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 ∠Q = 90°.

  Solution:

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

  Step 2: Draw ∠XQP = 90° at point Q.

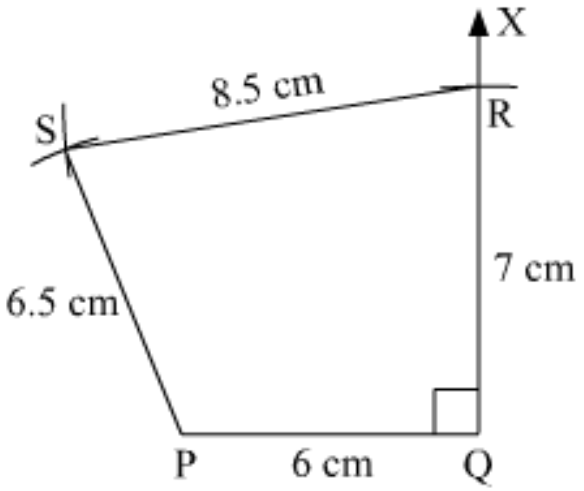
  Step 3: Taking Q as centre and 7 cm as radius, mark an arc on QX and name the point of intersection as R.

  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:

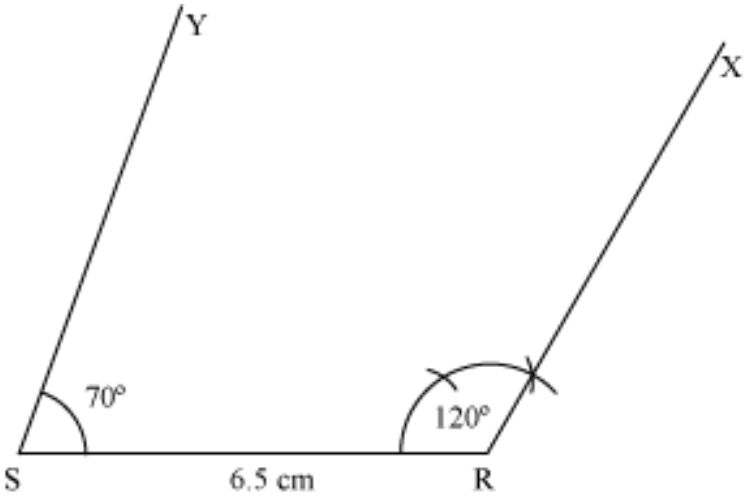
  Construct a quadrilateral PQRS with SR = 6.5 cm, PS = 5 cm, QR = 3 cm, ∠R = 120°, and ∠S = 70°.

  Solution:

  The steps of construction are as follows:

  Step 1:

  Draw SR = 6.5 cm. Draw ∠SRX = 120° at R and ∠RSY = 70° at S.

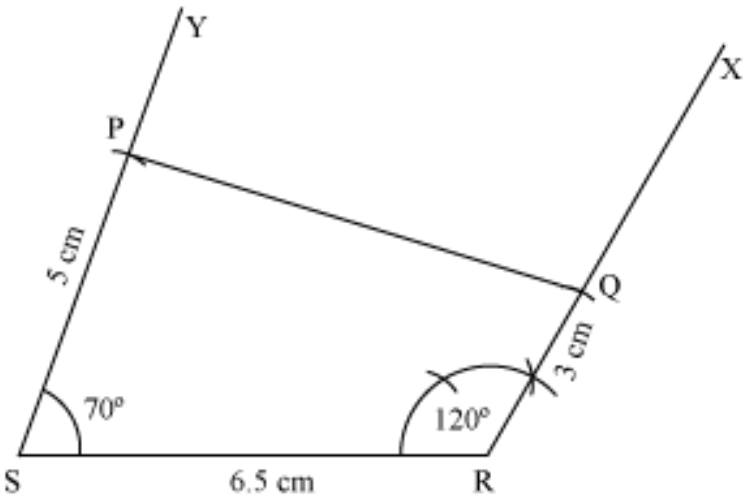


  Step 2:

  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.

