CBSE NCERT Solutions for Class 6 Mathematics Chapter 14

Back of Chapter Questions
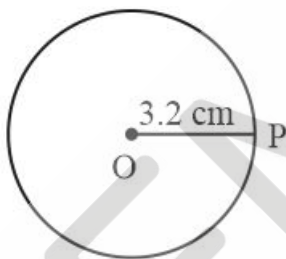
Exercise 14.1

1. Draw a circle of radius 3.2 cm.

Solution:

Steps of construction:

(i) Mark the center of the circle using a sharp pencil and name it O.

●

O

(ii) Given that the radius of the circle is 3.2 cm, measure 3.2 cm on compass using a ruler.

(iii) Keeping the compass intact, place the pointed end at O.

(iv) Complete the circle with the help of the compass.

The required circle with a radius of 3.2 cm is hence drawn.

2. With the same center O, draw two circles of radii 4 cm and 2.5 cm.

Solution:

Steps of construction:

(i) Mark the center of the two circles using a sharp pencil and name it O.

●

O

(ii) Given that the radius of the first circle is 4 cm, measure 4 cm on compass using a ruler.

(iii) Keeping the compass intact, place the pointed end at O.

(iv) Complete the circle with the help of the compass.

(v)   Now, in order to draw the second circle, measure $2.5\,\text{cm}$ on compass using a ruler.

(vi)   Place the pointed end of the compass at O and without changing the measurement, draw a circle.
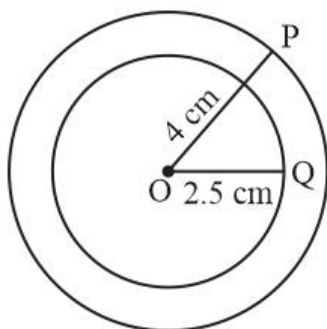
        The two required circles of radii $4\,\text{cm}$ and $2.5\,\text{cm}$ with same center are thus drawn.

3.   Draw a circle and any two of its diameters. If you join the ends of these diameters, what is the figure obtained? What figure is obtained if the diameters are perpendicular to each other? How do you check your answer?

        Solution:

        (i)   Let us construct a circle and draw two of its diameters.
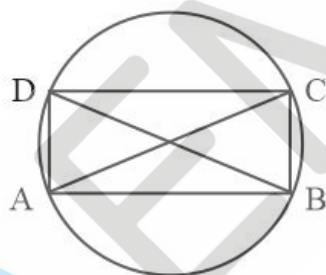
                By joining the ends of two diameters, we get a rectangle.
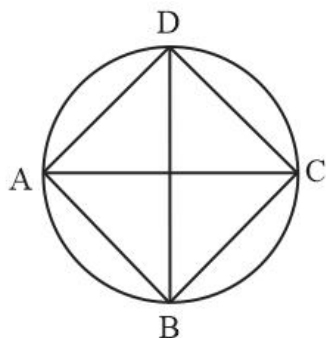
                By measurement, we find:

                $AB = CD$

                $BC = AD$, i.e., pairs of opposite sides are equal

                And also, $\angle A = \angle B = \angle C = \angle D = 90^\circ$, i.e. each angle is of 90°.

                Hence, we can conclude that the obtained figure is a rectangle.

        (ii)   Now, consider another circle and draw two diameters such that they are perpendicular to each other.

Upon joining the two diameters that are perpendicular to each other, we obtain a square.

By measurement, we find that:

AB = BC = CD = DA, i.e., all four sides are equal.

Also ∠A = ∠B = ∠C = ∠D = 90°, i.e. each angle is of 90°.

Hence, we can conclude that the figure obtained is a square.

4.   Draw any circle and mark points A, B and C such that:

(a)   A is on the circle.

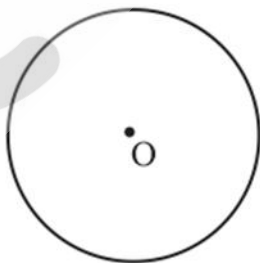(b)   B is in the interior of the circle.

(c)   C is in the exterior of the circle.

Solution:

(i)   Mark the center of the circle using a sharp pencil and name it O.

•

O

(ii)   Measure a suitable radius using a ruler and compass.

(iii)   Keeping the compass intact, place the pointed end at O.

(iv)   Complete the circle with the help of the compass.

(v)   Mark point A on the circumference of the circle.

(vi)   Mark a point B in the interior of the circle.

(vii) Mark a point C exterior to the circle.

The obtained figure is as shown below.
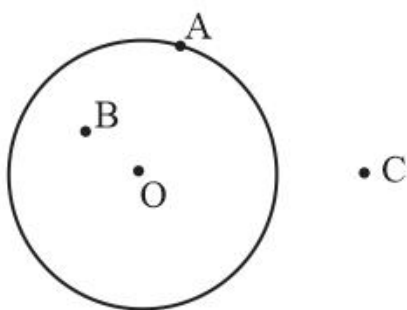
5. Let A, B be the centers of two circles of equal radii; draw them so that each one of them passes through the center of the other. Let them intersect at C and D. Examine whether $\overline{AB}$ and $\overline{CD}$ are at right angles.
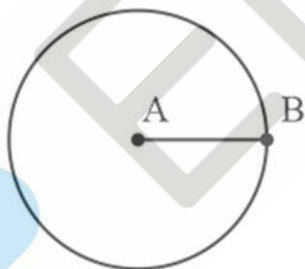
Solution:
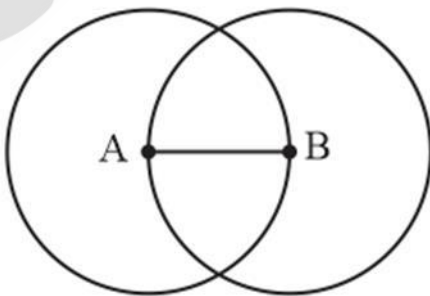
(i) Mark the center of the first circle and name it A.

(ii) Measure a suitable radius and draw a circle, keeping the pointed end of the compass at A.

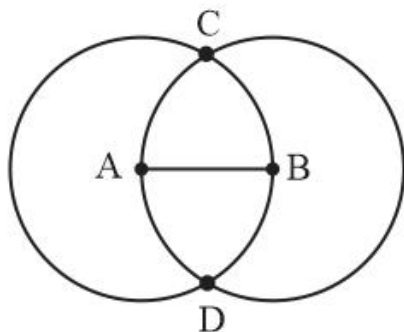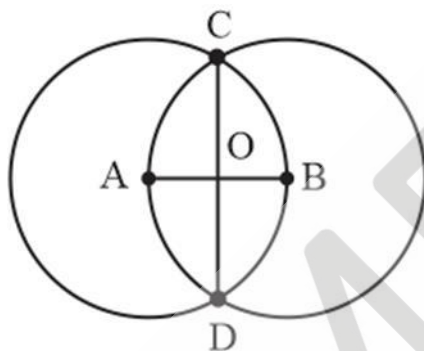(iii) Mark a point B on the circle

(iv) Now with the pointed end of the compass at B and with the same radius, draw a circle.

(v)   Clearly, the second circle passes through the center of the first circle. Name their point of intersections as C and D.

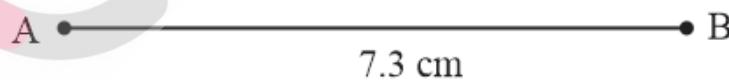(vi)   Join C and D. Let the point of intersection of $\overline{AB}$ and $\overline{CD}$ be O.

(vii)   Upon measuring

$$\angle COB = \angle AOC = 90^\circ$$

$$\angle DOA = \angle DOB = 90^\circ$$

Hence, line segments $\overline{AB}$ and $\overline{CD}$ intersect at right angles.

Exercise 14.2

1.   Draw a line segment of length 7.3 cm, using a ruler.

Solution:

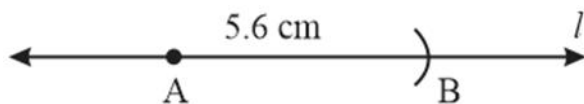Steps of construction:

7.3 cm

(i)   Mark a point. Name it A.

(ii)   Place the zero mark of the ruler at point A.

(iii)   Mark a point B at a distance of 7.3 cm from A.

(iv)   Join AB.

Hence, $\overline{AB}$ is the required line segment of length 7.3 cm.

2. Construct a line segment of length 5.6 cm using ruler and compasses.

Solution:

Steps of construction:

(i)   Draw a line 'l' of suitable length. Mark a point A on this line.

(ii)   Place the compasses pointer on zero mark of the ruler. Open it to place the pencil point up to 5.6 cm mark.

(iii) Keeping the opening of the compasses intact, place the pointer on A and cut an arc on the line 'l' at B.

       $\overline{AB}$ is the required line segment of length 5.6 cm.

3. Construct $\overline{AB}$ of length 7.8 cm. From this, cut off $\overline{AC}$ of length 4.7 cm. Measure $\overline{BC}$.
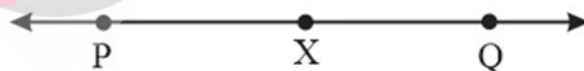
Solution:
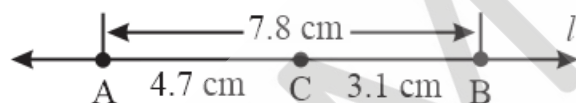
Steps of construction:

(i)   Mark a point A using a sharpened pencil.

(ii)   Place the zero mark of the ruler at A.

(iii) Mark a point B at a distance 7.8 cm from A.

(iv)   Again, mark a point C at a distance 4.7 from A.

