies on the right bisector of line AB.

Therefore, P is equidistant from A and B.  
i.e.  $PA = PB$

Hence, Perpendicular bisector of AB is the locus of all points which are equidistant from A and B.

**Question 14.**

Draw an angle  $ABC = 75^\circ$ . Draw the locus of all the points equidistant from AB and BC.

**Solution:**

Steps of Construction:

- i) Draw a ray BC.
- ii) Construct a ray RA making an angle of  $75^\circ$  with BC. Therefore,  $ABC = 75^\circ$ .
- iii) Draw the angle bisector BP of  $\angle ABC$ .  
BP is the required locus.
- iv) Take any point D on BP.
- v) From D, draw  $DE \perp AB$  and  $DF \perp BC$

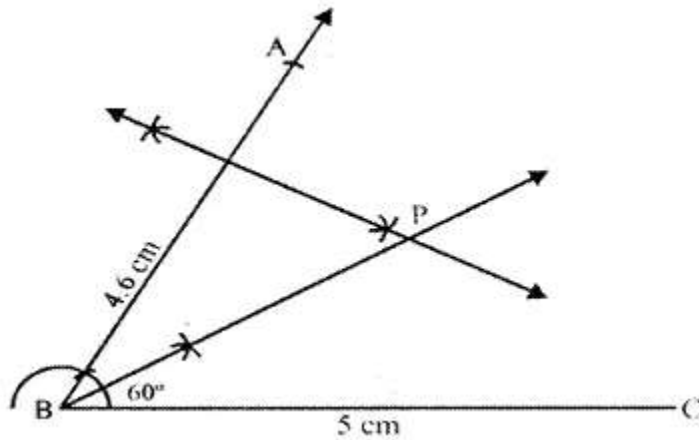
Since D lies on the angle bisector BP of  $\angle ABC$   
D is equidistant from AB and BC.  
Hence,  $DE = DF$

Similarly, any point on BP is equidistant from AB and BC.  
Therefore, BP is the locus of all points which are equidistant from AB and BC.

**Question 15.**

Draw an angle  $ABC = 60^\circ$ , having  $AB = 4.6$  cm and  $BC = 5$  cm. Find a point P equidistant from AB and BC ; and also equidistant from A and B.

**Solution:**

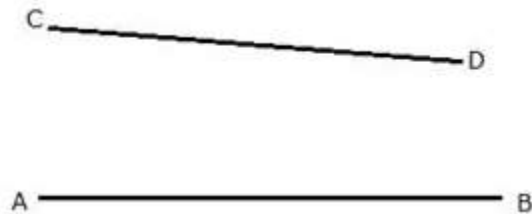


Steps of Construction:

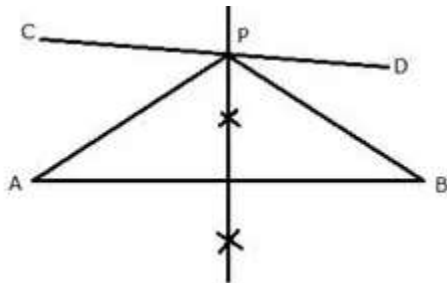
- i) Draw a line segment  $BC = 5 \text{ cm}$
  - ii) At B, draw a ray BX making an angle of  $60^\circ$  and cut off  $BA = 4.6 \text{ cm}$ .
  - iii) Draw the angle bisector of  $\angle ABC$ .
  - iv) Draw the perpendicular bisector of AB which intersects the angle bisector at P.
- P is the required point which is equidistant from AB and BC, as well as from A and B.

### Question 16.

In the figure given below, find a point P on CD equidistant from points A and B.



**Solution:**



Steps of Construction:

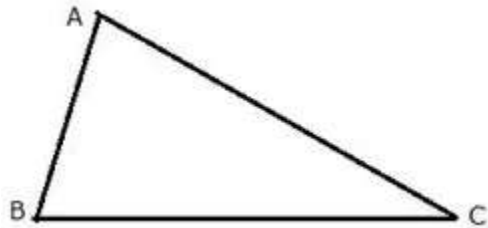
- i) AB and CD are the two lines given.
- ii) Draw a perpendicular bisector of line AB which intersects CD in P.



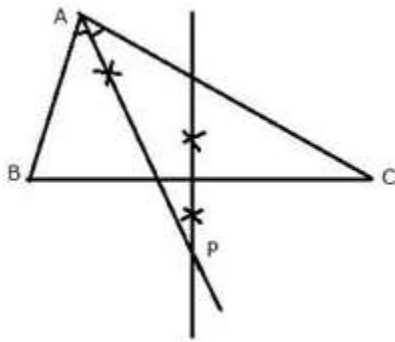
P is the required point which is equidistant from A and B.  
Since P lies on perpendicular bisector of AB;  $PA = PB$ .

**Question 17.**

In the given triangle ABC, find a point P equidistant from AB and AC; and also equidistant from B and C.



**Solution:**



Steps of Construction:

- i) In the given triangle, draw the angle bisector of  $\angle BAC$ .
- ii) Draw the perpendicular bisector of BC which intersects the angle bisector at P.

P is the required point which is equidistant from AB and AC as well as from B and C.  
Since P lies on angle bisector of  $\angle BAC$ ,  
It is equidistant from AB and AC.

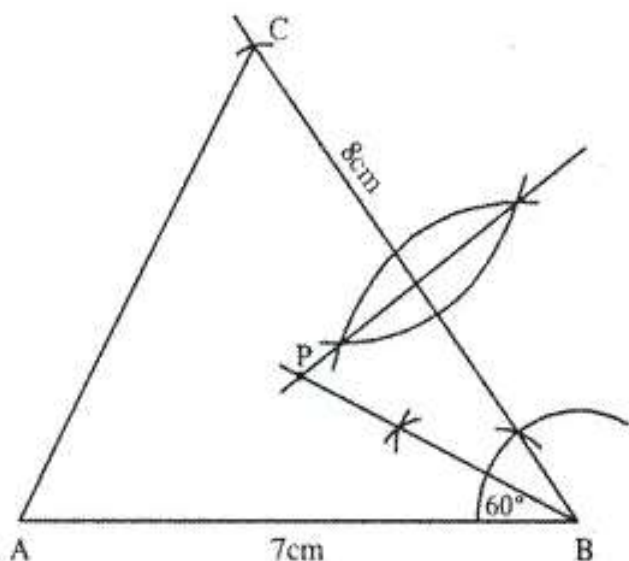
Again, P lies on perpendicular bisector of BC,  
Therefore, it is equidistant from B and C.

**Question 18.**

Construct a triangle ABC, with  $AB = 7$  cm,  $BC = 8$  cm and  $\angle ABC = 60^\circ$ . Locate by construction the point P such that :

- (i) P is equidistant from B and C.

- (ii) P is equidistant from AB and BC.
- (iii) Measure and record the length of PB.



**Solution:**

Steps of Construction:

- 1) Draw a line segment  $AB = 7 \text{ cm}$ .
- 2) Draw angle  $\angle ABC = 60^\circ$  with the help of compass.
- 3) Cut off  $BC = 8 \text{ cm}$ .
- 4) Join A and C.
- 5) The triangle ABC so formed is the required triangle.

i) Draw the perpendicular bisector of BC. The point situated on this line will be equidistant from B and C.

ii) Draw the angle bisector of  $\angle ABC$ . Any point situated on this angular bisector is equidistant from lines AB and BC.

