

Construction of Polygons

- **Construction of quadrilateral when one angle and four sides are given:**

Example:

Construct a quadrilateral PQRS with $PQ = 6$ cm, $QR = 7$ cm, $RS = 8.5$ cm, $PS = 6.5$ cm and $\angle Q = 90^\circ$.

Solution:

Step 1: Draw line segment PQ of length 6 cm.

Step 2: Draw $\angle XQP = 90^\circ$ at point Q.

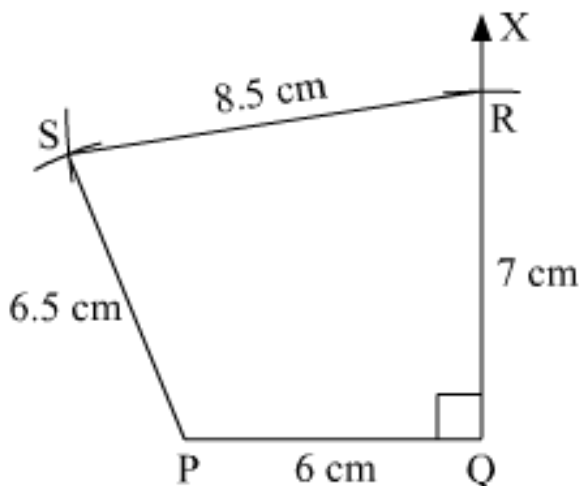
Step 3: Taking Q as centre and 7 cm as radius, mark an arc on QX and name the point of intersection as R.

Step 4: Taking R as centre and 8.5 cm as radius, mark an arc.

Step 5: Taking P as centre and 6.5 cm as radius, mark an arc. Let it intersect the previous arc at point S.

Step 6: Join PS and RS.

PQRS is the required quadrilateral.



- **Construction of a quadrilateral when three sides and two included angles are given**

Example:

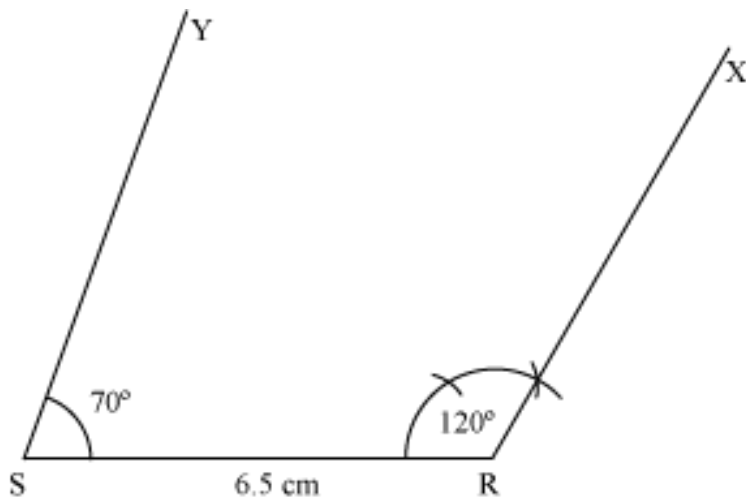
Construct a quadrilateral PQRS with $SR = 6.5$ cm, $PS = 5$ cm, $QR = 3$ cm, $\angle R = 120^\circ$, and $\angle S = 70^\circ$.

Solution:

The steps of construction are as follows:

Step 1:

Draw $SR = 6.5$ cm. Draw $\angle SRX = 120^\circ$ at R and $\angle RSY = 70^\circ$ at S.

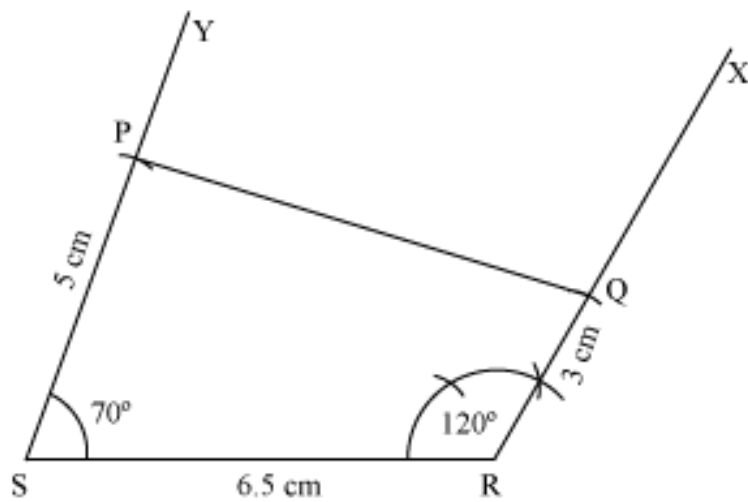


Step 2:

With S as centre, draw an arc of radius 5 cm intersecting SY at P.