       Hence, by measuring $\overline{BC}$, we find that BC = 3.1 cm

4. Given $\overline{AB}$ of length 3.9 cm, construct $\overline{PQ}$ such that the length of $\overline{PQ}$ is twice that of $\overline{AB}$. Verify by measurement.
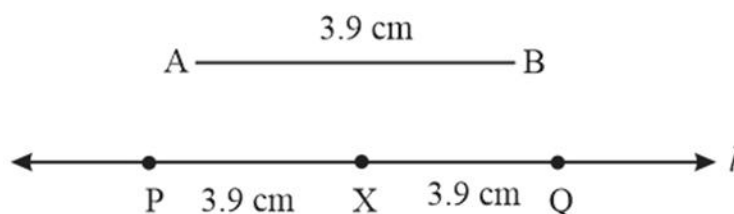

Hint:

Construct $\overline{PX}$ such that length of $\overline{PX}$ = length of $\overline{AB}$; then cut off $\overline{XQ}$ such that $\overline{XQ}$ also has the length of $\overline{AB}$.

Solution:

Steps of construction:

$$A \overline{\hspace{1.5cm} 3.9 \text{ cm} \hspace{1.5cm}} B$$

(i)   Draw a line 'l'. Mark point P on the line.

(ii) Place the pointed end of the compass at A and extend the other arm to B, on the given line $\overline{AB}$.

(iii) Keeping the arms of the compass intact, place the pointed end at P and cut an arc. Mark the point of intersection as X.

(iv) Now, with the pointed end at X, cut an arc of same length and name the point Q.

(v)   Clearly, length of $\overline{PX}$ = length of $\overline{AB}$ and $\overline{PX}$ = length of $\overline{XQ}$

(vi) Thus, the length of $\overline{PX}$ and the length of $\overline{XQ}$ added together gives twice the length of $\overline{AB}$.

Verification:

By measurement we find that PQ = 7.8 cm

$= 3.9 \text{ cm} + 3.9 \text{ cm}$

$= \overline{AB} + \overline{AB}$

$= 2 \times \overline{AB}$

Hence, line $\overline{PQ}$ with length twice as that of $\overline{AB}$ is constructed.

5.   Given $\overline{AB}$ of length 7.3 cm and $\overline{CD}$ of length 3.4 cm, construct a line segment $\overline{XY}$ such that the length of $\overline{XY}$ is equal to the difference between the lengths of $\overline{AB}$ and $\overline{CD}$. Verify the measurement.

Solution:

Steps of construction:

(i)   Draw a line 'l' and mark a point X on it.

(ii) Construct $\overline{XZ}$ such that length $\overline{XZ}$ = length of $\overline{AB}$ = 7.3 cm

(iii) Then from point Z, construct point Y such that $\overline{ZY}$ = length of $\overline{CD}$ = 3.4 cm

(iv) Thus, the length of $\overline{XY}$ = length of $\overline{AB}$ − length of $\overline{CD}$
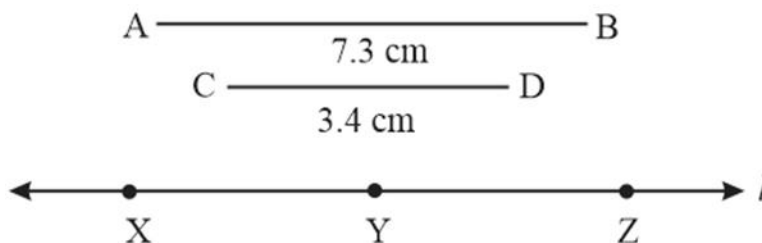
Verification:

By measurement we find that length of $\overline{XY} = 3.9$ cm

$= 7.3$ cm $- 3.4$ cm

$= \overline{AB} - \overline{CD}$

Hence, a line segment $\overline{XY}$ such that the length of $\overline{XY}$ is equal to the difference between the lengths of $\overline{AB}$ and $\overline{CD}$ is constructed.

Exercise 14.3

1. Draw any line segment $\overline{PQ}$. Without measuring $\overline{PQ}$, construct a copy of $\overline{PQ}$.
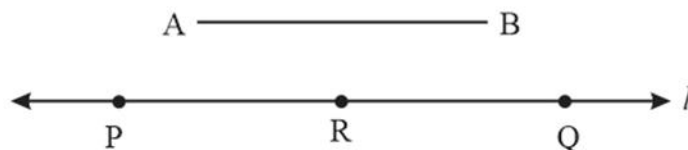
Solution:

Steps of construction:

(i)   Given $\overline{PQ}$ whose length is not known.

(ii)   Fix the compasses pointer on P and the pencil end on Q. The opening of the instrument now gives the length of $\overline{PQ}$.

(iii)   Draw any line 'l'. Mark a point A on 'l'. Without changing the compasses setting, place the pointer on A.

(iv)   Draw an arc such that it cuts the line 'l' at a point, say B.

Hence, we obtain $\overline{AB}$ which is the copy of $\overline{PQ}$.

2. Given some line segment $\overline{AB}$, whose length you do not know, construct $\overline{PQ}$ such that the length of $\overline{PQ}$ is twice that of $\overline{AB}$.

Solution:

Steps of construction:

(i)   Given $\overline{AB}$ whose length is not known.

(ii)   Fix the compasses pointer on A and the pencil end on B. The opening of the instrument now gives the length of $\overline{AB}$.

(iii)   Draw any line 'l'. Mark a point P on 'l'. Without changing the compasses setting, place the pointer on P.

(iv)   Draw an arc such that it cuts the line 'l' at a point say R.

(v)   Now place the pointer on R and without changing the compasses setting, draw another arc that cuts 'l' at another point say Q.

        Hence, we obtain $\overline{PQ}$, the required line segment whose length is twice that of AB.

Exercise 14.4

1.   Draw any line segment $\overline{AB}$. Mark any point M on it. Through M, draw a perpendicular to $\overline{AB}$. (use ruler and compasses)

Solution:

Steps of construction:
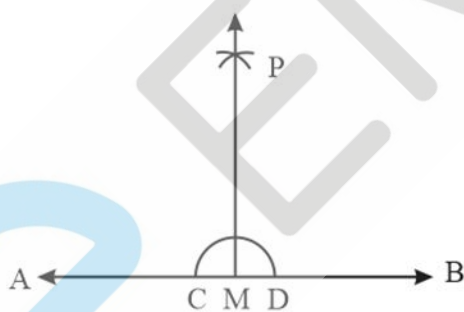
(i)   Draw any line segment $\overline{AB}$ and mark any point M on it.

(ii)   Choose any convenient radius and with the pointed end of the compass at M, draw an arc intersecting the line AB at two points say C and D.

(iii)   With C and D as centers and a radius greater than MC, draw two arcs, above the line segment $\overline{AB}$ which cut each other at a point say P.

(iv)   Join PM.

        Therefore, PM is the required perpendicular to AB through the point M.

2.   Draw any line segment $\overline{PQ}$. Take any point R not on it. Through R, draw a perpendicular to $\overline{PQ}$. (use ruler and set-square)

Solution:

Steps of construction:

(i)   Draw a line segment $\overline{PQ}$ and mark a point R above the line.
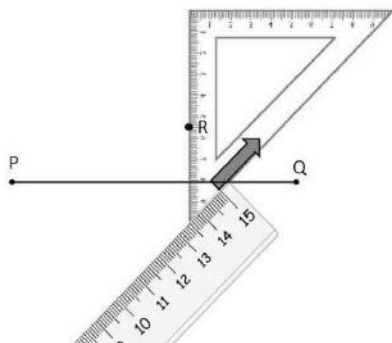
• R

P ————————————————— Q

(ii)   Place a set-square on $\overline{PQ}$ such that one arm of its right angle aligns along $\overline{PQ}$.
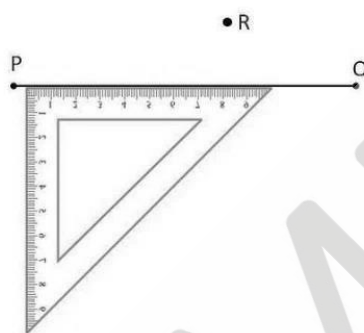
(iii)   Place a ruler along the edge opposite to the right angle of the set square.
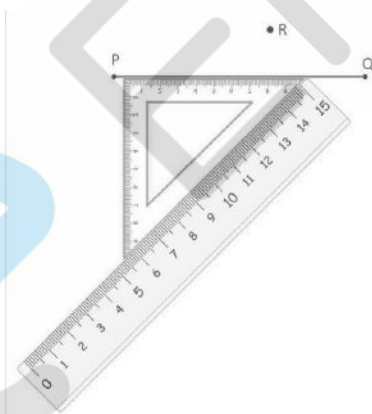
(iv)   Hold the ruler fixed. Slide the set square along the ruler till the point R touches the other arm of the set square.

(v)   Join RM along the edge through R meeting $\overline{PQ}$ at M.
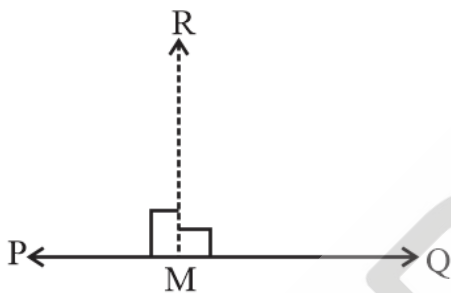
Therefore, we obtain $\overrightarrow{RM} \perp \overline{PQ}$.