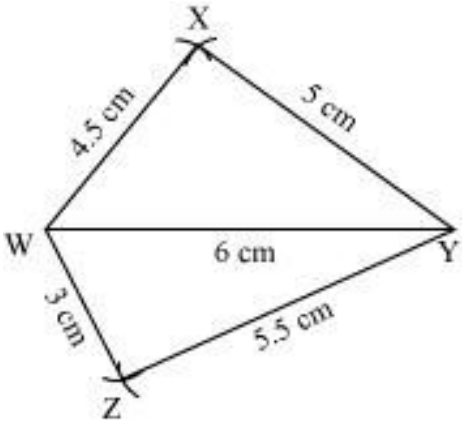
  Step 2:

  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.

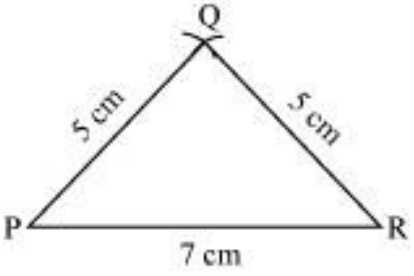
  Solution:

  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.

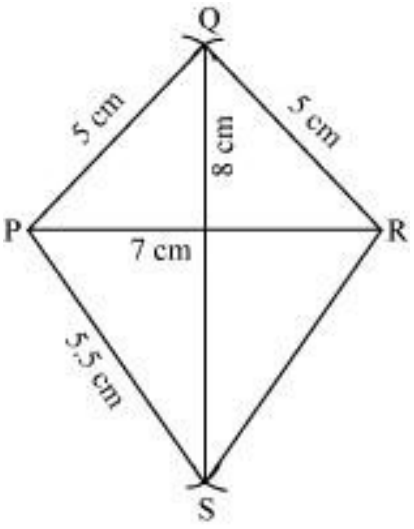


  Step 2:

  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.

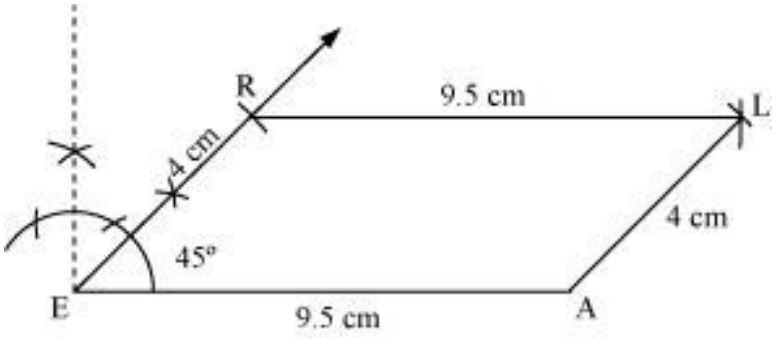
Let a parallelogram REAL has RE = 4 cm, EA = 9.5 cm, and $m\angle REA = 45°$.

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 45º at point E. As vertex R is 4 cm away from vertex E, cut a line segment EA of 4.5 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.

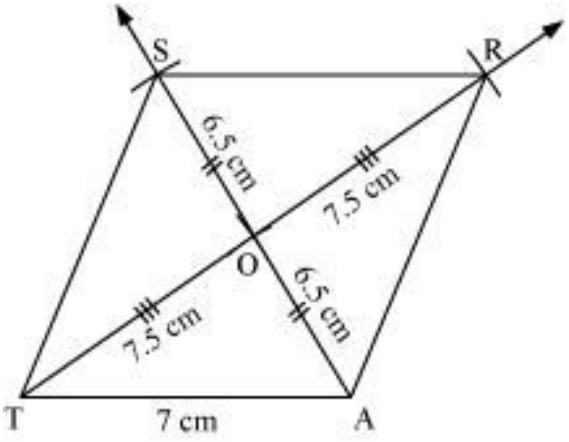
The steps of construction for this figure are as follows:

Step 1 ΔOTA 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.

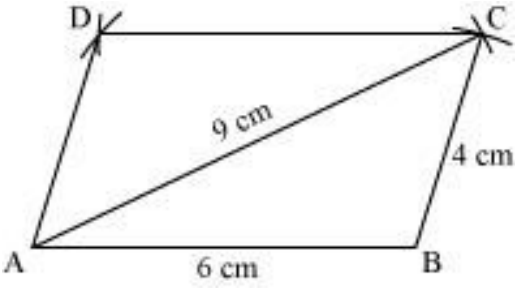
Let a parallelogram has adjacent sides of measures 6 cm and 4 cm and one diagonal of measure 9 cm.

