Geometrical Constructions

Exercise 13.1

Q. 1. A. Construct the following angles at the initial point of a given ray and justify the construction.

90º

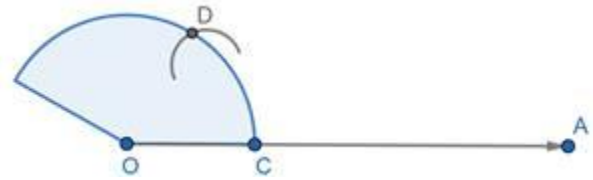
Answer : Construction of angle of 90°

Steps of construction:

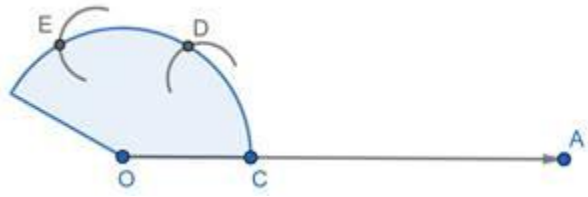
Step 1: Draw a ray OA.

Step 2: With its initial point O as center and any radius, draw an arc, cutting OA at C.

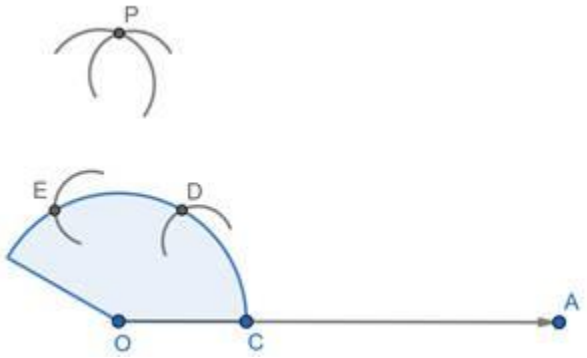
Step 3: With center c and same radius (as in step 2) draw an arc cutting arc at D.



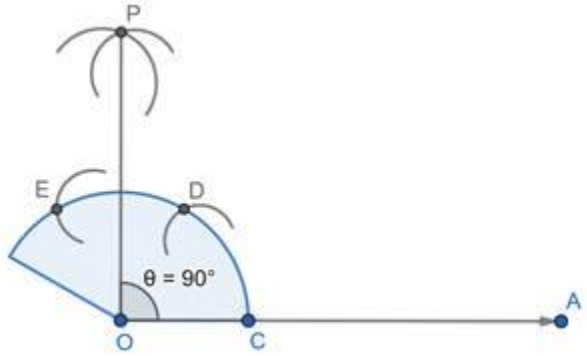
Step 4: With D as center and the same radius, draw an arc cutting the arc cutting at E.



Step 5: With D and E as centers and any convenient radius (more than $\frac{1}{2}$ DE). Draw to two arcs intersecting at P.



Step 6: Join OP. Then ∠AOP = 90°



Justification: -

By construction, OC = CD = OD

Therefore, ΔOCD is an equilateral triangle. So, ∠COD = 60°

Again OD = DE = OE

Therefore, ΔODE is also an equilateral triangle. So, ∠DOE = 60°

Since, OP bisects ∠DOE, so ∠POD = 30°.

Now,

∠AOP = ∠COD + ∠DOP

= 60° + 30°

= 90°

Q. 1. B. Construct the following angles at the initial point of a given ray and justify the construction.

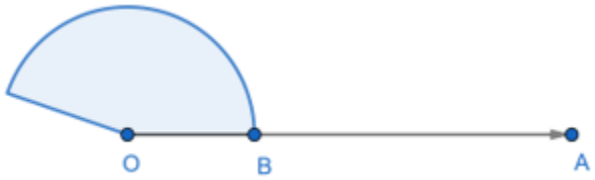
45º

Answer : Construction of angle of 45°

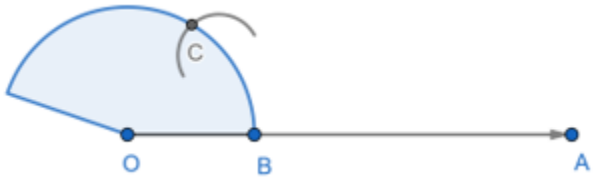
Steps of construction:

Step 1: Draw a ray OA.