3.   Draw a line l and a point X on it. Through X, draw a line segment $\overline{XY}$ perpendicular to l.

Now draw a perpendicular to $\overline{XY}$ at Y. (use ruler and compasses)

Solution:

Steps of construction:

(i)   Draw a line 'l' and mark a point X on it.

(ii)   Choose any convenient radius and with the pointed end of the compass at X, draw an arc intersecting the line 'l' at two points A and B.
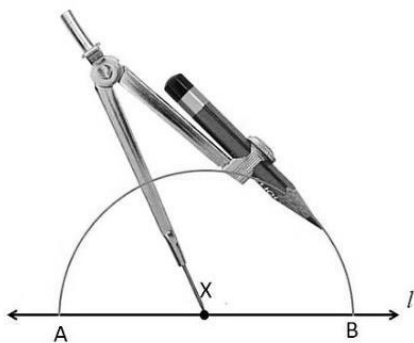
(iii)   With A and B as centers and a radius greater than XA, draw two arcs, which intersect at a point, say C.

(iv)   Join XC and produce it to Y. Therefore, we obtain XY perpendicular to 'l'.
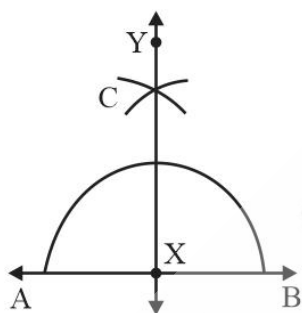
(v)   Choose any convenient radius and with the pointed end of the compass at Y, draw an arc intersecting XY at two points P and Q.
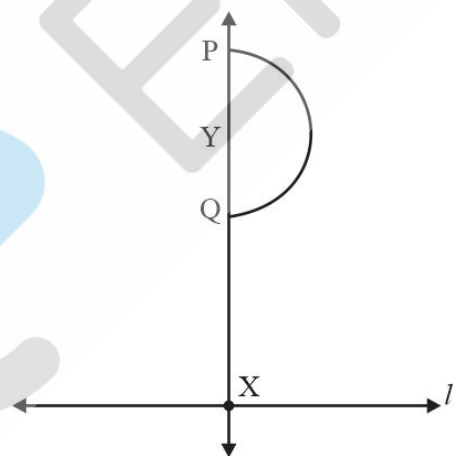
(vi)   With P and Q as centers and radius greater than YP, draw two arcs which intersect each other at a point say Z.

(vii)   Join YZ.
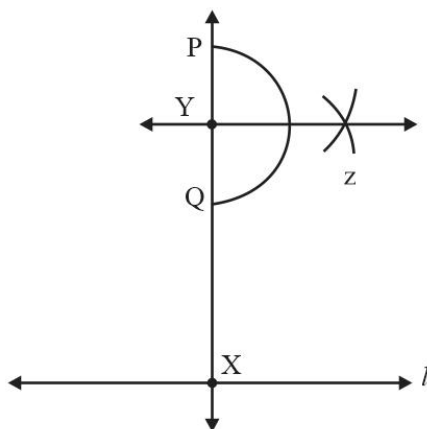
Therefore, we obtain YZ perpendicular to XY at Y.

Exercise 14.5

1.   Draw $\overline{AB}$ of length 7.3 cm and find its axis of symmetry.

Solution:

Axis of symmetry of line segment $\overline{AB}$ will be the perpendicular bisector of $\overline{AB}$. So, we need to construct the perpendicular bisector of AB.

Steps of construction:

(i)   Draw a line segment $\overline{AB} = 7.3$ cm

(ii)   With A as the center and radius more than half of $\overline{AB}$, draw arcs above and below the line segment $\overline{AB}$.

(iii)   With B as the center and radius same as in step (ii), draw arcs above and below the line segment $\overline{AB}$.

(iv)   Name the point of intersection above the line segment as C and the point of intersection below the line segment as D.

(v)   Join C and D.
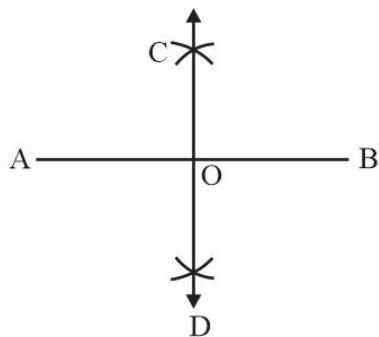
Therefore, CD is the axis of symmetry of the line segment AB.

2.   Draw a line segment of length 9.5 cm and construct its perpendicular bisector.

Solution:

Steps of construction:

(i)   Draw a line l and mark point A on it.

(ii)   Measure 9.5 cm using a compass and ruler and cur an arc of the same length with A as the center to obtain a line segment $\overline{AB}$ of length 9.5 cm.

(iii)   With A as the center and radius more than half of $\overline{AB}$, draw arcs above and below the line segment $\overline{AB}$.

(iv)   With B as the center and radius same as in step (iii), draw arcs above and below the line segment $\overline{AB}$.

(v)   Name the point of intersection above the line segment as C and the point of intersection below the line segment as D.

(vi)   Join C and D.
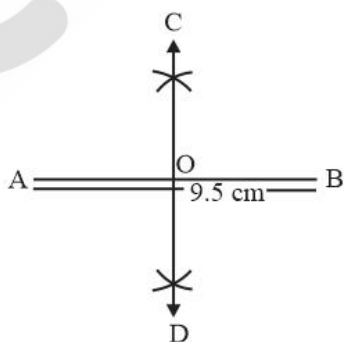
Therefore, CD is the perpendicular bisector of $\overline{AB}$,

3.   Draw the perpendicular bisector of $\overline{XY}$ whose length is 10.3 cm.

(a)   Take any point P on the bisector drawn. Examine whether PX = PY.

(b)   If M is the mid-point of $\overline{XY}$, what can you say about the lengths MX and XY?

Solution:

Steps of construction:

(i)   Draw a line l and mark a point X on it.

(ii)   Using a compass and ruler, cut an arc of 10.3 cm on the line. The point of intersection will be Y. So, we obtain $\overline{XY}$ = 10.3 cm

(iii)   With X as the center and radius more than half of $\overline{XY}$, draw arcs above and below the line segment $\overline{XY}$.

(iv)   With Y as the center and radius same as in step (iii), draw arcs above and below the line segment $\overline{XY}$.

(v)   Name the point of intersection above the line segment as C and the point of intersection below the line segment as D.

(vi)   Join C and D.

(vii)   CD is the required perpendicular bisector of $\overline{XY}$.
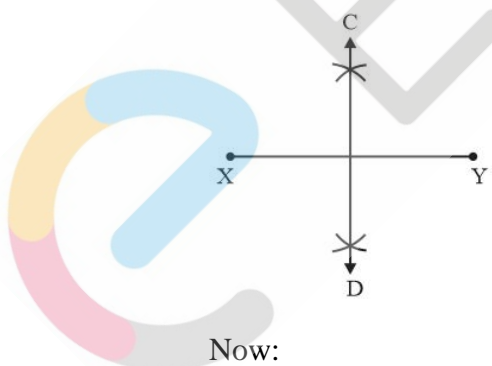
Now:

(a)   Take any point P on the bisector drawn. With the help of divider we can check that $\overline{PX} = \overline{PY}$.
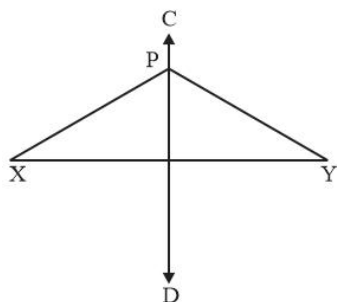
(b)   If M is the mid-point of $\overline{XY}$, it divides $\overline{XY}$ into two halves.

Therefore, $\overline{MX} = \frac{1}{2}\overline{XY} = \overline{MY}$
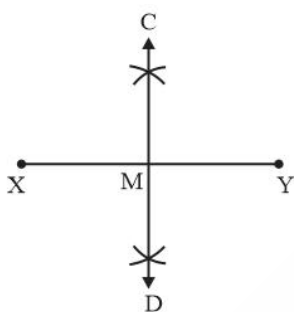
4.   Draw a line segment of length 12.8 cm. Using compasses, divide it into four equal parts. Verify by actual measurement.

Solution:

Steps of construction:
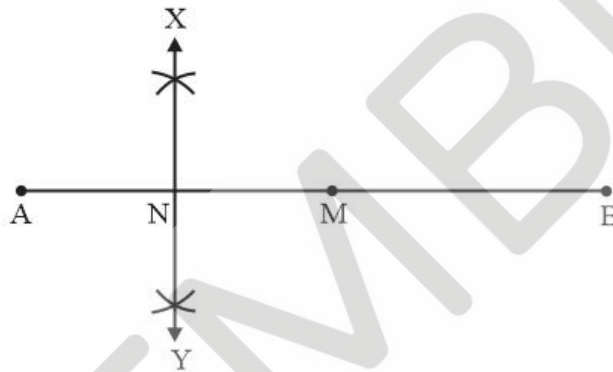
(i)   Draw a line segment AB = 12.8 cm

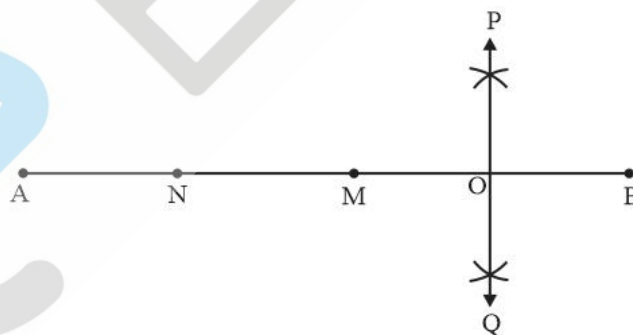(ii)   With A and B as the centers, draw arcs above and below the line segment such that they intersect each other.
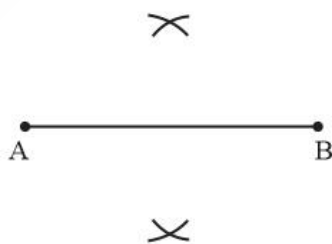
(iii)   Let the points of intersection be C and D. Join them to obtain the perpendicular bisector of $\overline{AB}$ which cuts it at a point say M. Thus, M is the mid-point of $\overline{AB}$.
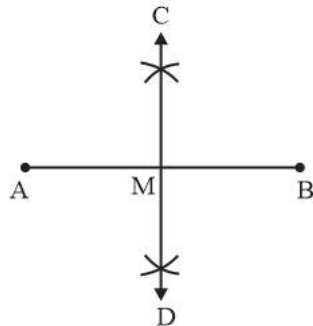
(iv)   Similarly, construct the perpendicular bisector of $\overline{AM}$ which cuts it at a point say N. Thus N is the mid-point of $\overline{AM}$.