With R as centre, draw an arc of radius 3 cm intersecting RX at Q.

Join PQ to obtain the required quadrilateral PQRS.



- A unique quadrilateral can be constructed, if any five measurements of the quadrilateral are given.
- **Construction of a quadrilateral when four sides and a diagonal are given:**

Example:

Construct a quadrilateral WXYZ, where $WX = 4.5$ cm, $XY = 5$ cm, $YZ = 5.5$ cm, $ZW = 3$ cm, and $WY = 6$ cm.

Solution:

Step 1:

Draw a line WY of length 6 cm. Draw an arc of radius 4.5 cm with W as centre and another arc of length 5 cm with Y as centre. The intersection of the two arcs will be the point, X.

Join WX and XY.

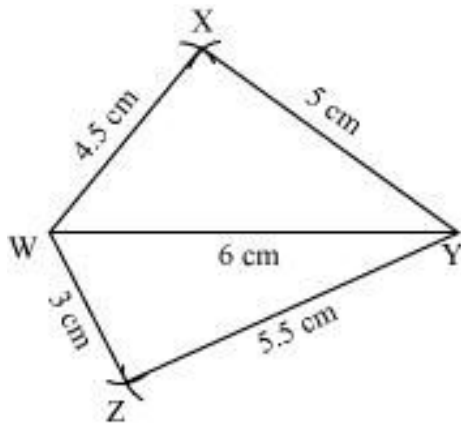
Step 2:

The point, Z, will be on the opposite side of point X with respect to WY.

Draw an arc of length 3 cm taking W as centre and another arc of length 5.5 cm taking Y as centre. The intersection of these arcs will be the point, Z.

Join WZ and YZ.

WXYZ is the required quadrilateral.



- **Construction of a quadrilateral when two diagonals and three sides are given**

Example:

Construct a quadrilateral PQRS, where $PR = 7$ cm, $QS = 8$ cm, $PQ = 5$ cm, $QR = 5$ cm, and $PS = 5.5$ cm.

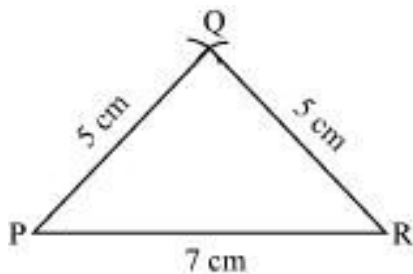
Solution:

The steps of constructing quadrilateral PQRS are as follows:

Step 1:

Draw a line PR of length 7 cm. Draw an arc of radius 5 cm taking P as centre and an arc of radius 5 cm taking R as centre. The point of intersection of these two arcs will be the point, Q .

Join PQ and RQ .

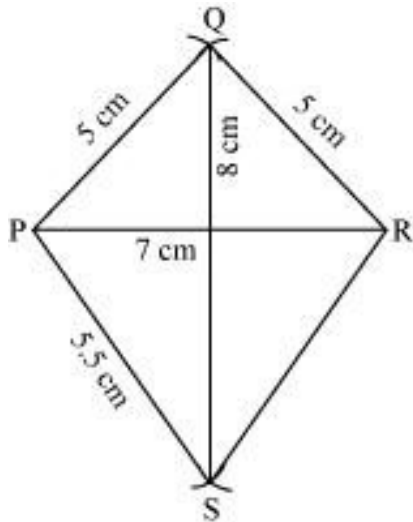


Step 2:

With Q as centre, draw an arc of radius 8 cm. The point, S , will lie on this arc.

Then, taking P as centre, draw an arc of radius 5.5 cm. The intersection point of the two arcs will be the point, S .

Join PS and RS.



PQRS is the required quadrilateral.

Construction of Parallelograms

Type : 1 To construct a parallelogram, whose two consecutive sides and the included angle are given.