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.

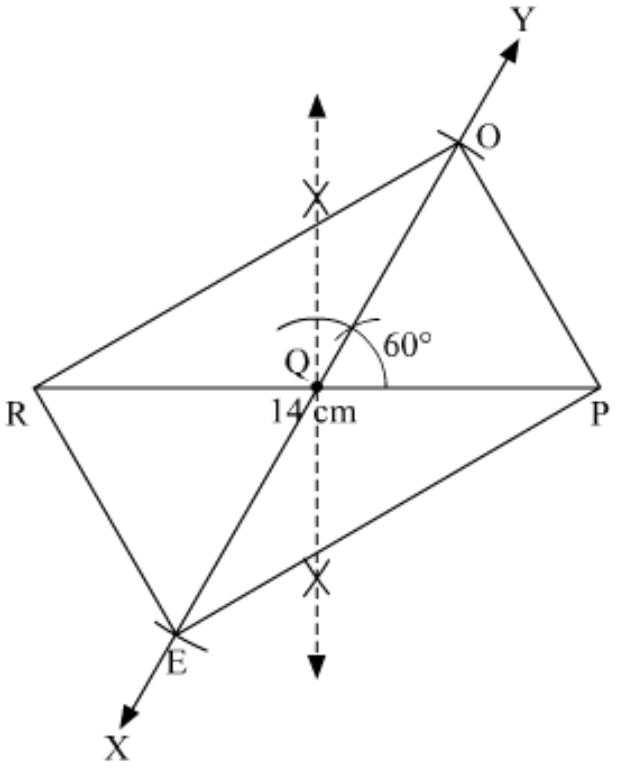
Let parallelogram ROPE has diagonals RP = 12 cm and EO = 14 cm amd the acute angle between the diagonals is 60º.

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 = 60º.

Step : 3 From line XY, cut QO = EO2=122=6 cm and QE = EO2=122=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 amd the acute angle between the diagonals is 60º.

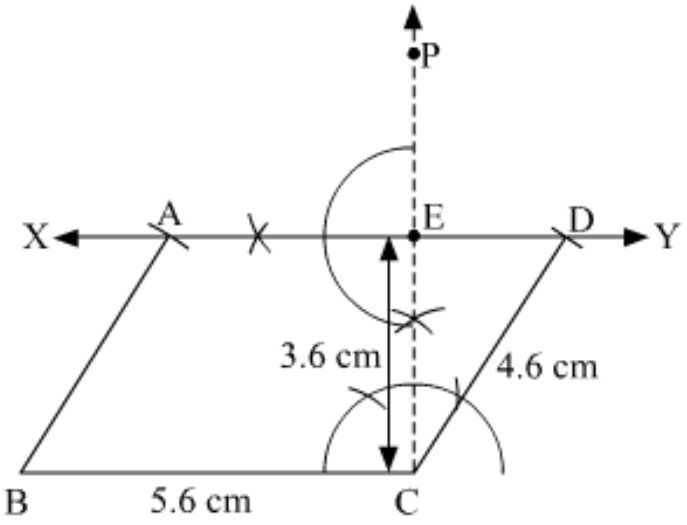
Step : 1 Draw BC = 5.6 cm. Then draw perpendicular at C. CP is perpendicular to BC.

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.

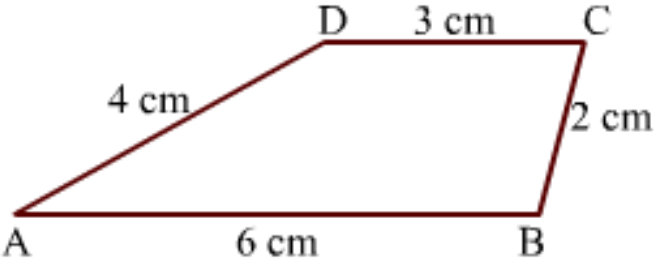
Step : 5 With C as a centre and radius 4.6 cm, draw one more arc which cuts XY at D.



