Practical Geometry

- We use mathematical instruments such as ruler, compass, divider, set squares, and protractor to construct different shapes in geometry.

- Using these instruments, we can construct
  - a circle if its radius is known
  - a line segment if its length is known
  - a copy of a line segment
  - a perpendicular to a line segment through a point on it
  - a perpendicular to a line segment through a point not on it
  - a perpendicular bisector of a line segment
  - an angle of a given measure using protractor
  - a copy of an angle
  - the bisector of a given angle
  - some angles of special measures such as 30°, 45°, 60°, 90°, 120°, 135°, etc.

Example: Draw a circle of centre O and radius 4 cm.

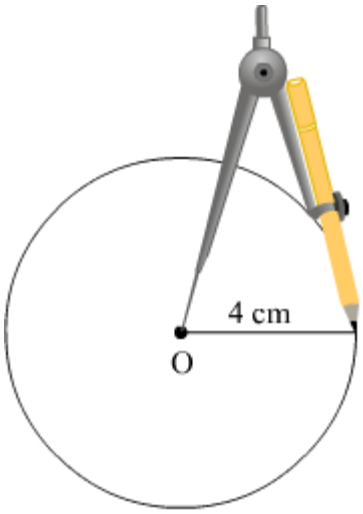
Solution: Following are the steps of construction of a circle of radius 4 cm:

(1) Open the compass for radius 4 cm.

(2) Mark a point O with a sharp pencil where we want the centre of the circle to be.

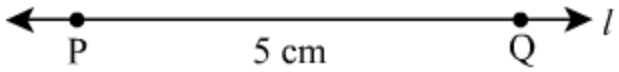
(3) Place the pointer of the compass at point O.

(4) Turn the compasses slowly to draw the circle.



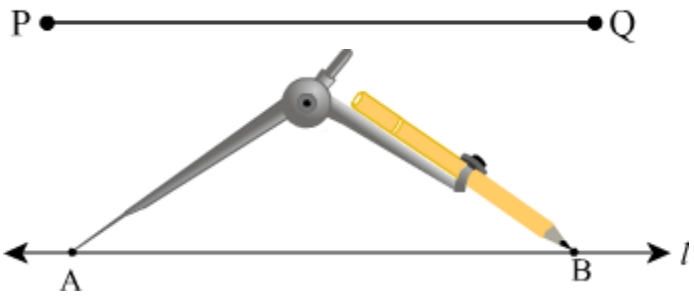
- **Steps to construct a line segment PQ of length 5 cm:**

1. Draw a line *l*. Mark a point P on it.
2. Open the compasses to the required length of 5 cm.
3. Without changing the opening of the compass, place the pointer on P and swing an arc to cut *l* at Q.
4. $\overline{PQ}$ is the line segment of required length.



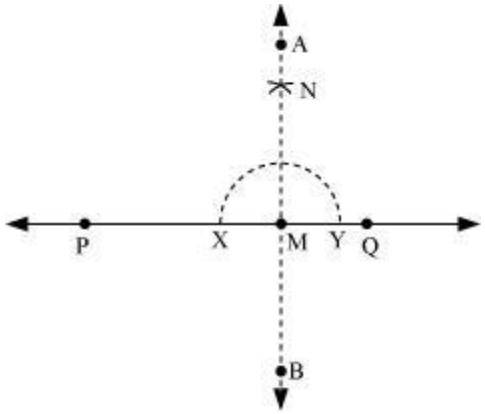
- **Steps to construct a copy of line segment PQ:**

1. Given $\overline{PQ}$ whose length is not known.
2. Fix the compasses pointer on P and pencil end on Q. The opening of the compass gives the length of $\overline{PQ}$.
3. Draw a line *l*. Choose a point A on *l* and place the pointer on A without changing the compass opening.
4. Swing an arc that cuts *l*. Name the point as B. Now $\overline{AB}$ is a copy of $\overline{PQ}$.



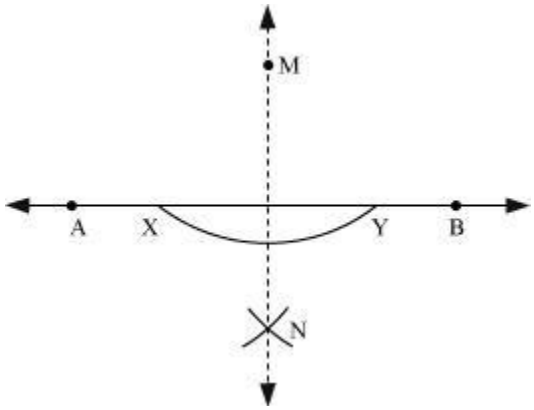
- **Steps to construct perpendicular to a line PQ through a point M on it:**

1. Draw a line $\overleftrightarrow{PQ}$ and mark a point M on it.
2. With M as the centre and a convenient radius, construct an arc intersecting $\overleftrightarrow{PQ}$ at two points i.e., X and Y. With X and Y as centres and radius greater than MX, construct two arcs that cut each other at N.
3. Draw a line through points M and N and name this line as $\overleftrightarrow{AB}$. Now, $\overleftrightarrow{AB} \perp \overleftrightarrow{PQ}$.