(iv)   Now, construct the perpendicular bisector of $\overline{MB}$ which cuts it at a point say O. Thus, O is the mid-point of $\overline{MB}$.

(v)   Now, points N, M and O divide the line segment $\overline{AB}$ in the four equal parts.

(vi)   Also, by actual measurement, we find that

$$\overline{AN} = \overline{NM} = \overline{MO} = \overline{OB} = 3.2 \text{ cm}$$

5.   With $\overline{PQ}$ of length 6.1 cm as diameter, draw a circle.

Solution:

Steps of construction:

(i)   Draw a line segment $\overline{PQ} = 6.1$ cm.

P   6.1 cm   Q
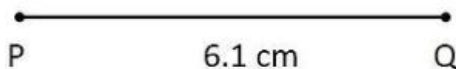
(ii)   With P and Q as the centers, draw arcs above and below the line segment such that they intersect each other. Join the points and this will be the perpendicular bisector of PQ which cuts it at a point say O. Thus O is the mid-point of the line segment $\overline{PQ}$.

C

P   O   Q

D
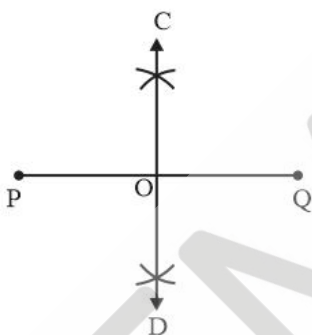
(iii)   With O as center, keep the pointed end of the compass at O and extend the other arm of the compass to touch the point Q.

(iv)   Keeping the arms of the compass intact, draw a circle.

P   O   Q
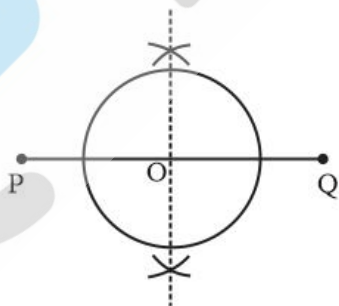
Hence, we have obtained a circle with a diameter of 6.1 cm.

6.   Draw a circle with center C and radius 3.4 cm. Draw any chord $\overline{AB}$. Construct the perpendicular bisector of $\overline{AB}$ and examine if it passes through C.

Solution:

Steps of construction:

(i)   Mark a point. This will be the center of the circle.

●
C

(ii)   Measure a radius of 3.4 cm and construct a circle at C as center.
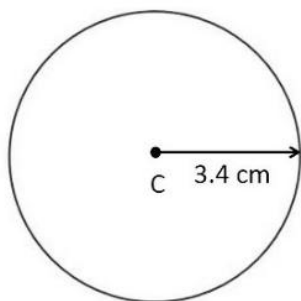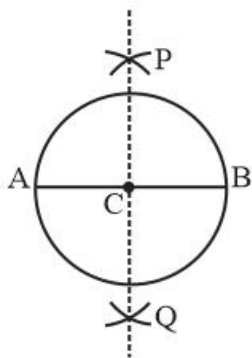

(iii)   Construct a chord $\overline{AB}$.
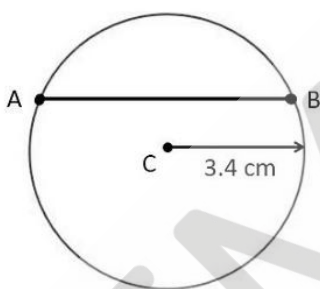
(iv)   With A as the center and radius more than half of $\overline{AB}$, draw arcs above and below the line segment $\overline{AB}$.

(v)   With B as the center and radius same as in step (iv), draw arcs above and below the line segment $\overline{AB}$.

(vi)   Name the point of intersection above the line segment as P and the point of intersection below the line segment as Q.

(vii)   Join P and Q. Thus, $\overline{PQ}$ is the required perpendicular bisector.
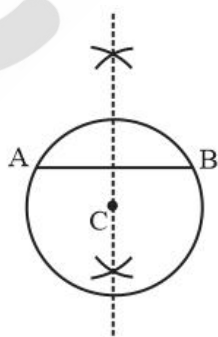
(viii)   Clearly, $\overline{PQ}$ passes through the center of the circle.

7.   Draw a circle with center C and radius 3.4 cm. Draw a diameter $\overline{AB}$. Construct the perpendicular bisector of $\overline{AB}$ and examine if it passes through C.

Solution:

Steps of construction:

(i)   Mark a point. This will be the center of the circle.

●
C

(ii)   Measure a radius of 3.4 cm and construct a circle at C.

C   3.4 cm
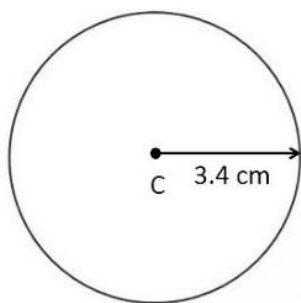
(iii)   Draw a diameter $\overline{AB}$.
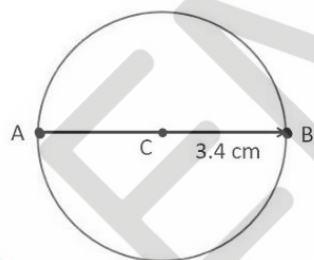
A   C   3.4 cm   B

(iv)   With A as the center and radius more than half of $\overline{AB}$, draw arcs above and below the line segment $\overline{AB}$.

(v)   With B as the center and radius same as in step (iv), draw arcs above and below the line segment $\overline{AB}$.

(vi)   Name the point of intersection above the line segment as P and the point of intersection below the line segment as Q.

(vii)   Join P and Q. Thus, $\overline{PQ}$ is the required perpendicular bisector.

(viii)   Clearly, $\overline{PQ}$ passes through the center of the circle.

8.   Draw a circle of radius 4 cm. Draw any two of its chords. Construct the perpendicular bisectors of these chords. Where do they meet?

Solution:

Steps of construction:

(i)   Draw the circle with center O and radius 4 cm.
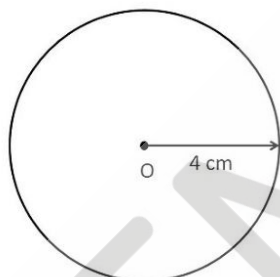
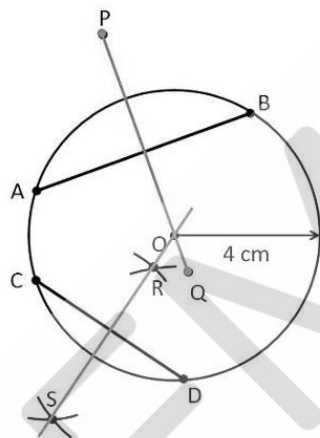(ii)   Draw any two chords $\overline{AB}$ and $\overline{CD}$ in this circle.
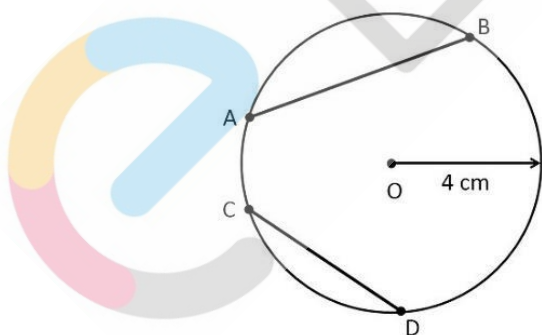
(iii)   With A as the center and radius more than half of $\overline{AB}$, draw arcs above and below the line segment $\overline{AB}$.

(iv)   With B as the center and radius same as in step (iii), draw arcs above and below the line segment $\overline{AB}$.

(v)   Name the point of intersection above the line segment as P and the point of intersection below the line segment as Q.
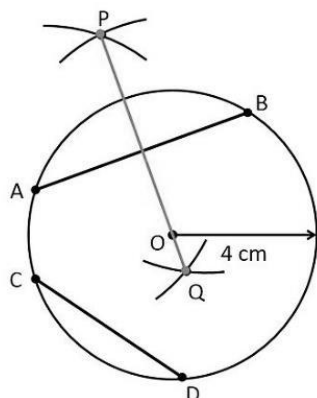
(vi)   Join $\overline{PQ}$. Thus $\overline{EF}$ is the perpendicular bisector of chord $\overline{AB}$.

(vi)   Similarly construct the perpendicular bisector of chord $\overline{CD}$ and name it $\overline{SR}$.

(vii)   Clearly, these two perpendicular bisectors meet at O, the center of the circle.