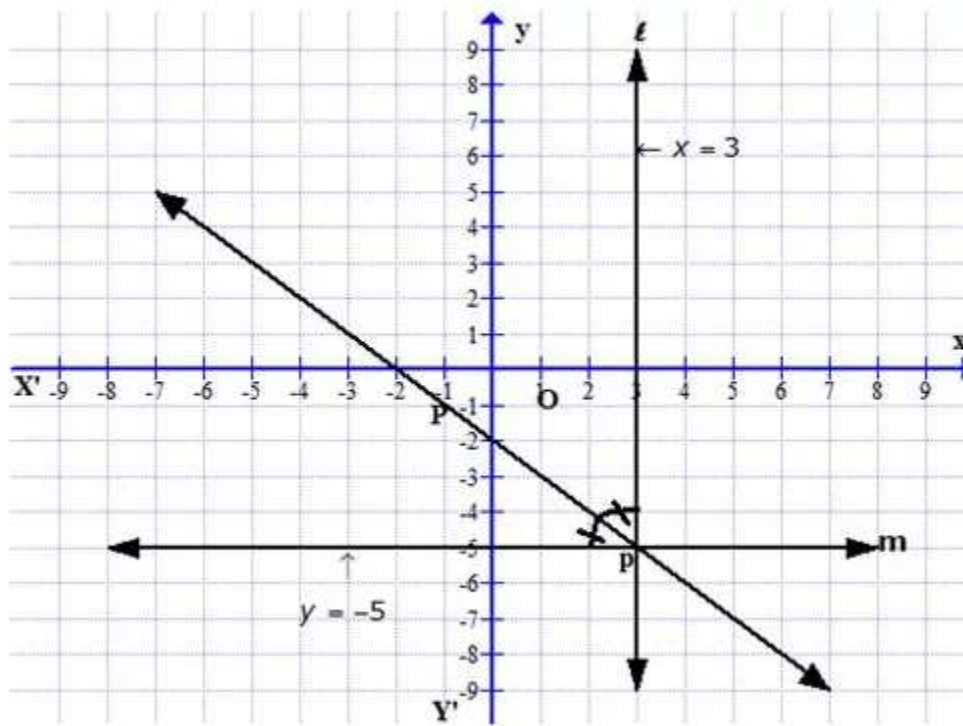
The point which fulfills the condition required in (i) and (ii) is the intersection point of bisector of line BC and angular bisector of  $\angle ABC$ .

P is the required point which is equidistant from AB and AC as well as from B and C. On measuring the length of line segment PB, it is equal to 4.5 cm.

**Question 19.**

On a graph paper, draw lines  $x = 3$  and  $y = -5$ . Now, on the same graph paper, draw the locus of the point which is equidistant from the given lines.

**Solution:**



On the graph, draw axis  $XOX'$  and  $YOY'$

Draw a line  $l$ ,  $x = 3$  which is parallel to  $y$ -axis

And draw another line  $m$ ,  $y = -5$ , which is parallel to  $x$ -axis

These two lines intersect each other at  $P$ .

Now draw the angle bisector  $p$  of angle  $P$ .

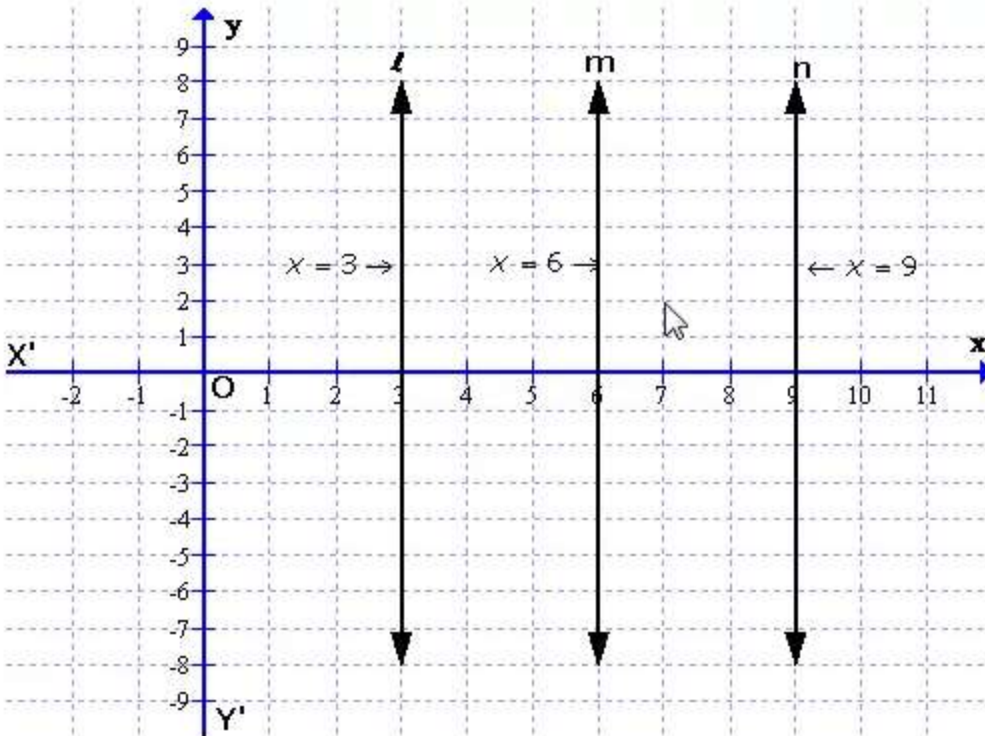
Since  $p$  is the angle bisector of  $P$ , any point on  $p$  is equidistant from  $l$  and  $m$ .

Therefore, this line  $p$  is equidistant from  $l$  and  $m$ .

**Question 20.**

On a graph paper, draw the line  $x = 6$ . Now, on the same graph paper, draw the locus of the point which moves in such a way that its distance from the given line is always equal to 3 units.

**Solution:**



On the graph, draw axis  $XOX'$  and  $YOY'$

Draw a line  $l$ ,  $x = 6$  which is parallel to  $y$ -axis

Take points  $P$  and  $Q$  which are at a distance of 3 units from the line  $l$ .

Draw lines  $m$  and  $n$  from  $P$  and  $Q$  parallel to  $l$

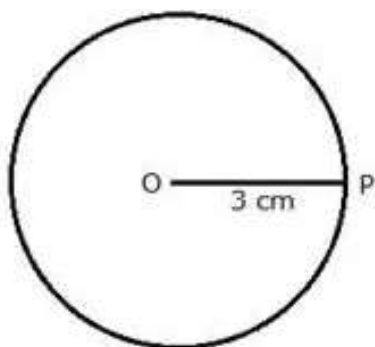
With locus = 3, two lines can be drawn  $x = 3$  and  $x = 9$ .

## Exercise 16B

### Question 1.

Describe the locus of a point at a distance of 3 cm from a fixed point.

**Solution:**

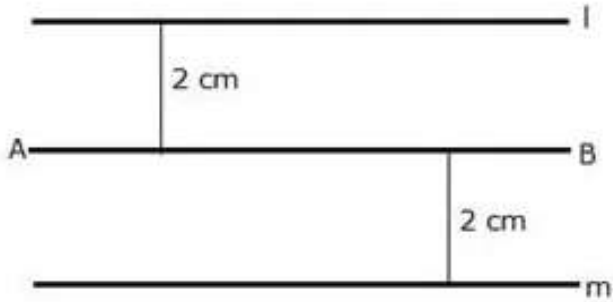


The locus of a point which is 3 cm away from a fixed point is circumference of a circle whose radius is 3 cm and the fixed point is the centre of the circle.

**Question 2.**

Describe the locus of a point at a distance of 2 cm from a fixed line.

**Solution:**

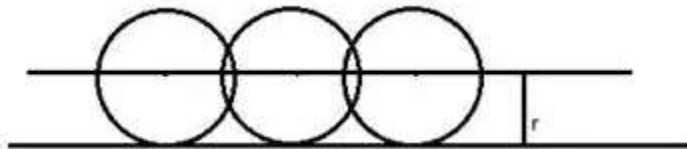


The locus of a point at a distance of 2 cm from a fixed line AB is a pair of straight lines l and m which are parallel to the given line at a distance of 2 cm.