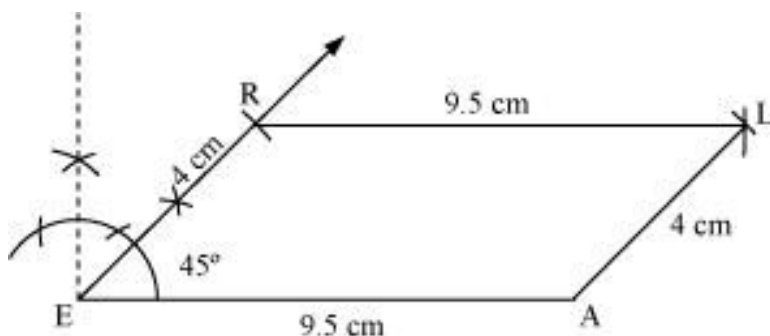
Let a parallelogram REAL has $RE = 4$ cm, $EA = 9.5$ cm, and $m\angle REA = 45^\circ$.

The steps of construction for this figure are as follows:

Step 1 Draw a line segment EA of 9.5 cm and an angle of 45° at point E. As vertex R is 4 cm away from vertex E, cut a line segment ER of 4 cm on this ray.

Step 2 Vertex L is 9.5 cm and 4 cm away from vertices R and A respectively. By taking radius as 9.5 cm and 4 cm, draw arcs from point R and A respectively. These will be intersecting each other at point L.

Step 3 Join L to R and A.



REAL is the required parallelogram.

Type : 2 To construct a parallelogram, whose one side and both the diagonals are given.

Let a parallelogram STAR has $TA = 7$ cm, $AS = 13$ cm, and $TR = 15$ cm.

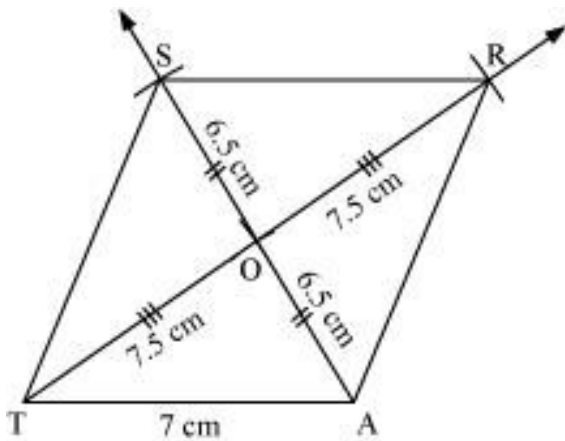
The steps of construction for this figure are as follows:

Step 1 $\triangle OTA$ can be constructed by using the given measurements as:

Step 2. Vertex TR is on the line joining TO and it is 7.5 cm from point O. Therefore, extend line segment TO and draw an arc of radius $OT = 7.5$ cm, taking centre as O that cuts ray TO at point R.

Step 3 Extend line segment AO and draw an arc of radius $OA = 6.5$ cm, taking centre as O that cuts ray AO at point S.

Step 4 Join AR, RS, and ST.



STAR is the required parallelogram.

Type : 3 To construct a parallelogram, whose two consecutive sides and one diagonal is given.

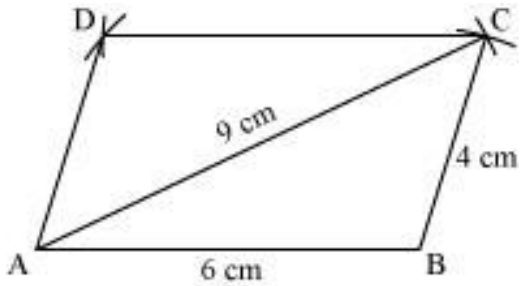
Let a parallelogram has adjacent sides of measures 6 cm and 4 cm and one diagonal of measure 9 cm.

The steps of construction for this figure are as follows:

Step 1: Draw line segment AB of length 6 cm. With A and B as centres, and radii 9 cm and 4 cm respectively, draw arcs intersecting each other at C.

Step 2: Taking C and A as centres and radii 6 cm and 4 cm respectively, draw arcs intersecting each other at D.

Step 3: Join AD and CD.



ABCD is the required parallelogram.

Type : 4 To construct a parallelogram, whose two diagonals and included angle are given.