9.   Draw any angle with vertex O. Take a point A on one of its arms and B on another such that OA = OB. Draw the perpendicular bisectors of $\overline{OA}$ and $\overline{OB}$. Let them meet at P. Is PA = PB?

Solution:

Steps of construction:

(i)   Draw any convenient angle at vertex O.
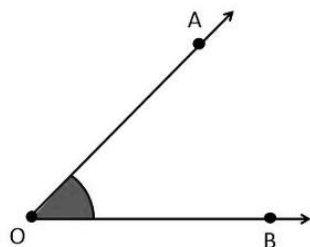
(ii)   Take a point A on one of its arms and B on another such that $OA = OB$.

(iii)   With A as the center and radius more than half of $\overline{AO}$, draw arcs above and below the line segment $\overline{AO}$.

(iv)   With O as the center and radius same as in step (iii), draw arcs above and below the line segment $\overline{AO}$.

(v)   Name the point of intersection above the line segment as X and the point of intersection below the line segment as Y. Join X and Y

(vi) $\overline{XY}$ is the perpendicular bisector of $\overline{AO}$.
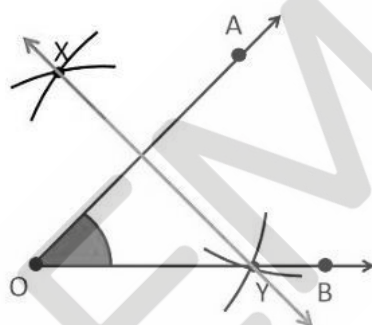
(vii)   With B as the center and radius more than half of $\overline{BO}$, draw arcs above and below the line segment $\overline{BO}$.

(viii)   With O as the center and radius same as in step (vii), draw arcs above and below the line segment $\overline{BO}$.

(ix)   Name the point of intersection above the line segment as M and the point of intersection below the line segment as N. Join M and N

(x) $\overline{MN}$ is the perpendicular bisector of $\overline{BO}$.
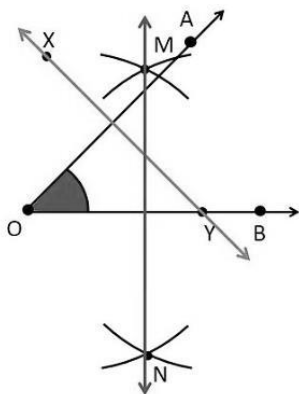
(xi)   The point of intersection of $\overline{MN}$ and $\overline{XY}$ gives point P.

(xii)   Join P to A and P to B.
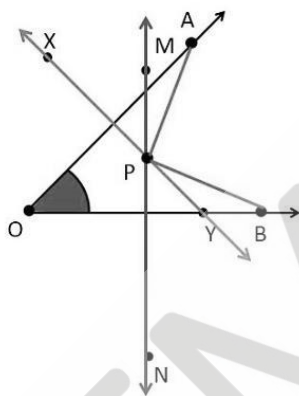
(xiii)   Use divider or ruler to measure the lengths of $\overline{PA}$ and $\overline{PB}$

         By measurement, we find that $\overline{PA} = \overline{PB}$.

Exercise 14.6

1.   Draw ∠POQ of measure 75⁰ and find its line of symmetry.

      Solution:

      Steps of construction:

      (a)   Construct a ray $\overrightarrow{OA}$.

      (b)   Place the center of the protractor at O. Note that the ray $\overrightarrow{OA}$ must coincide
             with 0° line of the protractor.

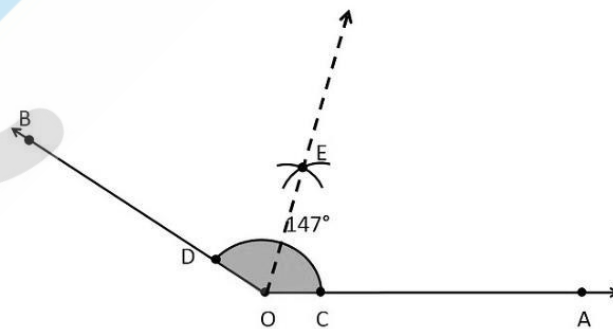   (c)   Construct an angle of 75° at O using the protractor. Mark point B on it.
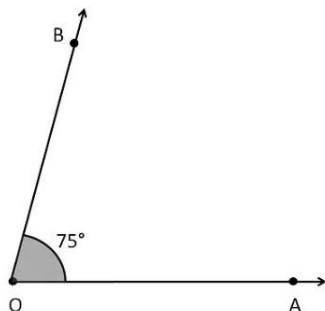
(d)   Place the pointer of the compasses at O and draw an arc of any convenient radius which intersects the ray $\overrightarrow{OA}$ at points C and D.

(e)   With C and D as the centers and radius greater than $\frac{1}{2}$ CD, construct arcs such that they intersect each other. Name this point E.

(f)   Upon joining O and E, we obtain the line of symmetry.
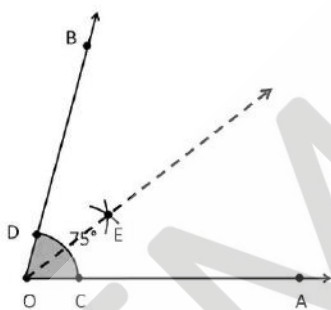
Hence, $\overrightarrow{OE}$ is the required line of symmetry.

2.   Draw an angle of measure 147° and construct its bisector.

Solution:

Steps of construction:

(a)   Draw a ray $\overrightarrow{OA}$.

(b)   Place the center of the protractor at O. Note that the ray $\overrightarrow{OA}$ must coincide with 0° line of the protractor.

(c)   Construct an angle of 147° at O using the protractor. Mark point B on it.
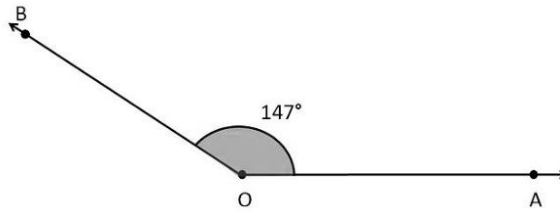
(d)   Taking center O and any convenient radius, draw an arc which intersects the arms $\overline{OA}$ and $\overline{OB}$ at C and D respectively.
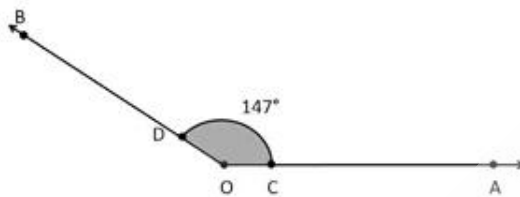
(e)   Taking C as center and radius more than half of CD, draw an arc.

(f)   Taking D as center and with the same radius, draw another arc which intersects the previous arc at E.
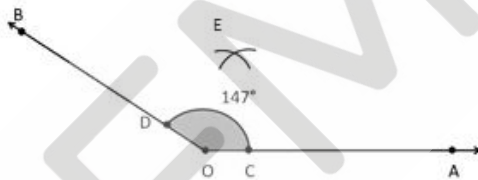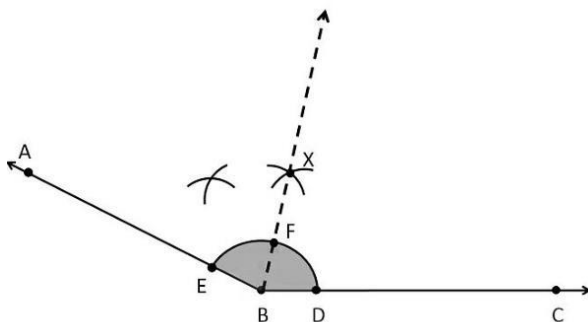

(g)   Join OE and produce it.

(h)   Thus, $\overrightarrow{OE}$ is the required bisector of ∠AOB.

3.   Draw a right angle and construct its bisector.

Solution:

Steps of construction:

(i)   Draw a ray $\overrightarrow{OA}$.

(ii)   Place the center of the protractor at O. Note that the ray $\overrightarrow{OA}$ must coincide with 0° line of the protractor.

(iii)   Construct an angle of 90° at O using the protractor. Mark point B on it.
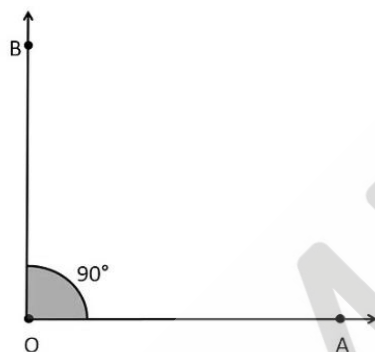
(iv)   Taking center O and any convenient radius, draw an arc which intersects the arms $\overline{OA}$ and $\overline{OB}$ at C and D respectively.

(v)   Taking C as center and radius more than half of CD, draw an arc.

(vi)   Taking D as center and with the same radius, draw another arc which intersects the previous arc at E.

(vii)   Join OE and produce it.
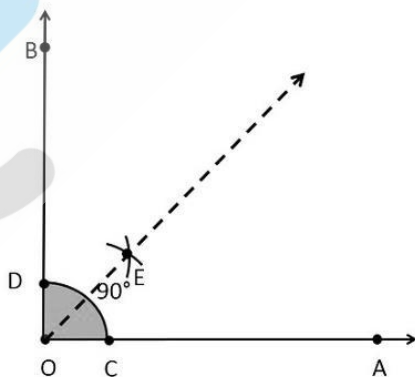
∴ $\overline{OE}$ is the required bisector of ∠BOA.