**Question 3.**

Describe the locus of the centre of a wheel of a bicycle going straight along a level road.

**Solution:**

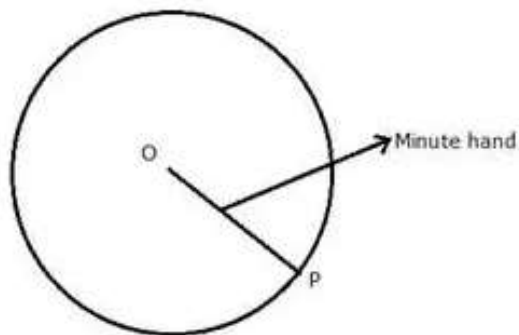


The locus of the centre of a wheel, which is going straight along a level road will be a straight line parallel to the road at a distance equal to the radius of the wheel.

**Question 4.**

Describe the locus of the moving end of the minute hand of a clock.

**Solution:**



The locus of the moving end of the minute hand of the clock will be a circle where radius will be the length of the minute hand.

### Question 5.

Describe the locus of a stone dropped from the top of a tower.

**Solution:**

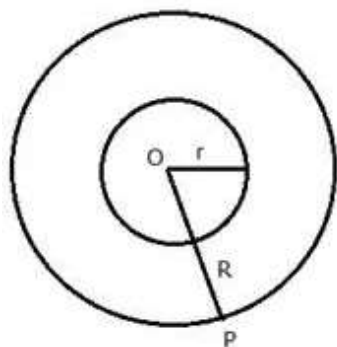


The locus of a stone which is dropped from the top of a tower will be a vertical line through the point from which the stone is dropped.

### Question 6.

Describe the locus of a runner, running around a circular track and always keeping a distance of 1.5 m from the inner edge.

**Solution:**

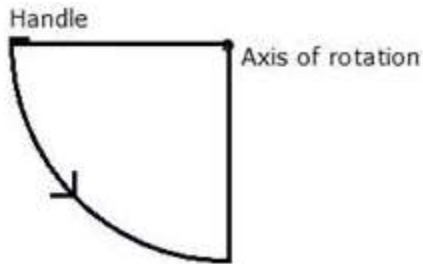


The locus of the runner, running around a circular track and always keeping a distance of 1.5 m from the inner edge will be the circumference of a circle whose radius is equal to the radius of the inner circular track plus 1.5 m.

**Question 7.**

Describe the locus of the door handle as the door opens.

**Solution:**

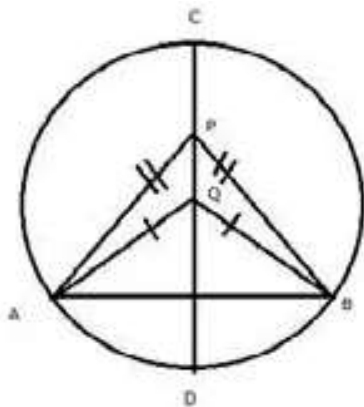


The locus of the door handle will be the circumference of a circle with centre at the axis of rotation of the door and radius equal to the distance between the door handle and the axis of rotation of the door.

**Question 8.**

Describe the locus of a point inside a circle and equidistant from two fixed points on the circumference of the circle.

**Solution:**

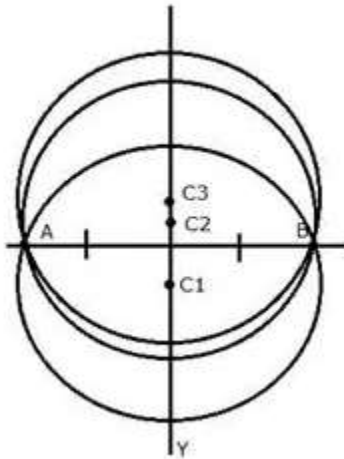


The locus of the points inside the circle which are equidistant from the fixed points on the circumference of a circle will be the diameter which is perpendicular bisector of the line joining the two fixed points on the circle.

**Question 9.**

Describe the locus of the centers of all circles passing through two fixed points.

**Solution:**

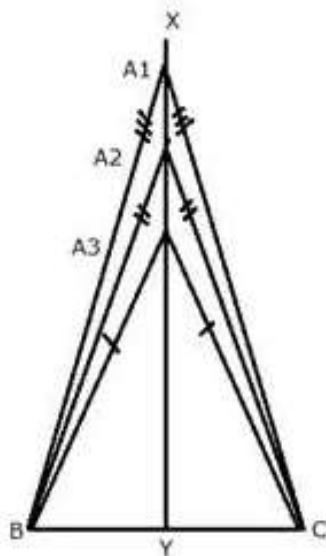


The locus of the centre of all the circles which pass through two fixed points will be the perpendicular bisector of the line segment joining the two given fixed points.

**Question 10.**

Describe the locus of vertices of all isosceles triangles having a common base.

**Solution:**



The locus of vertices of all isosceles triangles having a common base will be the perpendicular bisector of the common base of the triangles.



**Question 11.**

Describe the locus of a point in space which is always at a distance of 4 cm from a fixed point.

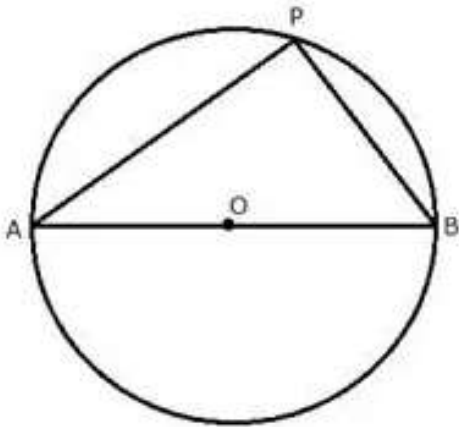
**Solution:**

The locus of a point in space is the surface of the sphere whose centre is the fixed point and radius equal to 4 cm.

**Question 12.**

Describe the locus of a point P so that:

$AB^2 = AP^2 + BP^2$ , where A and B are two fixed points.

**Solution:**

The locus of the point P is the circumference of a circle with AB as diameter and satisfies the condition  $AB^2 = AP^2 + BP^2$ .

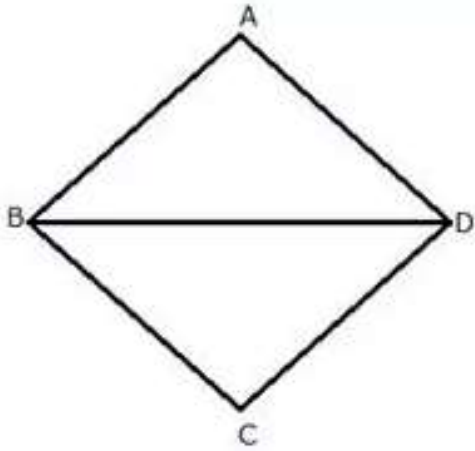
**Question 13.**

Describe the locus of a point in rhombus ABCD, so that it is equidistant from

- i) AB and BC
- ii) B and D.

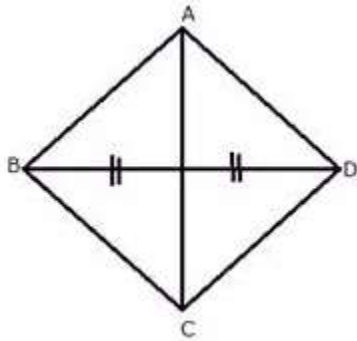
**Solution:**

- i)



The locus of the point in a rhombus ABCD which is equidistant from AB and BC will be the diagonal BD.

ii)



The locus of the point in a rhombus ABCD which is equidistant from B and D will be the diagonal AC.

#### Question 14.

The speed of sound is 332 meters per second. A gun is fired. Describe the locus of all the people on the Earth's surface, who hear the sound exactly one second later.

