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Construction of Regular Polygons

Regular Polygons are polygons in which all sides and all angles are equal.

The polygons which we use frequently in our drawings are triangle, square, pentagon, hexagon, heptagon, octagon, etc.

Methods of Drawing Polygons:

Usually polygons are drawn based on 2 types of data given in the problem. They are:

1) Construction of a polygon when its **side is given**. This can be solved by general method, the easiest of which is the inscribed circle method.

2) Construction of a polygon inscribed in a circle, whose **diameter** is given. For this, there are different methods of construction for each polygon separately.

→***Note***:

Usually, for regular polygons, the angle between the sides is $\mathbf{108^0}$ for a **pentagon** and $\mathbf{120^0}$ for a **hexagon**.

So, if a side is given (say 25 mm) and it is asked to draw a regular pentagon or hexagon, we must not draw the pentagon or hexagon directly by taking these angles and the given sides.

We must draw the polygon by the general method (Inscribed Circle method as it is the easiest).

Hence before deciding which method to draw, check carefully if the side is given or the diameter of the circle is given.

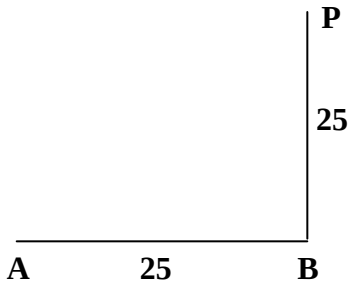
If diameter is given, it will be mentioned Clearly to inscribe a polygon in a circle of given diameter.

General Method of Polygons when a side is given

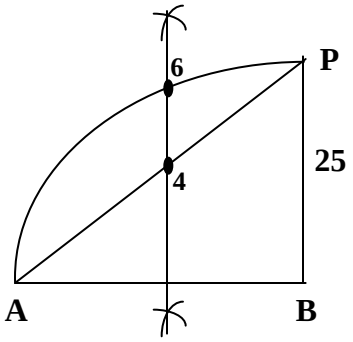
Q) Construct a square, pentagon, hexagon and heptagon of side 25 mm (sometimes it may be said by using inscribed circle method).

Common Procedure for all these polygons is as follows:

1) Draw the side AB = 25.
2) At B, draw BP ⊥ to AB (BP = AB=25)



3) Join AP by a straight line.
4) Draw an arc with B as center & BA as radius. Arc also will touch A & P.



5) Draw a ⊥ bisector to AB to cut the **line AP at 4 and arc AP at 6.**

(Use more than half radius to get the perpendicular bisector).

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6) The point **4** will be the center of the circle to obtain a **square**;
The point **6** will be the center of the circle to obtain a **hexagon**.

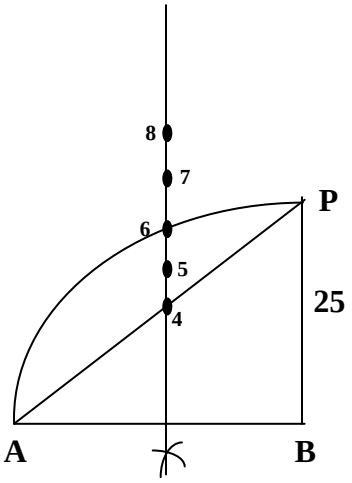
Mark point **5** at the **mid point** of **4 & 6.**

The point **5** will be the center of the circle to obtain a **pentagon**.

Mark **7** at a distance from 6 which is **same** as **4-5** or **5-6**.

The point **7** will be the center of the circle to obtain a **heptagon**.

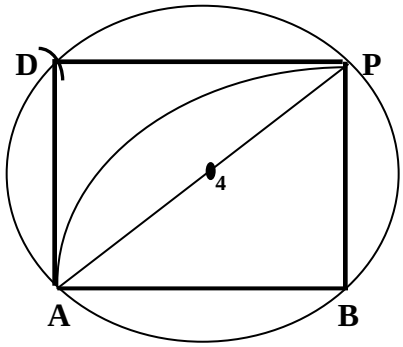
Similarly, we can get any no. of points to draw the polygon of required sides.



1) ***To Construct a Square***:

(i) With 4 as center and 4-A as radius, draw a circle passing through A, B & P.

(ii) With A as center, radius = side (=AB), cut an arc on the circle to get D. Join ABPD to get the required Square.