4.   Draw an angle of measure 153⁰ and divide it into four equal parts.

Solution:

Steps of construction:

(a)   Using a sharp pencil, draw a ray $\overrightarrow{BC}$.
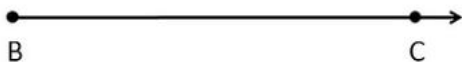
(b)   Place the center of the protractor at B. Note that the ray $\overrightarrow{BC}$ must coincide with 0° line of the protractor.

(c)   Construct an angle of 153° at B using the protractor. Mark point A on it.
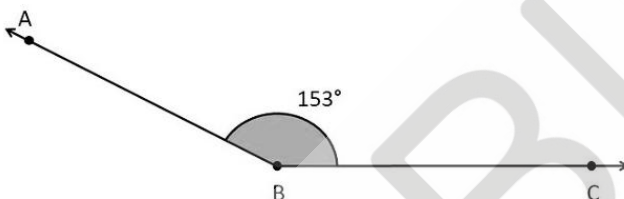
(d)   Taking center B and any convenient radius, draw an arc which intersects the arms $\overline{BA}$ and $\overline{CB}$ at E and D respectively.

(e)   Taking E as center and radius more than half of ED, draw an arc.

(f)   Taking D as center and with the same radius, draw another arc which intersects the previous arc at X.

(g)   Join BX and produce it.
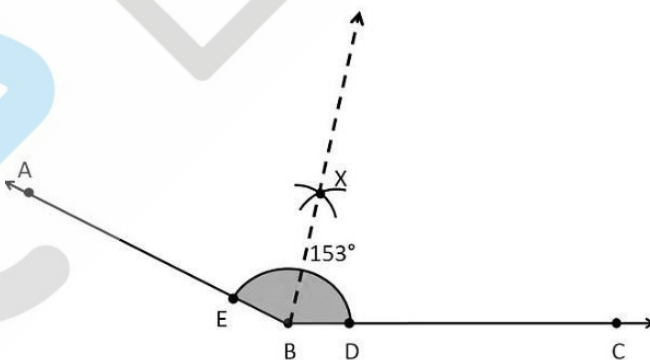
(h) $\overrightarrow{BX}$ is the bisector of ∠ABC = 153°

(i)   Mark the point of intersection of the arc with ray $\overrightarrow{BX}$ as F.

(j)   With E and F as centers and radius more than half of EF, draw arcs such that they intersect at each other.

(k)   Let the point of intersection be Y. Join B and Y and produce it.
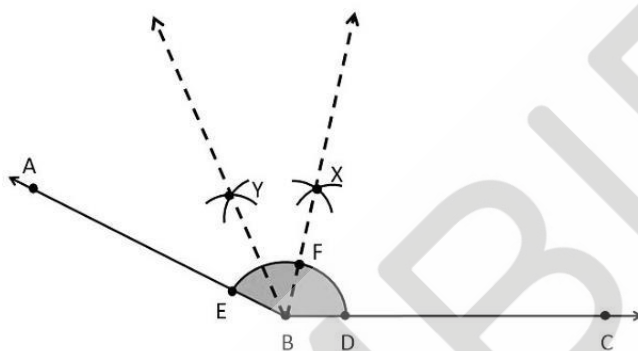
(l) $\overrightarrow{BY}$ is the bisector of ∠ABX

(m)   With D and F as centers and radius more than half of DF, draw arcs such that they intersect at each other.
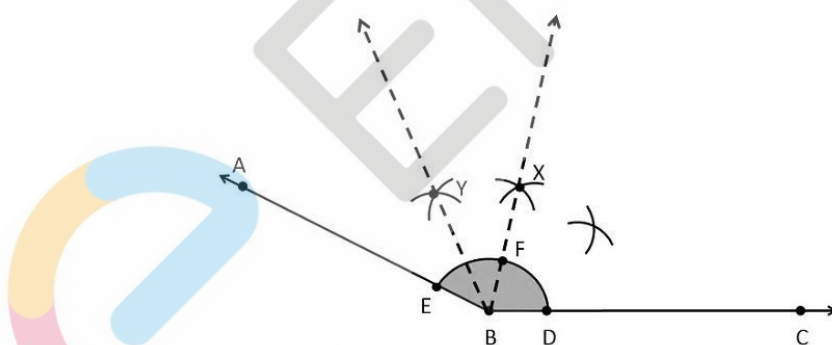
(n)   Let the point of intersection be Z. Join B and Z and produce it.
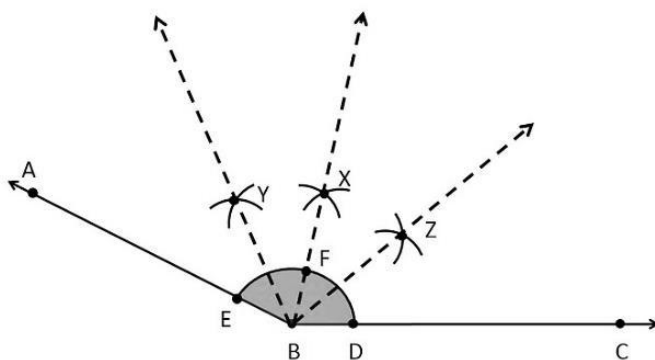
(o) $\overrightarrow{BZ}$ is the bisector of ∠ZDC.

Therefore, ∠ABC = 153° is divided into four equal parts by the rays $\overrightarrow{BY}, \overrightarrow{BX}$ and $\overrightarrow{BZ}$

5.   Construct with ruler and compasses, angles of following measures:

(a)   60⁰

(b)   30⁰

(c)   90⁰

(d)   120⁰

(e)   45⁰

(f)   135⁰

Solution:

(a)   60⁰ :

Steps of construction:
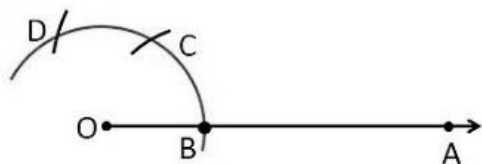
(i)   Draw a ray $\overrightarrow{AB}$.

(ii)   Choose a convenient radius and with A as the center, cut an arc such that it intersects the ray $\overrightarrow{AB}$ at D.
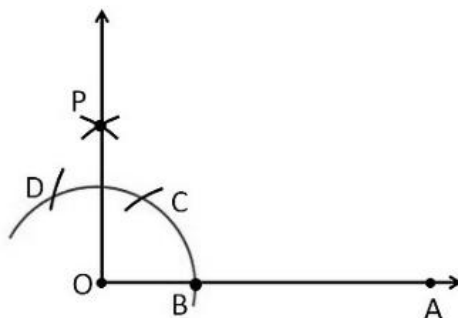
(iii) With D as the center and same radius as considered before, draw an arc such that it intersects the previously drawn arc at E. Draw a ray through the points A and E.
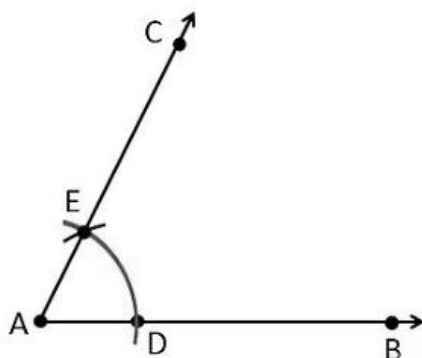
Hence, we obtain the required angle: ∠BAC = 60°

(b) 30°

(j) Draw a ray $\overrightarrow{OA}$.

(ii) Choose a convenient radius and with O as the center, cut an arc such that it intersects the ray $\overrightarrow{AO}$ at B.
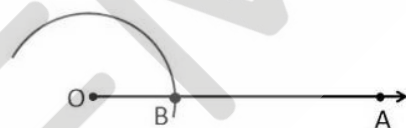
(iii) With B as the center and same radius as considered before, draw an arc such that it intersects the previously drawn arc at C. Draw a ray through the points O and D.
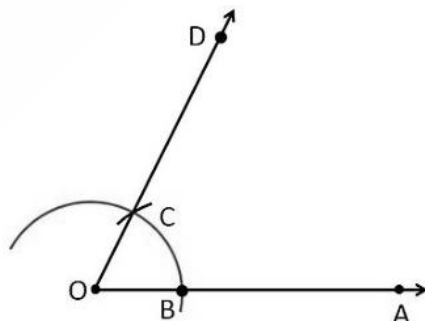
(iv) With B and C as centers and radius more than half of BC, draw arcs such that they intersect at each other. Let the point of intersection be E.

(v)   Join the points O and E and draw a ray through it.
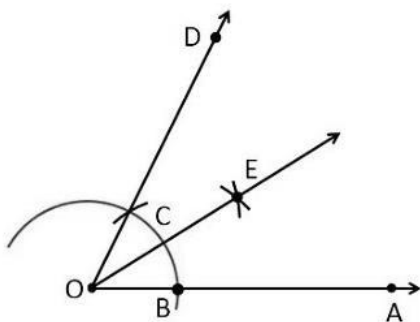
Therefore, we obtain the required angle: $\angle EOA = 30^\circ$.
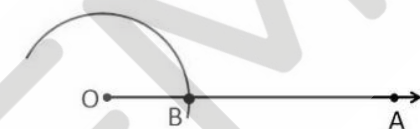
(c)   90°

Steps of construction:
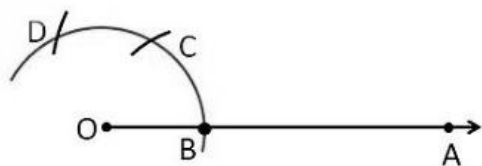
(i)   Draw a ray $\overrightarrow{OA}$.