#### Solution:

The locus of all the people on Earth's surface is the circumference of a circle whose radius is 332 m and centre is the point where the gun is fired.

#### Question 15.

Describe:

- i) The locus of points at distances less than 3 cm from a given point.
- ii) The locus of points at distances greater than 4 cm from a given point.
- iii) The locus of points at distances less than or equal to 2.5 cm from a given point.

iv) The locus of points at distances greater than or equal to 35 mm from a given point.  
v) The locus of the centre of a given circle which rolls around the outside of a second circle and is always touching it.

vi) The locus of the centers of all circles that are tangent to both the arms of a given angle.

vii) The locus of the mid-points of all chords parallel to a given chord of a circle.

viii) The locus of points within a circle that are equidistant from the end points of a given chord.

**Solution:**

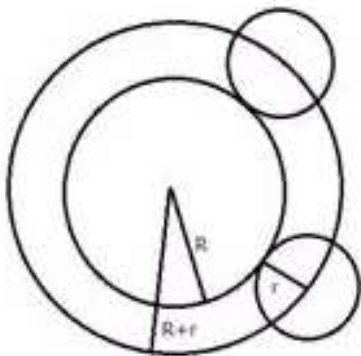
i) The locus is the space inside of the circle whose radius is 3 cm and the centre is the fixed point which is given.

ii) The locus is the space outside of the circle whose radius is 4 cm and centre is the fixed point which is given.

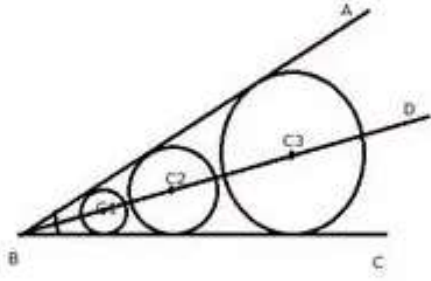
iii) The locus is the space inside and circumference of the circle with a radius of 2.5 cm and the centre is the given fixed point.

iv) The locus is the space outside and circumference of the circle with a radius of 35 mm and the centre is the given fixed point.

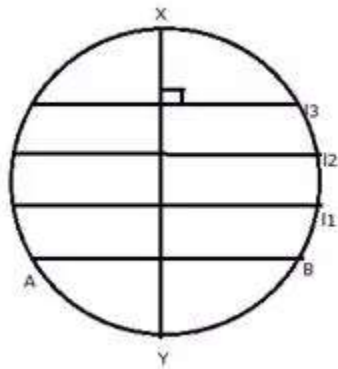
v) The locus is the circumference of the circle concentric with the second circle whose radius is equal to the sum of the radii of the two given circles.



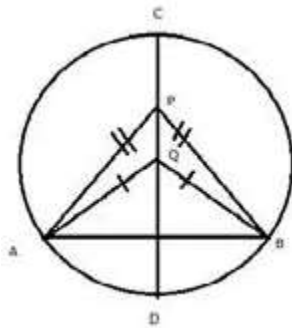
vi) The locus of the centre of all circles whose tangents are the arms of a given angle is the bisector of that angle.



vii) The locus of the mid-points of the chords which are parallel to a given chords is the diameter perpendicular to the given chords.



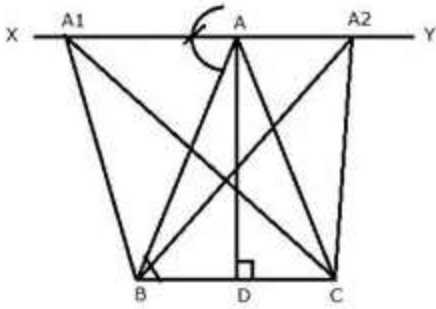
viii) The locus of the points within a circle which are equidistant from the end points of a given chord is the diameter which is perpendicular bisector of the given chord.



### Question 16.

Sketch and describe the locus of the vertices of all triangles with a given base and a given altitude.

**Solution:**

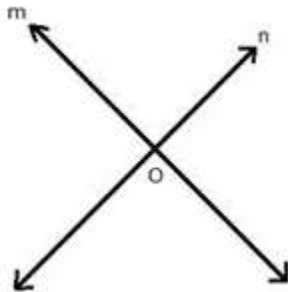


Draw a line XY parallel to the base BC from the vertex A.

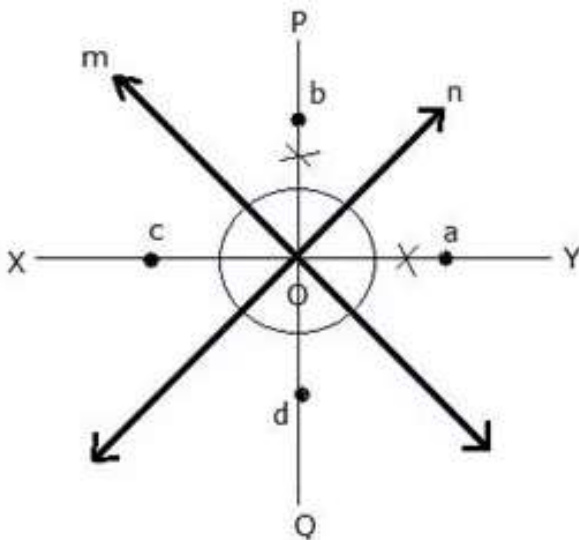
This line is the locus of vertex A of all the triangles which have the base BC and length of altitude equal to AD.

**Question 17.**

In the given figure, obtain all the points equidistant from lines m and n ; and 2.5 cm from O.



**Solution:**



Draw an angle bisector PQ and XY of angles formed by the lines m and n. From O, draw arcs with radius 2.5 cm, which intersect the angle bisectors at a, b, c and d respectively. Hence, a, b, c and d are the required four points.

### Question PQ.

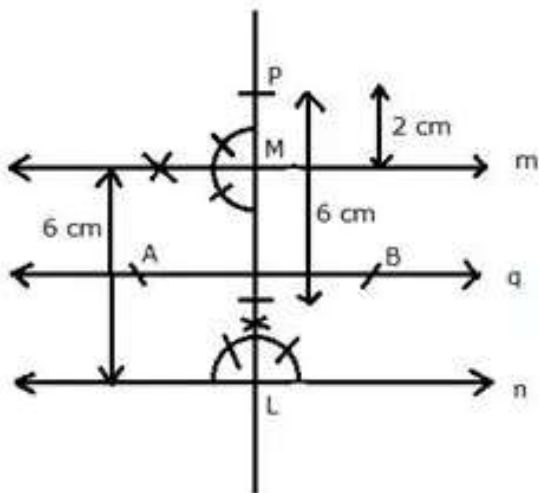
By actual drawing obtain the points equidistant from lines m and n and 6 cm from the point P, where P is 2 cm above m, m is parallel to n and m is 6 cm above n.

### Solution:

Steps of construction:

- i) Draw a line n.
- ii) Take a point L on n and draw a perpendicular to n.
- iii) Cut off LM = 6 cm and draw a line q, the perpendicular bisector of LM.
- iv) At M, draw a line m making an angle of  $90^\circ$ .
- v) Produce LM and mark a point P such that PM = 2 cm.
- vi) From P, draw an arc with 6 cm radius which intersects the line q, the perpendicular bisector of LM, at A and B.

A and B are the required points which are equidistant from m and n and are at a distance of 6 cm from P.