- **Steps to construct perpendicular to a line AB through a point M not on it:**

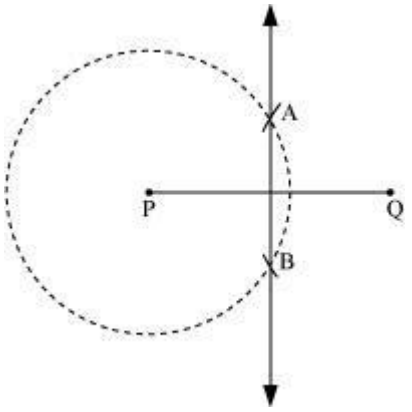
1. Draw line $\overleftrightarrow{AB}$. Mark a point M outside it.
2. With M as the centre, draw an arc that intersects $\overleftrightarrow{AB}$ at two points i.e., X and Y.
3. Using the same radius and with X and Y as centres, construct two arcs such that they intersect at N on the other side of the line.
4. Join $\overleftrightarrow{MN}$ to get $\overleftrightarrow{MN} \perp \overleftrightarrow{AB}$.



- **Steps of construction for the perpendicular bisector of a line segment $\overline{PQ}$ where $\overline{PQ}$= 9.4 cm:**

1. Draw a line segment $\overline{PQ}$ whose length is 9.4 cm.
2. With P as the centre and radius more than half of $\overline{PQ}$, draw a circle using compass.

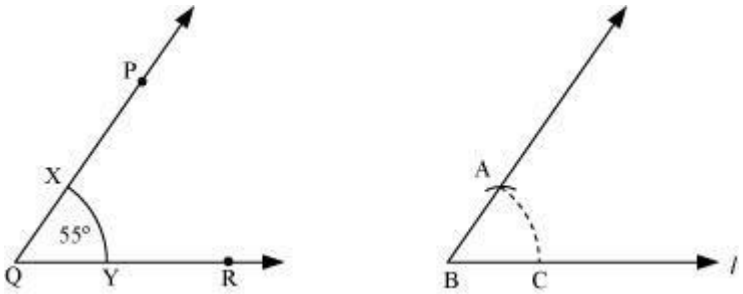
3. With the same radius and Q as the centre, draw two arcs that cut the previous circle at points A and B. Join AB to get the perpendicular bisector of $\overline{PQ}$.



- **Steps for the construction of copy of a given angle:**

  Given ∠PQR = 55°.

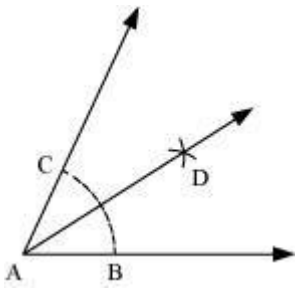
1.
1. Draw a line *l* and mark a point B on it.
2. Place the compass at Q and draw an arc to cut the rays QP and QR at points X and Y respectively.
3. Use the same compass setting to draw an arc with B as the centre, cutting *l* at C.
4. Set your compass to length XY.
5. Place the compass pointer at C and draw the arc (with the same setting) that cuts the arc drawn earlier at A.
6. Join B with A and extend it.



Now, ∠ABC = ∠PQR = 55°

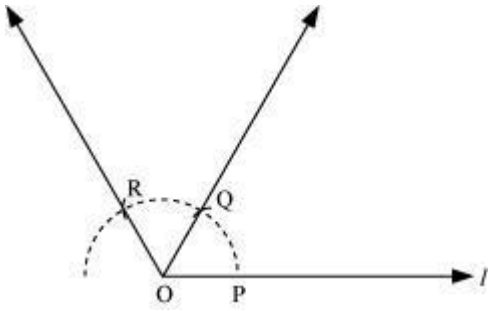
- **Steps of construction for the bisector of a given angle (say 60°):**

1. Draw ∠A such that ∠A = 60°
2. With A as the centre, draw an arc that cuts both the rays of ∠A at B and C.
3. With B and C as centres and radius more than $\frac{1}{2}$ BC, draw two arcs that intersect each other at D.
4. Join AD. AD is the bisector of ∠A.

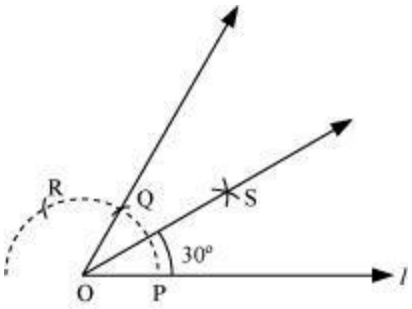


- The steps for the construction of angles of measures 60° and 120° are as follows:

1. Draw a line *l* and mark a point O on it.
2. Place the pointer of the compass at O and draw an arc of convenient radius that cuts *l* at P.
3. With the same radius, draw an arc with centre P that cuts the previous arc at Q.
4. Similarly, with the same radius, draw an arc with centre Q that cuts the arc at R.
5. Join OQ and OR to get ∠QOP = 60° and ∠ROP = 120°.



- Now, 30° is nothing but half of angle 60°. Therefore, 30°angle can be obtained by drawing the bisector of ∠QOP.



Here, ∠SOP = 30°.

Similarly, we can draw other angles of measures 45°, 90°, 135°, and 150° using the above method.