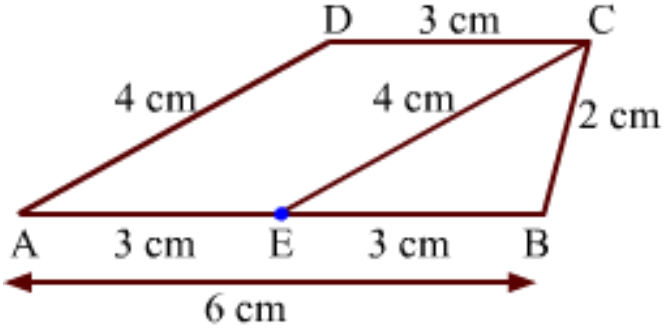
- **Construction of a trapezium when measures of all the sides are given:**

  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.



  ∴ EC = AD = 4 cm

  Also, EB = AB – CD = 6 cm – 3 cm = 3 cm

∴ AE = 3 cm

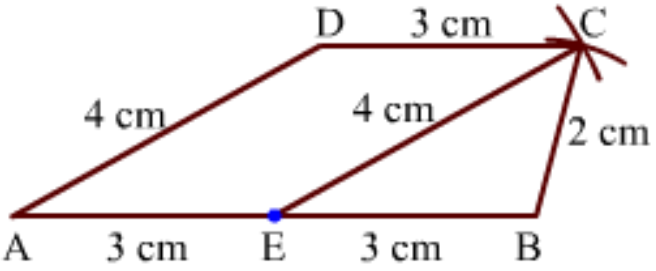
The trapezium, ABCD, can be constructed by following the given steps of construction:

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 ΔECB.

4) Join AD.



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

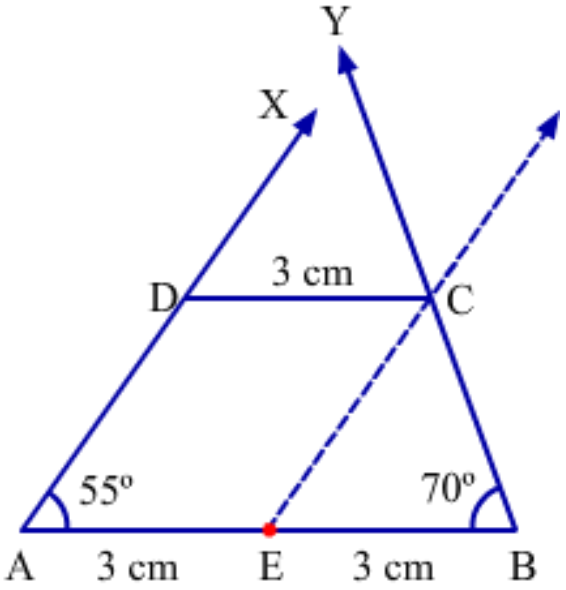
To construct a trapezium, in which AB = 6 cm, ∠A = 55°, ∠B = 70°, CD = 3 cm, we need to follow the given steps:

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 ∠BAX = 55° and ∠ABY = 70° 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 ∠ABC = 90°, we need to follow the given steps:

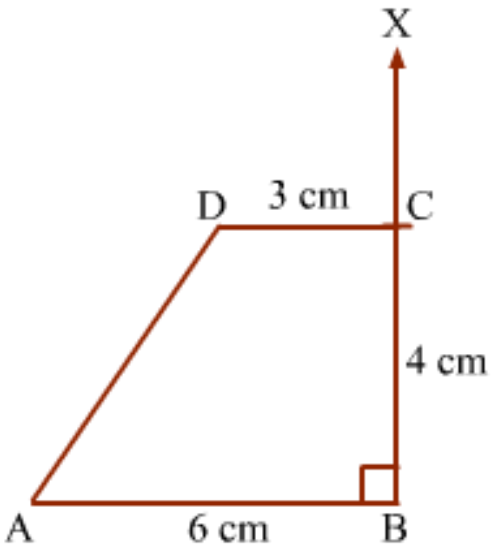
  1) Draw a line segment, AB, of length 6 cm as the bottom side of the trapezium.