### Question 18.

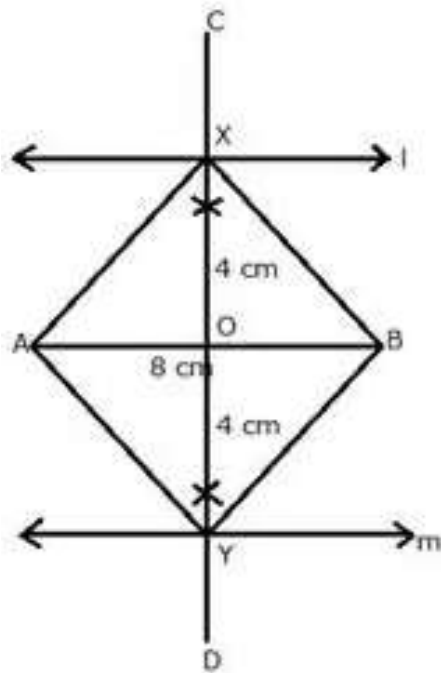
A straight line AB is 8 cm long. Draw and describe the locus of a point which is:

- (i) always 4 cm from the line AB
- (ii) equidistant from A and B.

Mark the two points X and Y, which are 4 cm from AB and equidistant from A and B.

Describe the figure AXBY.

**Solution:**



- (i) Draw a line segment  $AB = 8$  cm.
- (ii) Draw two parallel lines  $l$  and  $m$  to  $AB$  at a distance of 4 cm.
- (iii) Draw the perpendicular bisector of  $AB$  which intersects the parallel lines  $l$  and  $m$  at  $X$  and  $Y$  respectively then,  $X$  and  $Y$  are the required points.
- (iv) Join  $AX$ ,  $AY$ ,  $BX$  and  $BY$ .

The figure AXBY is a square as its diagonals are equal and intersect at  $90^\circ$ .

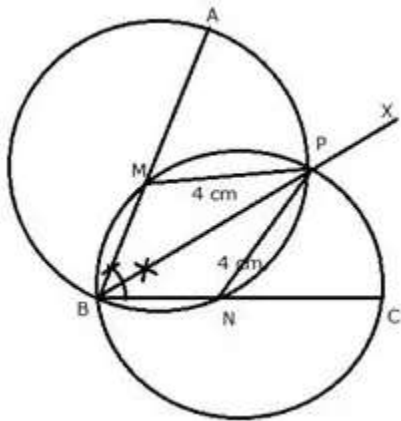
**Question 19.**

Angle  $ABC = 60^\circ$  and  $BA = BC = 8$  cm. The mid-points of  $BA$  and  $BC$  are  $M$  and  $N$  respectively. Draw and describe the locus of a point which is :

- (i) equidistant from  $BA$  and  $BC$ .
- (ii) 4 cm from  $M$ .
- (iii) 4 cm from  $N$ .

Mark the point  $P$ , which is 4 cm from both  $M$  and  $N$ , and equidistant from  $BA$  and  $BC$ . Join  $MP$  and  $NP$ , and describe the figure  $BMPN$ .

**Solution:**



- i) Draw an angle of  $60^\circ$  with  $AB = BC = 8$  cm
- ii) Draw the angle bisector BX of  $\angle ABC$
- iii) With centre M and N, draw circles of radius equal to 4 cm, which intersects each other at P. P is the required point.
- iv) Join MP, NP

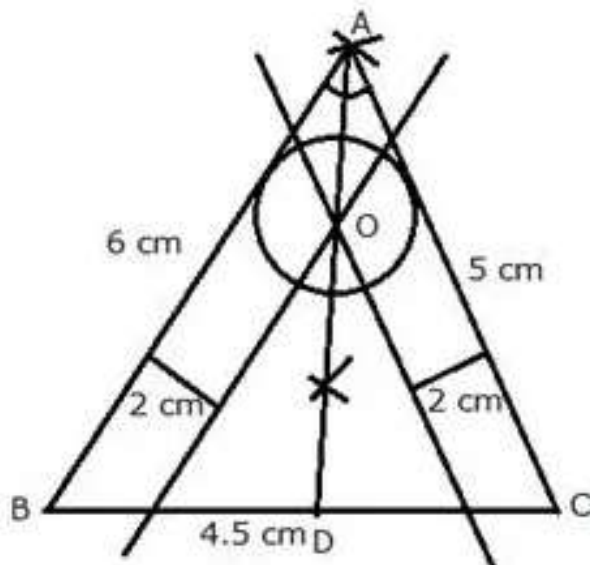
BMPN is a rhombus since  $MP = BM = NB = NP = 4$  cm

**Question 20.**

Draw a triangle ABC in which  $AB = 6$  cm,  $BC = 4.5$  cm and  $AC = 5$  cm. Draw and label:

- (i) the locus of the centers of all circles which touch AB and AC.
  - (ii) the locus of the centers of all circles of radius 2 cm which touch AB.
- Hence, construct the circle of radius 2 cm which touches AB and AC.

**Solution:**





Steps of Construction:

- i) Draw a line segment  $BC = 4.5$  cm
- ii) With B as centre and radius 6 cm and C as centre and radius 5 cm, draw arcs which intersect each other at A.
- iii) Join AB and AC.

ABC is the required triangle.

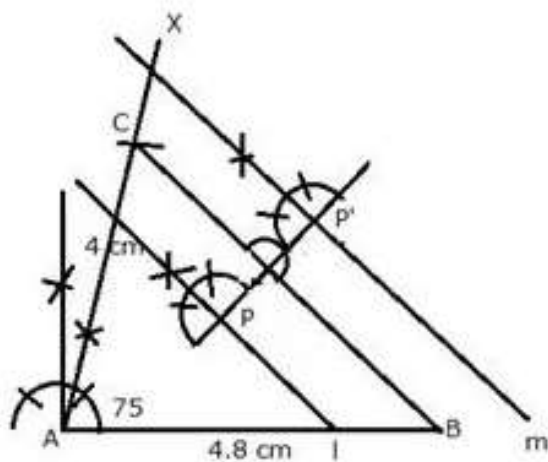
- iv) Draw the angle bisector of  $\angle BAC$
- v) Draw lines parallel to AB and AC at a distance of 2 cm, which intersect each other and AD at O.
- vi) With centre O and radius 2 cm, draw a circle which touches AB and AC.

### Question 21.

Construct a triangle ABC, having given  $AB = 4.8$  cm.  $AC = 4$  cm and  $\angle A = 75^\circ$ . Find a point P.

- (i) inside the triangle ABC.
  - (ii) outside the triangle ABC.
- Equidistant from B and C; and at a distance of 1.2 cm from BC.

**Solution:**



Steps of Construction:

- i) Draw a line segment  $AB = 4.8$  cm
- ii) At A, draw a ray AX making an angle of  $75^\circ$
- iii) Cut off  $AC = 4$  cm from AX
- iv) Join BC.

ABC is the required triangle.

- v) Draw two lines  $l$  and  $m$  parallel to  $BC$  at a distance of 1.2 cm
  - vi) Draw the perpendicular bisector of  $BC$  which intersects  $l$  and  $m$  at  $P$  and  $P'$
- $P$  and  $P'$  are the required points which are inside and outside the given triangle  $ABC$ .

### Question PQ.

$O$  is a fixed point. Point  $P$  moves along a fixed line  $AB$ .  $Q$  is a point on  $OP$  produced such that  $OP = PQ$ . Prove that the locus of point  $Q$  is a line parallel to  $AB$ .

### Solution:

$P$  moves along  $AB$ , and  $Q$  moves in such a way that  $PQ$  is always equal to  $OP$ .