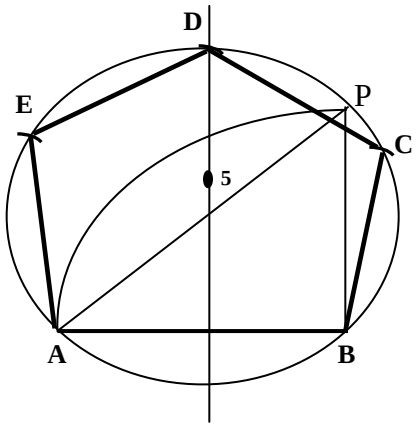


2) ***Construct a Pentagon***:

(i) With 5 as center and 5-A as radius, draw a circle passing through A, B.

(ii) With A & B as centers, radius = side (=AB), cut arcs on the circle to get C & E.

(iii) With E as center & radius = AB, cut an arc on circle to get point D. Join ABCDE to get the required Pentagon.



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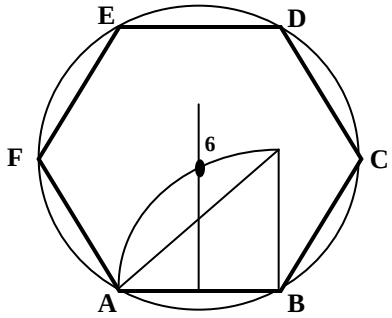
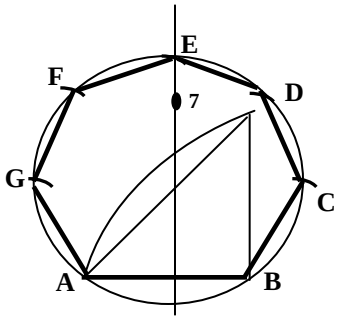
3) To construct a hexagon:

(i) The point **6** will be the center of the circle to obtain a **hexagon**.
(ii) With 6 as center and radius = 6-A, draw a circle through AB.
(iii) With A & B as centers & radius = AB, cut arcs on circle to get C & F.
(iv) With C & F as centers & radius = AB, cut arcs on circle to get D & E.
(v) Join ABCDEF to get the required (vi) Hexagon.



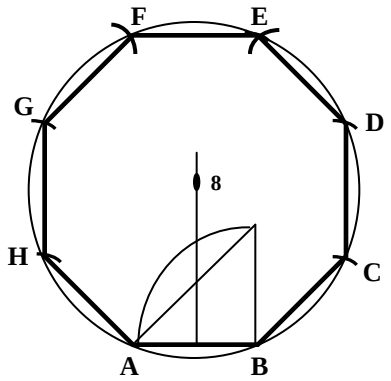
4) *Construct a Heptagon*:

(i) With 7 as center and radius = 7-A, draw a circle through AB.
(ii) With A & B as centers, radius = AB (=25), cut arcs on the circle to get C & G.
(iii) With C & G as centers, radius = AB, cut arcs on circle to get D & F.
(iv) With D as center & radius = AB, cut an arc on circle to get E.
(v) Join ABCDEFG to get the required Heptagon.



5) To construct an octagon

(i) With 8 as center and radius = 8-A, draw a circle through AB.
(ii) With A & B as centers, radius = AB, cut arcs on the circle to get C & H.
(iii) With C & H as centers, radius = AB, cut arcs on circle to get D & G.
(iv) With D & G as centers & radius = AB, cut an arc on circle to get E & F.
(v) Join ABCDEFGH to get the required Octagon.



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Construction of Polygons inside circles (Inscribed Polygons in Circles)

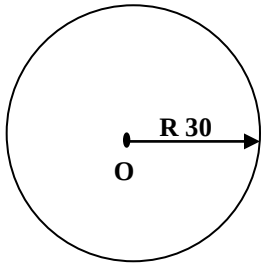
This method is used when the **diameter of a circle is given** (Side of polygon is not given)

To Construct a Pentagon when circle is given:

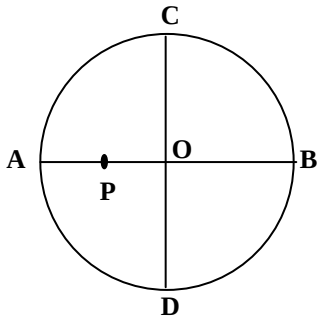
Q) Inscribe a pentagon in a circle of 60 mm diameter.