  2) Draw ∠ABX = 90° 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:

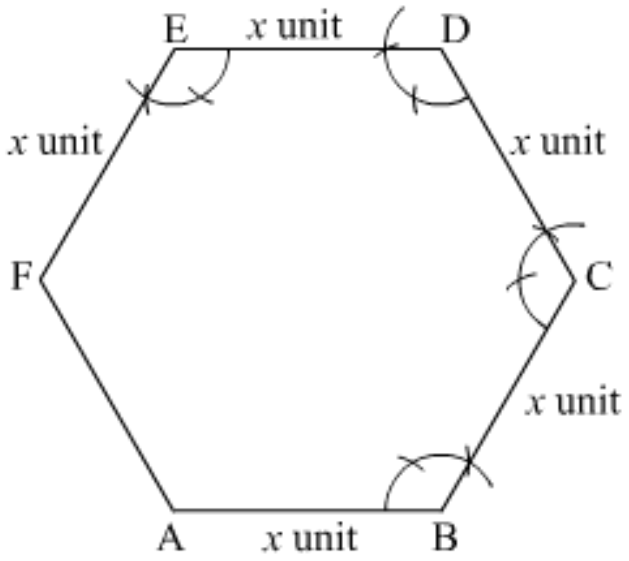
  (1) Draw AB of length x unit.

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

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

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

  (5) At E, draw $\angle DEF = 120°$, 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.

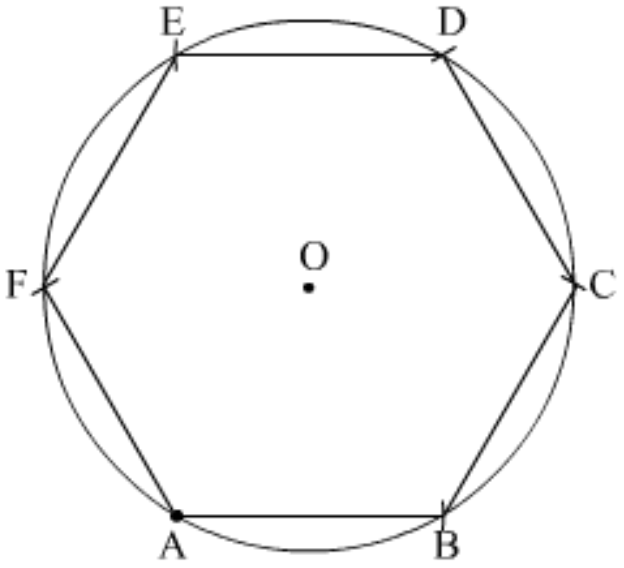
  (2) Take any point A on its circumference. With A as the centre and radius as x unit, draw two arcs to cut the circle at points B and F.

  (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.

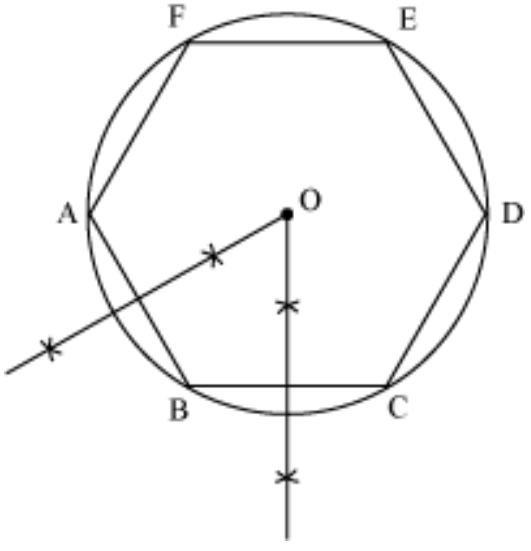
- **Construction of circumcircle of a regular hexagon:**

  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:**

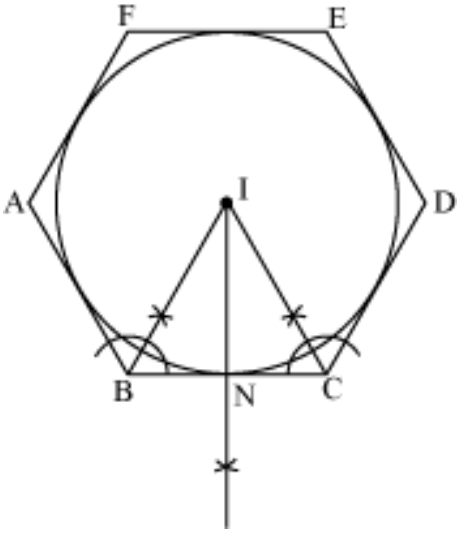
  Following are the steps of construction of incircle of a regular hexagon ABCDEF.

  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.