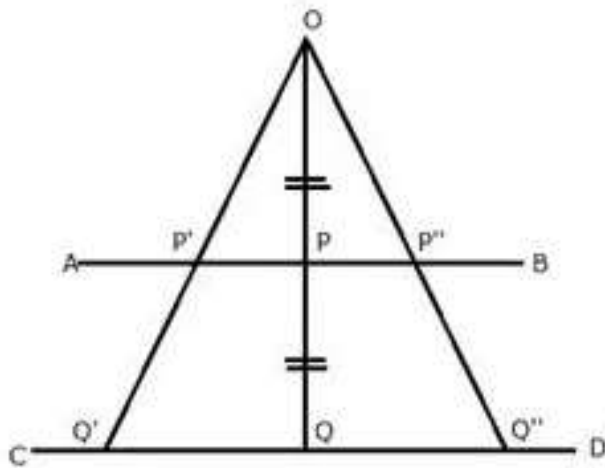
But  $P$  is the mid-point of  $OQ$

Now in  $\triangle OQQ'$

$P'$  and  $P''$  are the mid-points of  $OQ'$  and  $OQ''$

Therefore,  $AB \parallel Q'Q''$

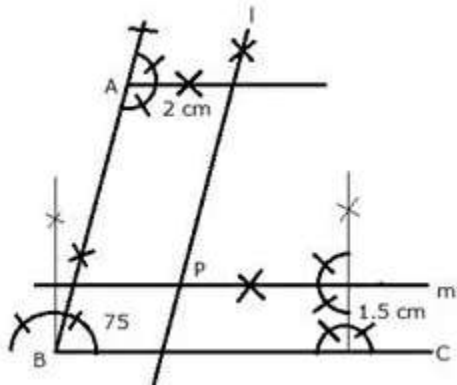
Therefore, Locus of  $Q$  is a line  $CD$  which is parallel to  $AB$ .



### Question 22.

Draw an angle  $ABC = 75^\circ$ . Find a point  $P$  such that  $P$  is at a distance of 2 cm from  $AB$  and 1.5 cm from  $BC$ .

### Solution:



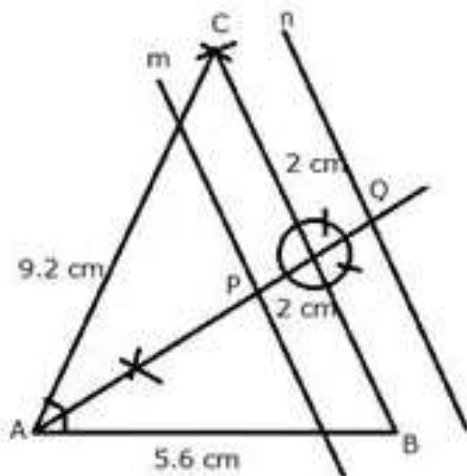
Steps of Construction:

- i) Draw a ray BC.
- ii) At B, draw a ray BA making an angle of  $75^\circ$  with BC.
- iii) Draw a line  $l$  parallel to AB at a distance of 2 cm
- iv) Draw another line  $m$  parallel to BC at a distance of 1.5 cm which intersects line  $l$  at P. P is the required point.

### Question 23.

Construct a triangle ABC, with  $AB = 5.6$  cm,  $AC = BC = 9.2$  cm. Find the points equidistant from AB and AC; and also 2 cm from BC. Measure the distance between the two points obtained.

**Solution:**



Steps of Construction:

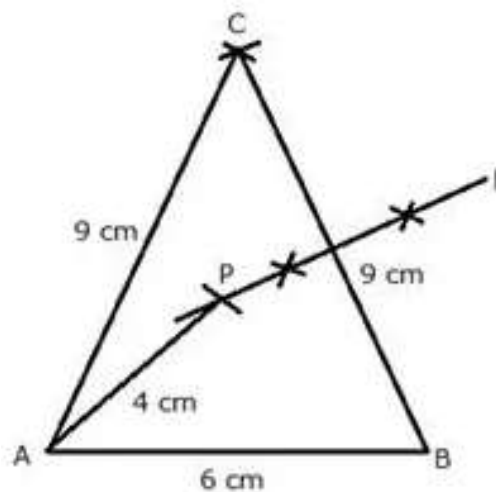
- i) Draw a line segment  $AB = 5.6$  cm
- ii) From A and B, as centers and radius 9.2 cm, make two arcs which intersect each other at C.
- iii) Join CA and CB.

- iv) Draw two lines  $n$  and  $m$  parallel to  $BC$  at a distance of 2 cm
- v) Draw the angle bisector of  $\angle BAC$  which intersects  $m$  and  $n$  at  $P$  and  $Q$  respectively.  $P$  and  $Q$  are the required points which are equidistant from  $AB$  and  $AC$ . On measuring the distance between  $P$  and  $Q$  is 4.3 cm.

#### Question 24.

Construct a triangle  $ABC$ , with  $AB = 6$  cm,  $AC = BC = 9$  cm. Find a point 4 cm from  $A$  and equidistant from  $B$  and  $C$ .

**Solution:**



Steps of Construction:

- i) Draw a line segment  $AB = 6$  cm
- ii) With  $A$  and  $B$  as centers and radius 9 cm, draw two arcs which intersect each other at  $C$ .
- iii) Join  $AC$  and  $BC$ .
- iv) Draw the perpendicular bisector of  $BC$ .
- v) With  $A$  as centre and radius 4 cm, draw an arc which intersects the perpendicular bisector of  $BC$  at  $P$ .

$P$  is the required point which is equidistant from  $B$  and  $C$  and at a distance of 4 cm from  $A$ .

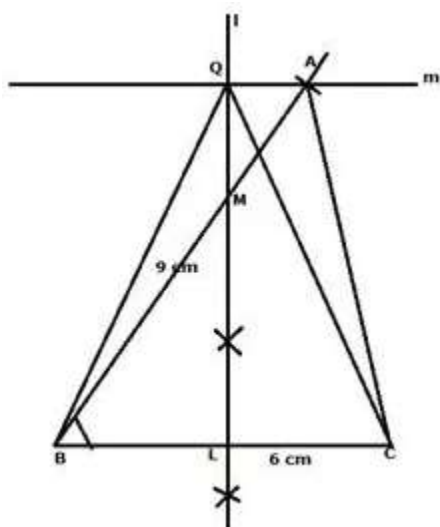
#### Question 25.

Ruler and compasses may be used in this question. All construction lines and arcs must be clearly shown and be of sufficient length and clarity to permit assessment.

- (i) Construct a triangle  $ABC$ , in which  $BC = 6$  cm,  $AB = 9$  cm and angle  $ABC = 60^\circ$ .
- (ii) Construct the locus of all points inside triangle  $ABC$ , which are equidistant from  $B$  and  $C$ .

- (iii) Construct the locus of the vertices of the triangles with BC as base and which are equal in area to triangle ABC.
- (iv) Mark the point Q, in your construction, which would make  $\triangle QBC$  equal in area to  $\triangle ABC$ , and isosceles.
- (v) Measure and record the length of CQ.

**Solution:**



Steps of Construction:

- (i) Draw a line segment  $BC = 6$  cm.
- (ii) At B, draw a ray BX making an angle  $60^\circ$  and cut off  $BA = 9$  cm.
- (iii) Join AC.  $\triangle ABC$  is the required triangle.
- (iv) Draw perpendicular bisector of BC which intersects BA in M, then any point on LM is equidistant from B and C.
- (v) Through A, draw a line  $m \parallel BC$ .
- (vi) The perpendicular bisector of BC and the parallel line m intersect each other at Q.
- (vii) Then triangle QBC is equal in area to triangle ABC. m is the locus of all points through which any triangle with base BC will be equal in area of triangle ABC.

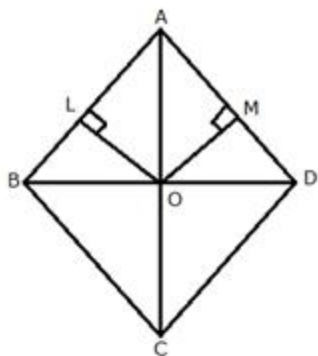
On measuring  $CQ = 8.4$  cm.

### Question 26.

State the locus of a point in a rhombus ABCD, which is equidistant

- (i) from AB and AD;
- (ii) from the vertices A and C.

**Solution:**



**Steps of Construction:**

i) In rhombus ABCD, draw angle bisector of  $\angle A$  which meets in C.

ii) Join BD, which intersects AC at O.