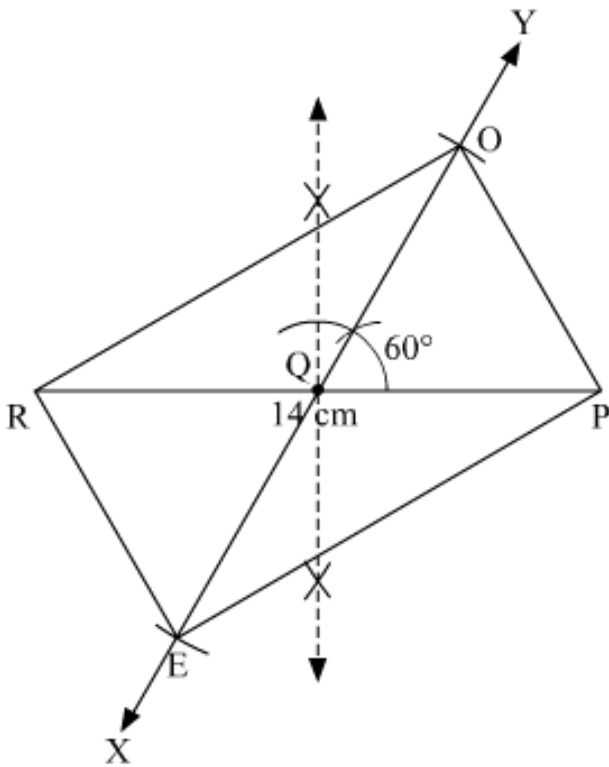
Let parallelogram ROPE has diagonals $RP = 12$ cm and $EO = 14$ cm and the acute angle between the diagonals is 60° .

Step 1: Draw $RP = 14$ cm. Then draw perpendicular bisector of RP to get the midpoint Q.

Step 2: Draw line XY, such that angle $YQP = 60^\circ$.

Step : 3 From line XY, cut $QO = EO/2 = 14/2 = 7$ cm and $QE = RO/2 = 12/2 = 6$ cm.

Step : 4 Join RO, OP, PE and ER.



Type : 5 To construct a parallelogram, whose two adjacent sides and height are given.

Let parallelogram ROPE has diagonals $RP = 12$ cm and $EO = 14$ cm and the acute angle between the diagonals is 60° .

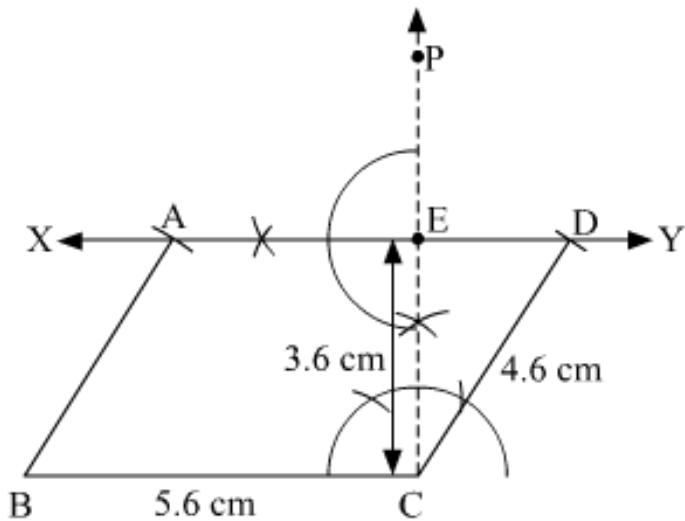
Step : 1 Draw $BC = 5.6$ cm. Then draw perpendicular at C. CP is perpendicular to BC .

Step : 2 From CP , cut 3.6 cm, i.e height of the parallelogram.

Step : 3 Through E , draw perpendicular to CP to get XY parallel to BC .

Step : 4 With B as a centre and radius 4.6 cm, draw an arc which cuts XY at A .

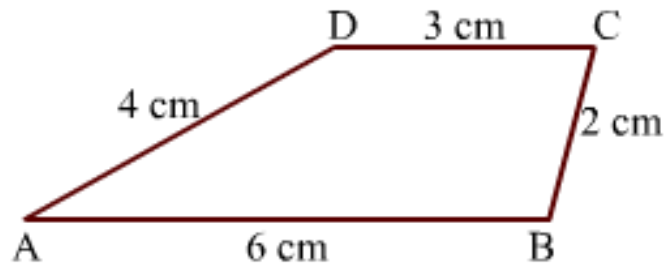
Step : 5 With C as a centre and radius 4.6 cm, draw one more arc which cuts XY at D .