(ii)   Choose a convenient radius and with O as the center, cut an arc such that it intersects the ray $\overrightarrow{AO}$ at B.
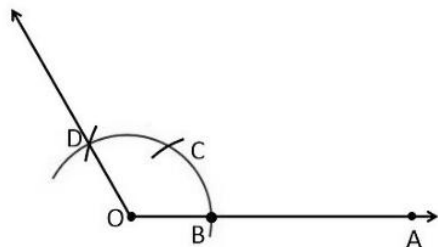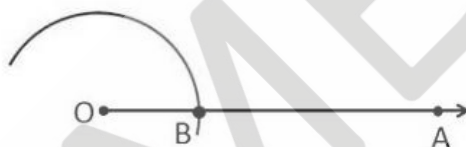

(iii)   With B as the center and same radius as considered before, draw an arc such that it intersects the previously drawn arc at C.

(iv)   Now, with C as the center and same radius as before, draw another arc such that it intersects the previously drawn arc at D.

(v)   With D and C as centers and radius more than half of DC, draw arcs such that they intersect at each other. Let the point of intersection be P.

(vi)   Join the points O and P and draw a ray through it.

Hence, ∠POA = 90° is the required angle.

(d)   120°

Steps of construction:

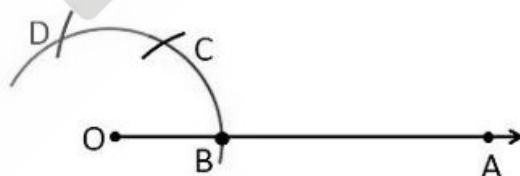(vii)   Draw a ray $\overrightarrow{OA}$.

(viii)   Choose a convenient radius and with O as the center, cut an arc such that it intersects the ray $\overrightarrow{AO}$ at B.
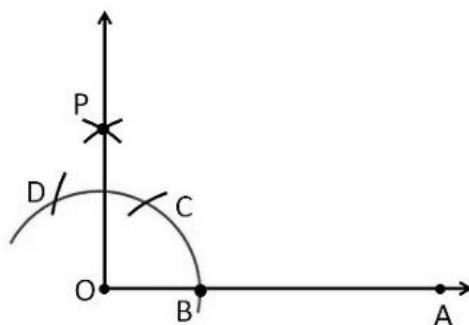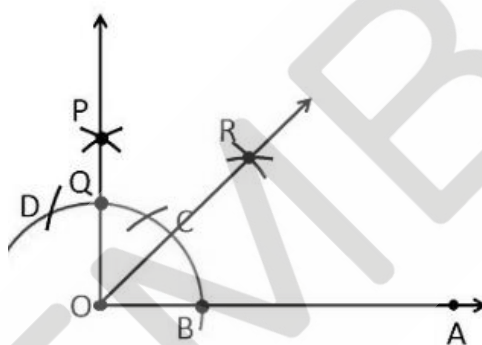
(ix)   With B as the center and same radius as considered before, draw an arc such that it intersects the previously drawn arc at C.

(x)   Now, with C as the center and same radius as before, draw another arc such that it intersects the previously drawn arc at D.

(xi)   Join the points O and D. Draw a ray through the points.

Therefore, we obtain the required angle ∠DOA = 120°.

(e)   45°

Steps of construction:

(i)   Draw a ray $\overrightarrow{OA}$.

(ii)   Choose a convenient radius and with O as the center, cut an arc such that it intersects the ray $\overrightarrow{AO}$ at B.

(iii)   With B as the center and same radius as considered before, draw an arc such that it intersects the previously drawn arc at C.

(iv)   Now, with C as the center and same radius as before, draw another arc such that it intersects the previously drawn arc at D.

(v)   With D and C as centers and radius more than half of DC, draw arcs such that they intersect at each other. Let the point of intersection be P.

(vi)   Join the points O and P and draw a ray through it.

(vii)   Let the point of intersection of the arc and ray $\overrightarrow{PO}$ be Q. With B and Q as the centers and radius greater than half of BQ, draw arcs such that they intersect at R.

(viii) Upon joining points O and R and drawing a ray through the points, we obtain the required angle.

Thus, ∠ROA is required angle of 45°.

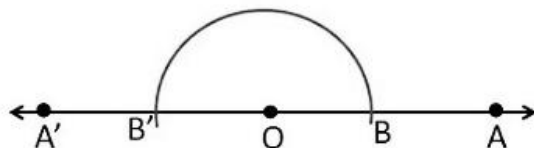(f)   135°

135° = 90° + 45°

So, in order to construct an angle of 135°, we first construct an angle of 90° on a line and then bisect the other 90° to obtain 45°

Steps of construction:

(i)   Draw a line AOA′.

(ii)   With O as the center and any convenient radius, draw an arc such that it cuts the line at points B and B′.

(iii)   With B as center and radius same as before, draw an arc such that it cuts the previously drawn arc at C.

(iv)   With C as the center and radius as same before, draw an arc such that it cuts the previously drawn arc at D.

(v)   With C and D as the centers and radius more than half of CD, draw two arcs such that they intersect each other at P.

(vi)   Draw an arc through points O and P.
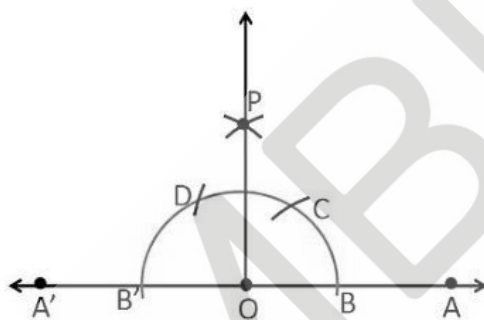
Now, ∠A′OP = 90° = ∠AOP.

(vii)   Let the point of intersection of the arc and ray $\overrightarrow{OP}$ be Q. We, now bisect ∠A′OP.

(viii)   With B′ and Q as centers and radius greater than half of B′Q, draw two arcs such that they intersect each other at point R. Join the points O and R and draw a ray through it.

∠ROP = 45°
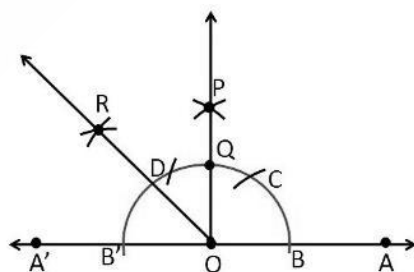
Therefore, the required angle is ∠ROA = 135°

6.   Draw an angle of measure **45°** and bisect it.

Solution:

Steps of construction:
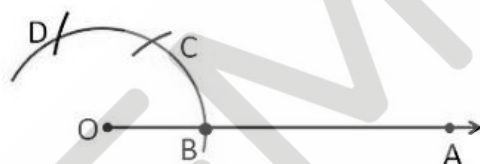
(i)   Draw a ray $\overrightarrow{OA}$.

(ii)   Choose a convenient radius and with O as the center, cut an arc such that it intersects the ray $\overrightarrow{AO}$ at B.
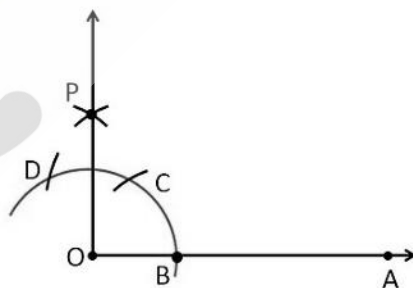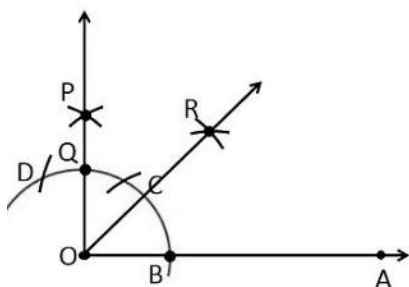

(iii)   With B as the center and same radius as considered before, draw an arc such that it intersects the previously drawn arc at C.

(iv)   Now, with C as the center and same radius as before, draw another arc such that it intersects the previously drawn arc at D.

(v)   With D and C as centers and radius more than half of DC, draw arcs such that they intersect at each other. Let the point of intersection be P.

(vi)   Join the points O and P and draw a ray through it.

(vii)   Let the point of intersection of the arc and ray $\overrightarrow{PO}$ be Q. With B and Q as the centers and radius greater than half of BQ, draw arcs such that they intersect at R.

(viii)   Upon joining points O and R and drawing a ray through the points, we obtain the required angle.

Thus, ∠ROA is required angle of 45°. Now, we need to construct a bisector for this angle.

(ix)   Let the point of intersection of the arc with the ray $\overrightarrow{OR}$ be S. With S and B as centers and radius greater than half of BS, draw two arcs such that they intersect each other at point T.

(x)   Draw a ray through points O and T.
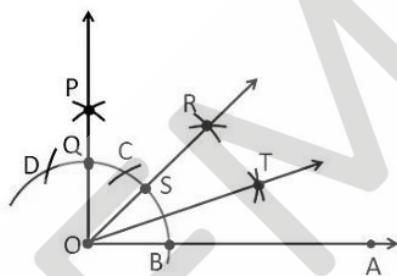
Therefore, $\overrightarrow{OT}$ is the required bisector.

7.   Draw an angle of measure 135° and bisect it.

Solution:

Steps of construction:

(a)   Draw a ray $\overrightarrow{OA}$.

(b)   Place the center of the protractor at O. Note that the ray $\overrightarrow{OA}$ must coincide with 0° line of the protractor.