Sol) The following are the steps involved in the construction:

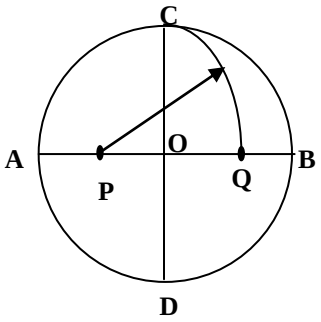
(i) Draw a circle of given radius (Radius= 30 mm) with O as center of circle.
(ii) Draw the horizontal and vertical diameters AB & CD.
(iii) Bisect AO to get P (Midpoint of AO is P; it is the perpendicular bisector).



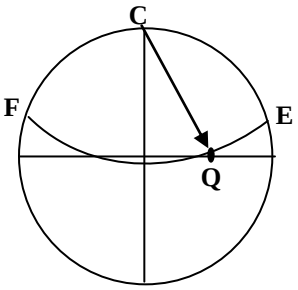
(i)



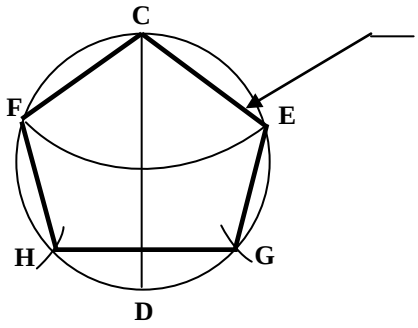
(ii) & (iii)



(iv)



(v)



Final Pentagon

CD = Φ 60

(vi) & (vii)

(iv) With **P** as center & **PC** as radius, draw an arc to cut **OB** at **Q.**
(v) With **C** as center & **CQ** as radius, draw an arc to cut the circle at **E** & **F**.
CE or **CF** is the side of pentagon.
(vi) **Join** CE & CF to get 2 sides of pentagon. With **E** & **F** as centers & radius = **CE**, cut arcs on the circle to get **G** & **H**.
(vii) Join **CEGHF** to get the required pentagon inside the circle of **60** mm diameter.

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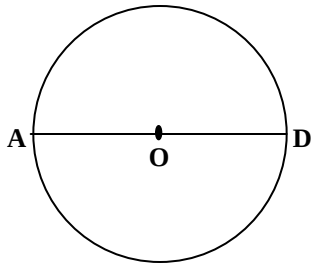
To Construct a Hexagon inside a circle whose diameter is given:

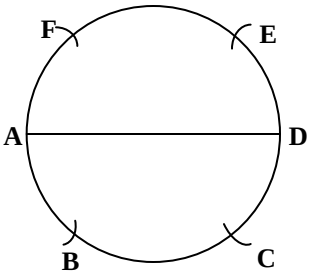
Q) Inscribe a hexagon in a circle of 60 mm diameter.

Sol) The following are the steps involved in the construction:

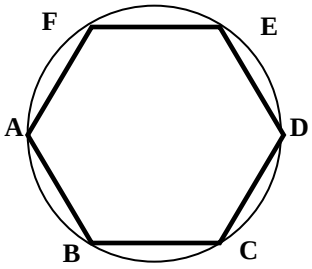
(i) Draw a circle of given radius (Radius= 30 mm) with O as center of circle.
(ii) Draw a horizontal diameter AD through O.
(iii) With **radius = 30** & **A** as center, cut 2 arcs on the circle below & above A to get B & F.
(iv) With **same radius (30)** & **D** as center, cut arcs above & below D to get E & C.
(v) Join **ABCDEF** to get the required hexagon inside the circle of given diameter (60 mm).



(i)& (ii) **Rad = 30**



(iii) & (iv)

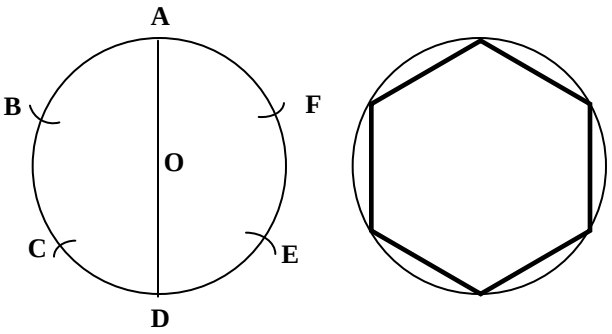


(v)

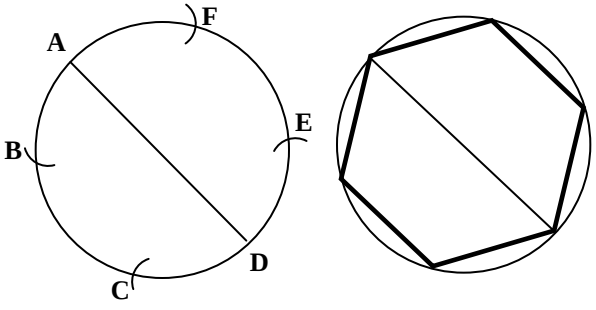
Note: **(i)** If the side of the hexagon is to be **vertical**, then take the diameter **AD** as **vertical** and cut arcs to left and right of A & D as done above to get the required hexagon.