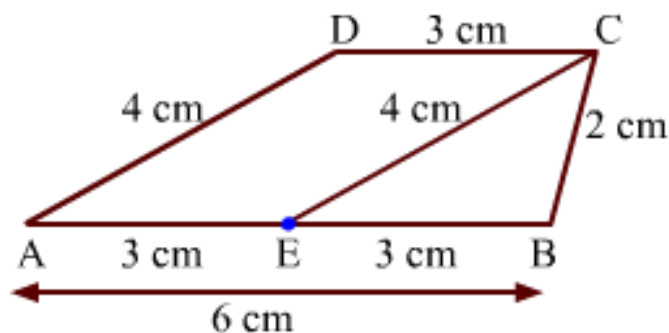
- **Construction of a trapezium when measures of all the sides are given:**

Let us construct a trapezium ABCD, in which $AB = 6$ cm, $BC = 2$ cm, $CD = 3$ cm, $DA = 4$ cm.

Rough sketch:.



A suitable point, E, is marked on AB ($EB = AB - CD$), so as to draw a line segment, EC, parallel to AD. AECD becomes a parallelogram.



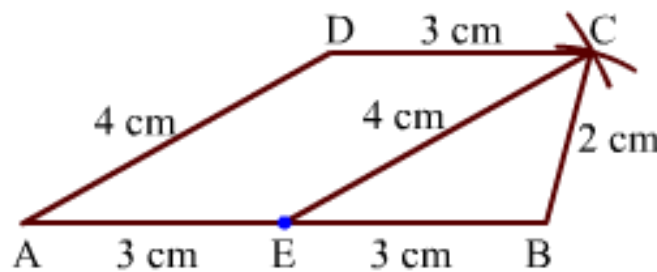
$$\therefore EC = AD = 4 \text{ cm}$$

$$\text{Also, } EB = AB - CD = 6 \text{ cm} - 3 \text{ cm} = 3 \text{ cm}$$

$\therefore AE = 3 \text{ cm}$

The trapezium, ABCD, can be constructed by following the given steps of construction:

- 1) Draw a line segment, AB, of length 6 cm as the bottom side of the trapezium. Then, mark a point, E, at a distance of 3 cm from its right end such that EB is of length 3 cm.
- 2) Taking E and B as the centres and radii as 4 cm and 2 cm respectively, draw arcs intersecting each other at point C. Join EC and BC.
- 3) Draw a line segment, DC, of length 3 cm, parallel to the bottom line, AB, through the top vertex of $\triangle ECB$.
- 4) Join AD.

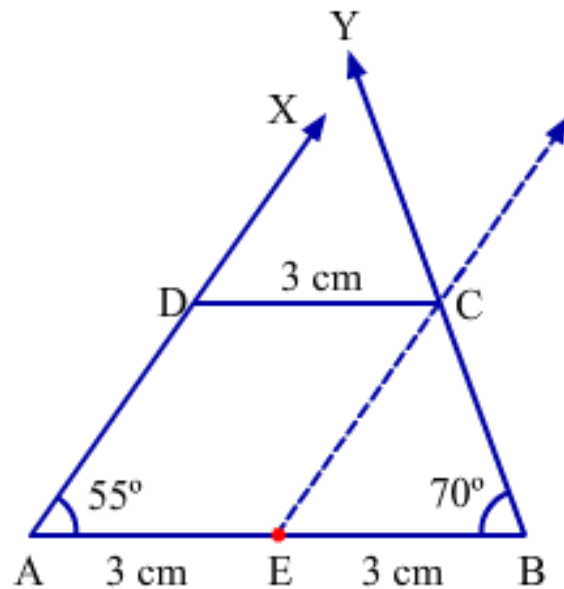


- **Construction of a trapezium when the measures of parallel sides and the angles on the longer side are given:**

To construct a trapezium, in which $AB = 6 \text{ cm}$, $\angle A = 55^\circ$, $\angle B = 70^\circ$, $CD = 3 \text{ cm}$, we need to follow the given steps:

- 1) Draw a line segment, AB, of length 6 cm as the bottom side of the trapezium. Then, mark a point, E, at a distance of 3 cm from its right end such that EB is of length 3 cm.
- 2) Draw $\angle BAX = 55^\circ$ and $\angle ABY = 70^\circ$ at points A and B respectively.
- 3) Draw a ray parallel to ray AX from point E such that it intersects ray BY at point C.