O is the required locus.

iii) From O, draw  $OL \perp AB$  and  $OM \perp AD$

In  $\triangle AOL$  and  $\triangle AOM$

$$\angle OLA = \angle OMA = 90^\circ$$

$$\angle OAL = \angle OAM \text{ (AC is bisector of angle A)}$$

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

By Angle-Angle-Side criterion of congruence,

$$\triangle AOL \cong \triangle AOM \text{ (AAS Postulate)}$$

The corresponding parts of the congruent triangles are congruent

$$\Rightarrow OL = OM \text{ (CPCT)}$$

Therefore, O is equidistant from AB and AD.

Diagonal AC and BD bisect each other at right angles at O.

$$\text{Therefore, } AO = OC$$

Hence, O is equidistant from A and C.

**Question 27.**

Use a graph paper for this question. Take 2 cm = 1 unit on both the axes.

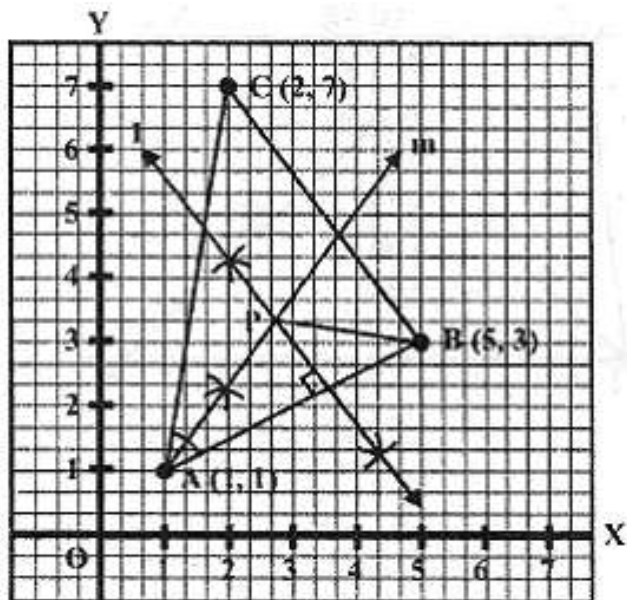
(i) Plot the points A(1,1), B(5,3) and C(2,7).

(ii) Construct the locus of points equidistant from A and B.

(iii) Construct the locus of points equidistant from AB and AC.

- (iv) Locate the point P such that  $PA = PB$  and P is equidistant from AB and AC.  
 (v) Measure and record the length PA in cm.

**Solution:**



Steps of Construction:

- i) Plot the points A(1, 1), B(5, 3) and C(2, 7) on the graph and join AB, BC and CA.
- ii) Draw the perpendicular bisector of AB and angle bisector of angle A which intersect each other at P.

P is the required point.

Since P lies on the perpendicular bisector of AB.

Therefore, P is equidistant from A and B.

Again,

Since P lies on the angle bisector of angle A.

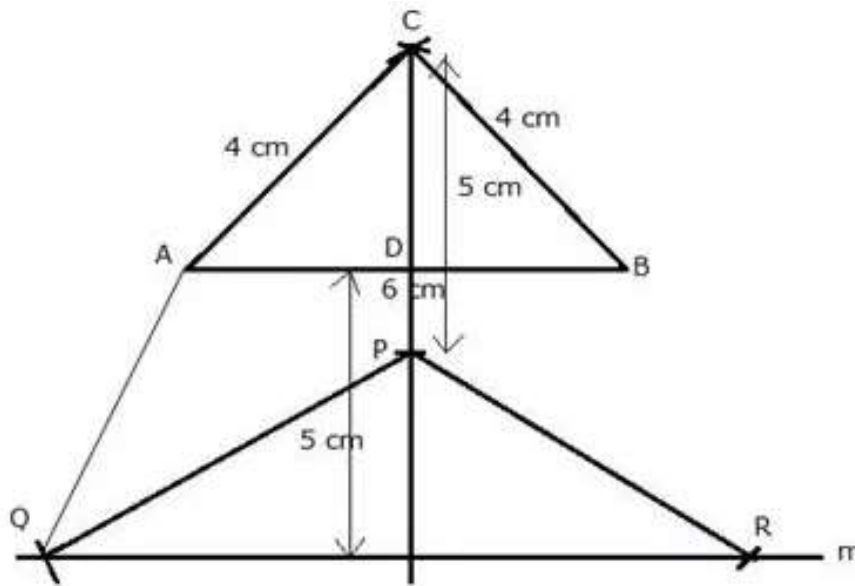
Therefore, P is equidistant from AB and AC.

On measuring, the length of  $PA = 5.2$  cm

Question 28.

Construct an isosceles triangle ABC such that  $AB = 6$  cm,  $BC = AC = 4$  cm. Bisect angle C internally and mark a point P on this bisector such that  $CP = 5$  cm. Find the points Q and R which are 5 cm from P and also 5 cm from the line AB.

**Solution:**



Steps of Construction:

- i) Draw a line segment  $AB = 6$  cm.
- ii) With centers A and B and radius 4 cm, draw two arcs which intersect each other at C.
- iii) Join CA and CB.
- iv) Draw the angle bisector of angle C and cut off  $CP = 5$  cm.
- v) A line m is drawn parallel to AB at a distance of 5 cm.
- vi) P as centre and radius 5 cm, draw arcs which intersect the line m at Q and R.
- vii) Join PQ, PR and AQ.

Q and R are the required points.

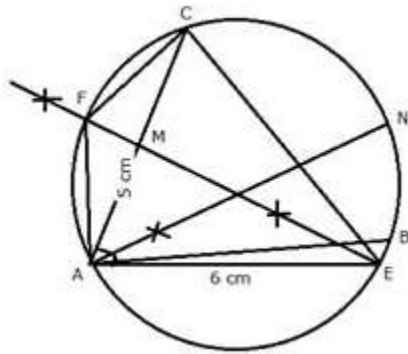
**Question PQ.**

Use ruler and compasses only for this question. Draw a circle of radius 4 cm and mark two chords AB and AC of the circle of lengths 6 cm and 5 cm respectively.

- (i) Construct the locus of points, inside the circle, that are equidistant from A and C. Prove your construction.
- (ii) Construct the locus of points, inside the circle, that are equidistant from AB and AC.



**Solution:**



**Steps of Construction:**

- i) Draw a circle with radius = 4 cm.
- ii) Take a point A on it.
- iii) A as centre and radius 6 cm, draw an arc which intersects the circle at B.
- iv) Again A as centre and radius 5 cm, draw an arc which intersects the circle at C.
- v) Join AB and AC.
- vi) Draw the perpendicular bisector of AC, which intersects AC at M and meets the circle at E and F.

EF is the locus of points inside the circle which are equidistant from A and C.

- vii) Join AE, AF, CE and CF.

**Proof:**

i) In  $\triangle CME$  and  $\triangle AME$

$CM = AM$  (EF is the bisector of AC)

$\angle CME = \angle CMA = 90^\circ$

$EM = EM$  (Common)

$\therefore$  By Side-Angle-Side criterion of congruence,

$\triangle CME \cong \triangle AME$  (SAS Postulate)

The corresponding parts of the congruent triangles are congruent.

$\Rightarrow CE = AE$  (CPCT)

Similarly, we can prove that  $CF = AF$

Hence EF is the locus of points which are equidistant from A and C.