(ii) If the side of the hexagon is to be **inclined** (say at $\mathbf{45^0}$), then take the diameter AD at 45^0 and then repeat the same procedure to get the inclined hexagon.

The radius of the arcs will always be same, as equal to the radius of circle (here 30 mm)



(i) When side is vertical



(ii) When Side is Inclined at 45^0

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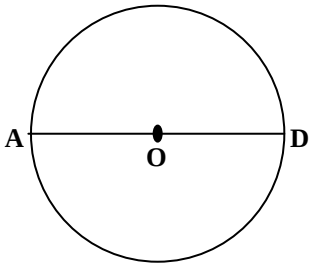
To Construct a Heptagon (7 sides) inside a circle whose diameter is given:

Q) Inscribe a heptagon in a circle of 60 mm diameter.

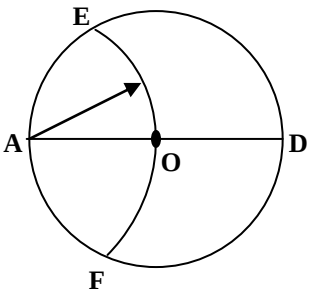
Sol) The following are the steps involved in the construction:

(i) Draw a circle of given radius (Radius= 30 mm) with O as center of circle.
(ii) Draw a horizontal diameter AD through O.
(iii) With A as center & AO as radius, draw an arc cutting the circle at E & F.
(iv) Join EF to cut diameter AD at G. EG or FG is the side of the heptagon.
(v) From A, cut arcs with radius = EG to get the points of heptagon 1, 2, 3, 4, 5 & 6.
(vi) Join A123456A to get the required heptagon.

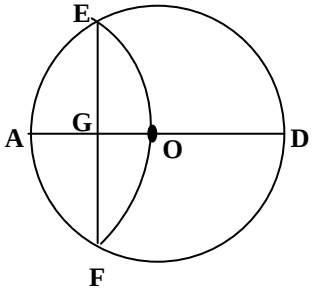
(i) & (ii)

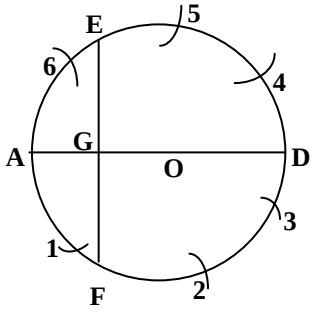


(iii)

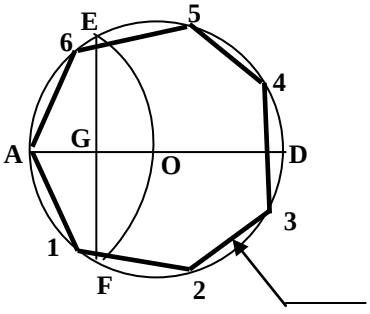


(iv)





(v)



Final Heptagon

(vi)

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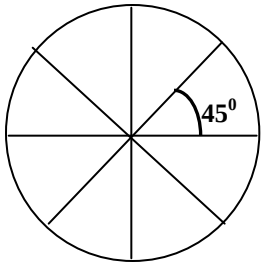
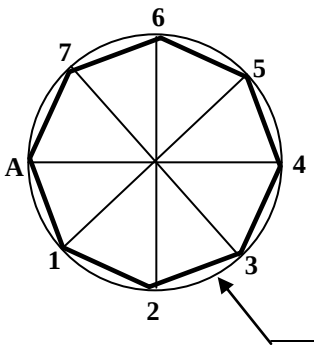
To Construct an Octagon (8 sides) inside a circle whose diameter is given:

Q) Inscribe an octagon in a circle of 60 mm diameter.

Sol) The following are the steps involved in the construction:

(i) Draw a circle of given radius (Radius= 30 mm) with O as center of circle.
(ii) Divide the circle into 8 equal parts with angle = 45^0 ($360/8 = 45^0$).
(iii) Join all the points in sequence to get the required octagon.





Final Octagon