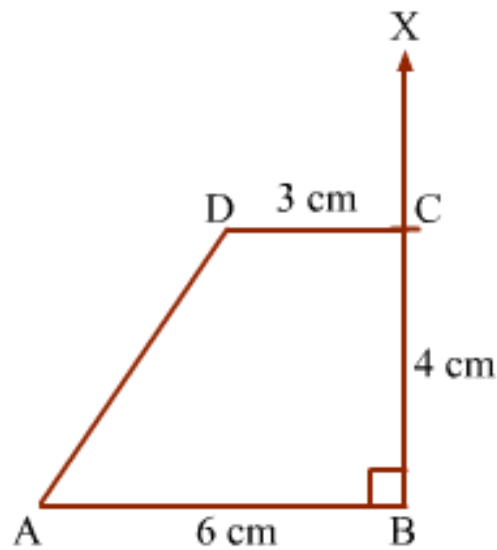
4) Draw a line segment from point C, parallel to the bottom line, AB, which intersects the ray AX at point D.



- **Construction of a trapezium when measures of three sides and one included angle are given:**

To construct a trapezium, ABCD, $AB = 6$ cm, $CD = 3$ cm, $BC = 4$ cm and $\angle ABC = 90^\circ$, we need to follow the given steps:

- 1) Draw a line segment, AB, of length 6 cm as the bottom side of the trapezium.
- 2) Draw $\angle ABX = 90^\circ$ at point B.
- 3) Taking B as the centre and radius 4 cm, draw an arc on ray BX and name the point of intersection as C.
- 4) From point C, draw a line segment CD parallel to the bottom line segment, AB, of length 3 cm.
- 5) Join AD.



- **Construction of regular hexagon:**

- We can construct a regular hexagon by making use of any of the following rules relating to a regular hexagon:

(1) Each interior angle of a regular hexagon = 120°

(2) Length of a side of a regular hexagon = Radius of its circumcircle

- To construct the regular hexagon ABCDEF of side x unit using the first rule, i.e., each interior angle of a regular hexagon is equal to 120° .

The steps of construction are as follows:

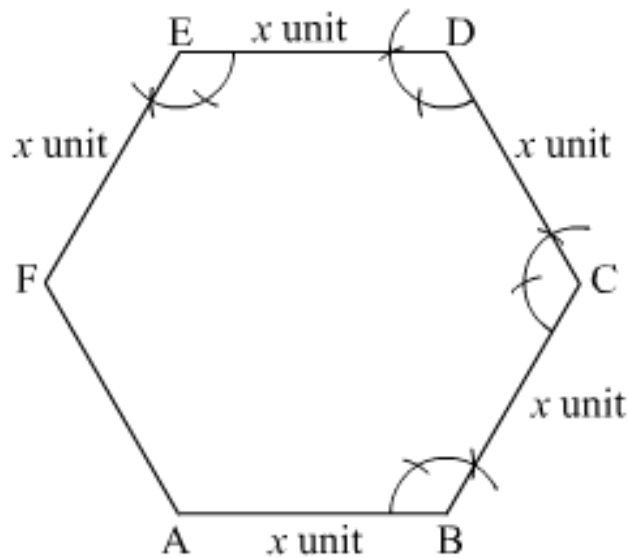
(1) Draw AB of length x unit.

(2) At B, draw $\angle ABC = 120^\circ$, where $BC = x$ unit.

(3) At C, draw $\angle BCD = 120^\circ$, where $CD = x$ unit.

(4) At D, draw $\angle CDE = 120^\circ$, where $DE = x$ unit.

(5) At E, draw $\angle DEF = 120^\circ$, where $EF = x$ unit. Join AF.



ABCDEF is the required regular hexagon of side x unit.

- To construct a regular hexagon using the second rule, i.e., the length of a side of a regular hexagon is equal to the radius of its circumcircle.

The steps of construction are as follows:

(1) Draw a circle of radius x unit.