(c)   Construct an angle of 135° at O using the protractor. Mark point B on it.
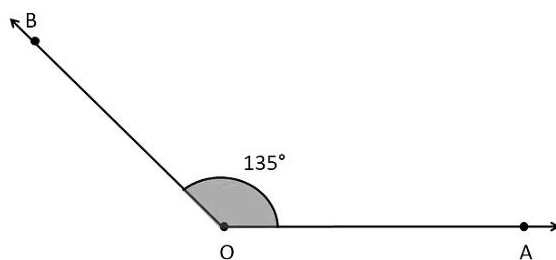
(d)   Taking center O and any convenient radius, draw an arc which intersects the arms $\overline{OA}$ and $\overline{OB}$ at C and D respectively.

(e)   Taking C as center and radius more than half of CD, draw an arc.

(f)   Taking D as center and with the same radius, draw another arc which intersects the previous arc.
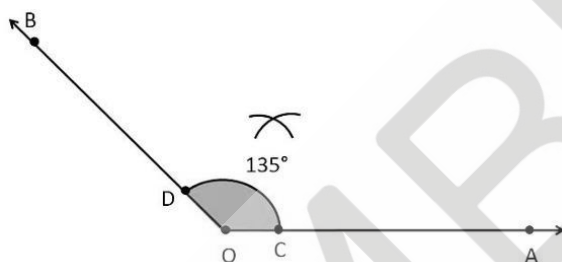
(g)   Let the point of intersection be E. Join OE and produce it.
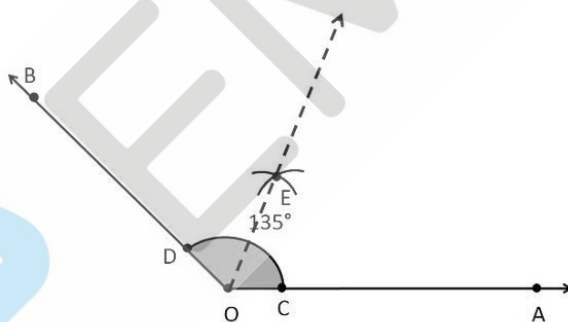
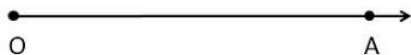(h)   Thus, $\overrightarrow{OE}$ is the required bisector of ∠AOB.

8.   Draw an angle of 70°. Make a copy of it using only a straight edge and compasses.

Solution:

Steps of construction:

First, let us construct an angle of 70° using protractor.

(a)   Draw a ray $\overrightarrow{OA}$.

(b)   Place the center of the protractor at O. Note that the ray $\overrightarrow{OA}$ must coincide with 0° line of the protractor.

(c)   Construct an angle of 70° at O using the protractor. Mark point B on it.
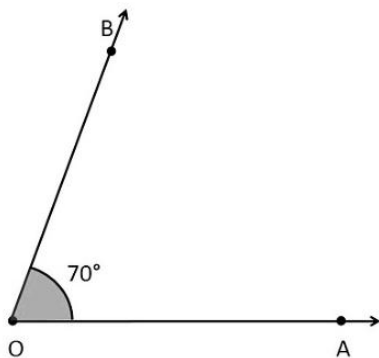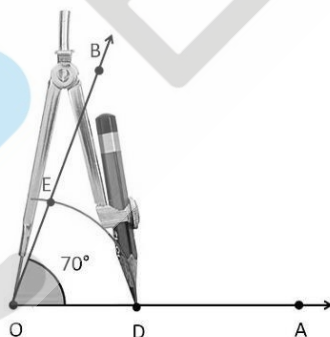
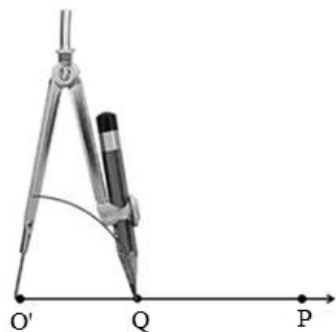

(Figure 1)

We need to make a copy of it using compasses.
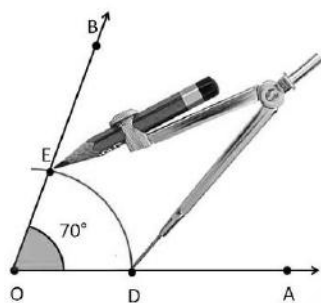
(a)   Draw a ray $\overrightarrow{O'P}$.

(b)   Keeping the pointed end of the compass at O of the figure 1, cut an arc such that it intersects $\overrightarrow{OA}$ at D and $\overrightarrow{OB}$ at E.
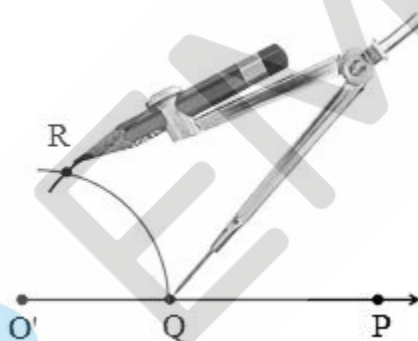

(c)   Keeping the arms of the compasses intact cut an arc on ray $\overrightarrow{O'P}$ with O' as the center. Let the point of intersection of the arc and the ray be Q.
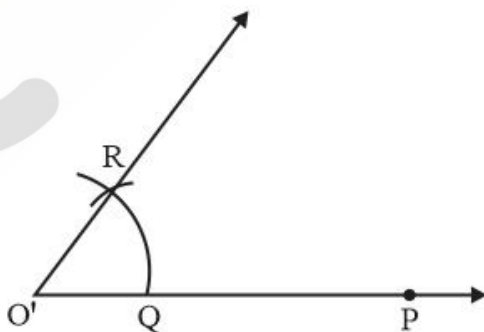
(d)   In figure 1, fix the arms of the compasses to the length of ED

(e)   Keeping the setting of the compasses intact, place the pointed end at Q and cut an arc such that it intersects the previously drawn arc at R.

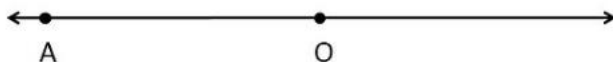(f)   Upon joining the points O′ and R, we obtain an exact copy of figure 1.

Hence, $\angle PO'R = 70^\circ = \angle AOB$

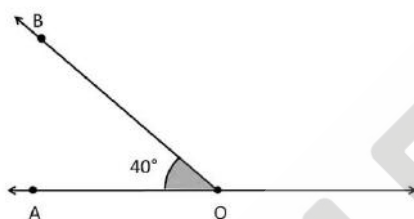**9.**   Draw an angle of 40º. Copy its supplementary angle.

Solution:

We need to first construct an angle of 40°

(a)   Draw a line and mark points A and O on it.

(b)   Place the center of the protractor at O. Note that the ray $\overrightarrow{OA}$ must coincide with 0° line of the protractor.

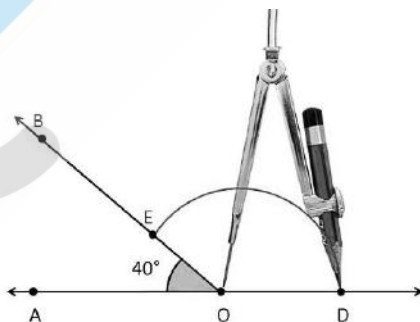(c)   Construct an angle of 40° at O using the protractor. Mark point B on it. Let us call this figure (1).

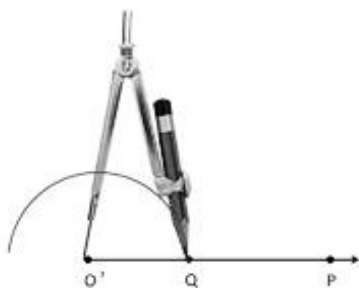Now, we need to construct an exact copy of its supplement.

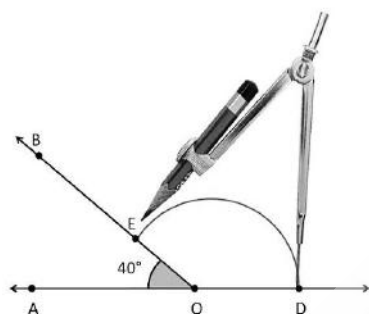(a)   Draw a ray with initial point O′ and mark a point P on it.

(b)   Consider figure (1). Draw an arc of any convenient radius on the supplement angle of 40°, with center at O. Let the points of intersection be D and E.
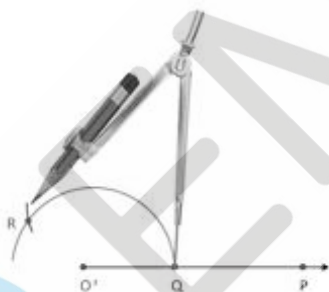

(c)   Keeping the settings of the compasses intact, draw an arc with center at O′ such that it cuts the ray $\overrightarrow{O'P}$ at Q.
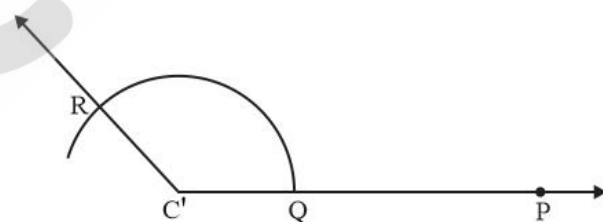
(d)   Consider figure (1). Fix the arms of the compasses to ED.

(e)   Keeping the settings of the compasses intact, place the pointed end at Q and draw an arc such that it cuts the previously drawn arc at R.

(f)   Upon joining the points O' and R, we obtain an exact copy of the supplement angle of $40°$.

Hence, $\angle RO'P = 140°$