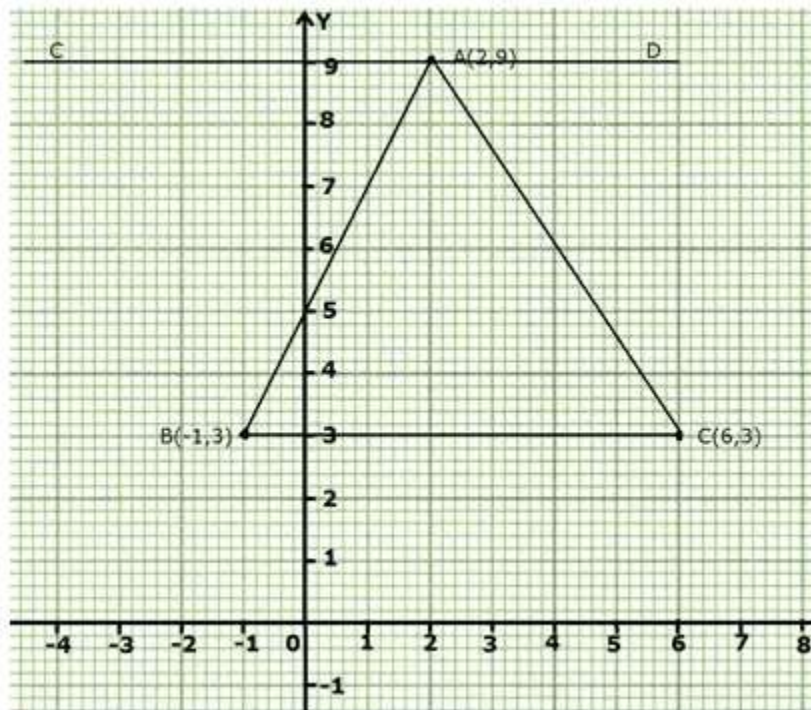
- ii) Draw the bisector of angle A which meets the circle at N.

Therefore. Locus of points inside the circle which are equidistant from AB and AC is the perpendicular bisector of angle A.

**Question 29.**

Plot the points A(2,9), B(-1,3) and C(6,3) on a graph paper. On the same graph paper, draw the locus of point A so that the area of triangle ABC remains the same as A moves.

**Solution:**



Steps of construction:

- Plot the given points on graph paper.
- Join AB, BC and AC.
- Draw a line parallel to BC at A and mark it as CD.

CD is the required locus of point A where area of triangle ABC remains same on moving point A.

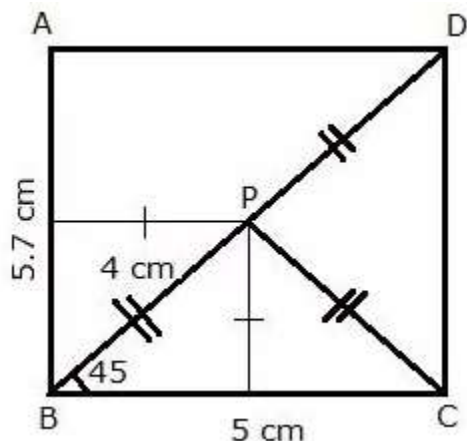
**Question 30.**

Construct a triangle BCP given  $BC = 5$  cm,  $BP = 4$  cm and  $\angle PBC = 45^\circ$ .

- Complete the rectangle ABCD such that:
  - P is equidistant from A B and BC.
  - P is equidistant from C and D.

(ii) Measure and record the length of AB.

**Solution:**



i) Steps of Construction:

- 1) Draw a line segment  $BC = 5\text{ cm}$
- 2) B as centre and radius  $4\text{ cm}$  draw an arc at an angle of  $45^\circ$  from BC.
- 3) Join PC.
- 4) B and C as centers, draw two perpendiculars to BC.
- 5) P as centre and radius PC, cut an arc on the perpendicular on C at D.
- 6) D as centre, draw a line parallel to BC which intersects the perpendicular on B at A.

ABCD is the required rectangle such that P is equidistant from AB and BC (since BD is angle bisector of angle B) as well as C and D.

ii) On measuring  $AB = 5.7\text{ cm}$

### Question 31.

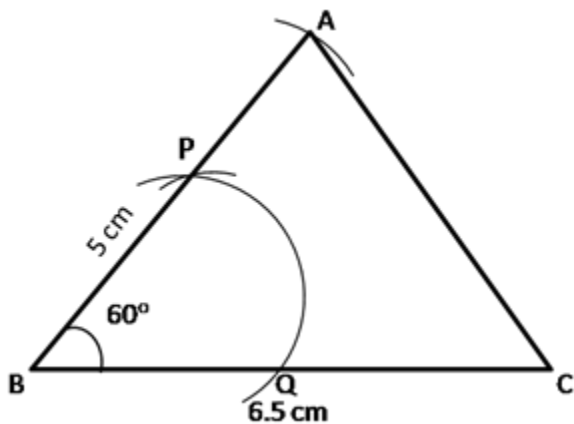
Use ruler and compasses only for the following questions. All constructions lines and arcs must be clearly shown.

- (i) Construct a  $\triangle ABC$  in which  $BC = 6.5\text{ cm}$ ,  $\angle ABC = 60^\circ$ ,  $AB = 5\text{ cm}$ .
- (ii) Construct the locus of points at a distance of  $3.5\text{ cm}$  from A.
- (iii) Construct the locus of points equidistant from AC and BC.
- (iv) Mark 2 points X and Y which are at distance of  $3.5\text{ cm}$  from A and also equidistant from AC and BC. Measure XY.

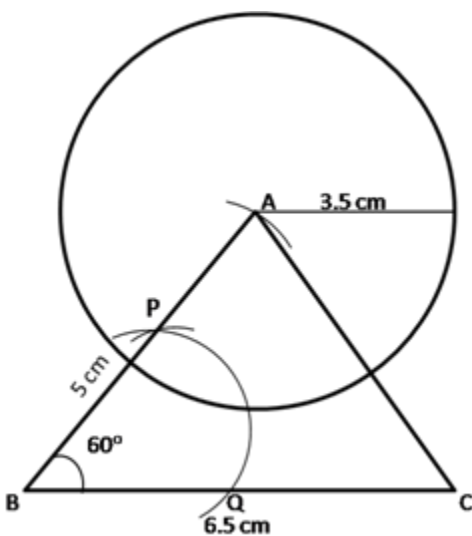
**Solution:**

i. Steps of construction:

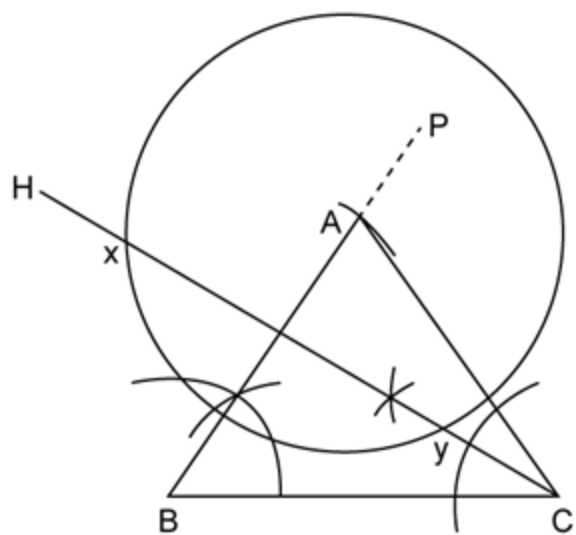
1. Draw  $BC = 6.5$  cm using a ruler.
2. With B as center and radius equal to approximately half of BC, draw an arc that cuts the segment BC at Q.
3. With Q as center and same radius, cut the previous arc at P.
4. Join BP and extend it.
5. With B as center and radius 5 cm, draw an arc that cuts the arm PB to obtain point A.
6. Join AC to obtain  $\triangle ABC$ .



ii. With A as center and radius 3.5 cm, draw a circle.  
The circumference of a circle is the required locus.



iii. Draw CH, which is bisector of  $\triangle ACB$ . CH is the required locus.



iv. Circle with center A and line CH meet at points X and Y as shown in the figure.  $xy = 8.2$  cm (approximately)