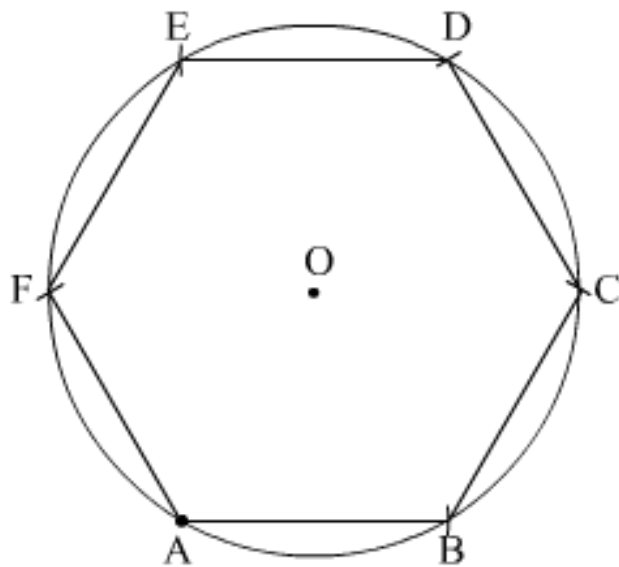
(2) Take any point A on its circumference. With A as the centre and radius as x unit, draw two arcs to cut the circle at points B and F.

(3) With B as the centre and radius as x unit, draw an arc that cuts the circle at point C.

(4) With C as the centre and radius as x unit, draw an arc that cuts the circle at point D.

(5) With D as the centre and radius as x unit, draw an arc that cuts the circle at point E.

(6) Join AB, BC, CD, DE, EF and AF.



ABCDEF is the required regular hexagon of side x unit.

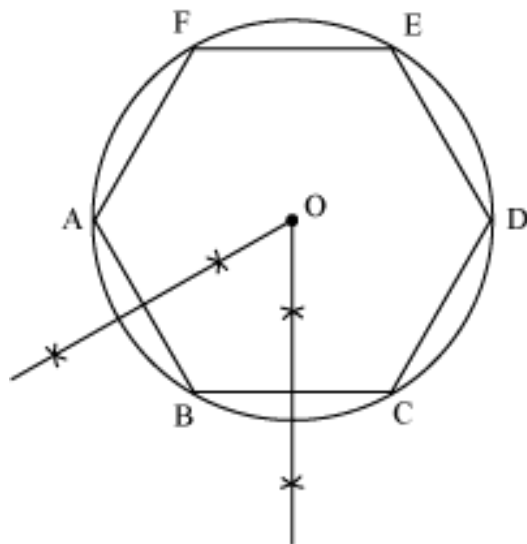
- **Construction of circumcircle of a regular hexagon:**

Following are the steps of construction of circumcircle of a regular hexagon ABCDEF.

Step 1: Construct a regular hexagon of side x unit.

Step 2: Draw perpendicular bisectors of sides AB and BC. Let them intersect at a point O.

Step 3: With O as centre and radius equal to OA, draw a circle.



This circle touches all the vertices A, B, C, D, E, and F of the regular hexagon ABCDEF. Hence, it is the required circumcircle of the regular hexagon.

- **Construction of incircle of a regular hexagon:**

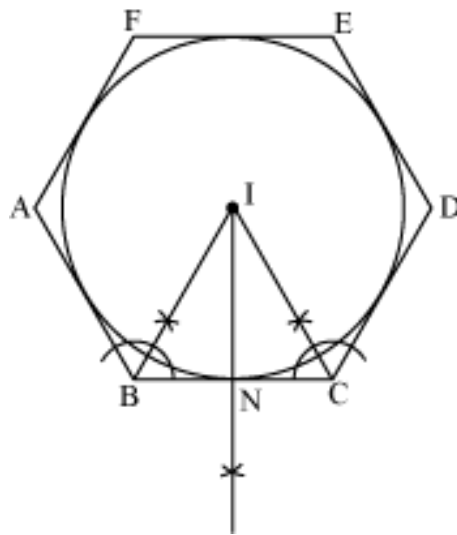
Following are the steps of construction of incircle of a regular hexagon ABCDEF.

Step 1: Construct a regular hexagon of side x unit.

Step 1: Draw the bisectors of $\angle B$ and $\angle C$. Let them meet at point I.

Step 2: From I, draw IN perpendicular to BC.

Step 3: Taking I as centre and radius equal to IN, draw a circle.



This circle touches each side of regular hexagon ABCDEF. Hence, it is the required incircle.