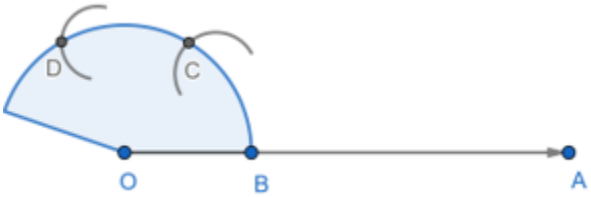
Step 2: With its initial point O as center and any radius, draw an arc, cutting OA at B.



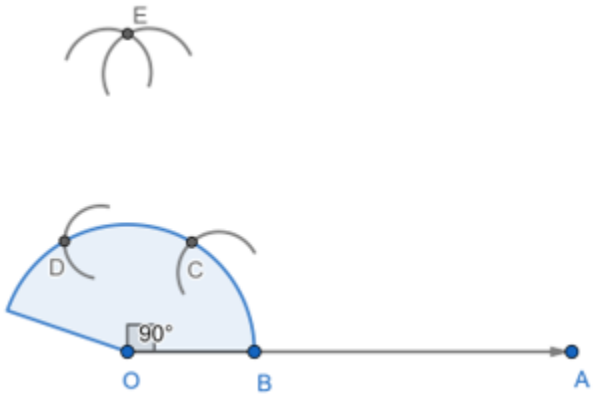
Step 3: With center B and same radius (as in step 2), cut the previous drawn arc at C.



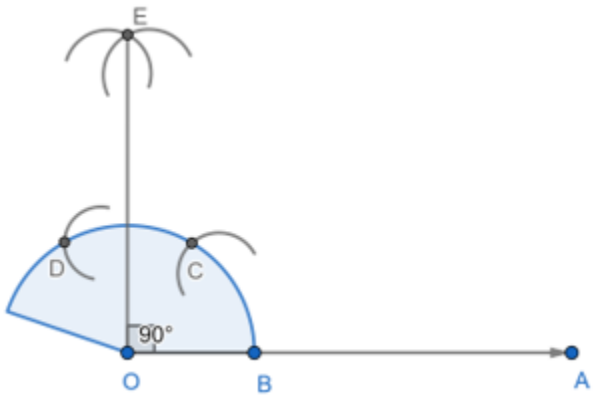
Step 4: With C as center and the same radius, draw an arc cutting the arc drawn in step 2 cutting at D.



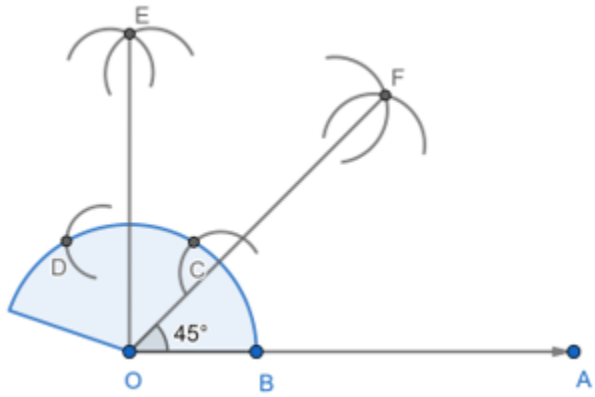
Step 5: With D and E as centers and any convenient radius (more than $\frac{1}{2}$ DE). Draw to two arcs intersecting at E.



Step 6: Join OE. Then ∠AOE = 90°



Step 7: Draw the bisector ‘OF’ of ∠AOE. Then, ∠AOF = 45°



Justification: -

By construction, ∠AOE = 90° and OF is the bisector of ∠AOE.

Therefore,

$\angle AOF = \frac{1}{2} \angle AOE$

$= \frac{1}{2} \times 90°$

= 45°

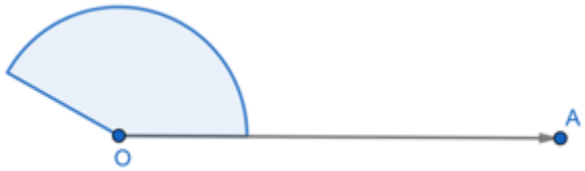
Q. 2. A. Construct the following angles using ruler and compass and verify by measuring them by a protractor.

30º

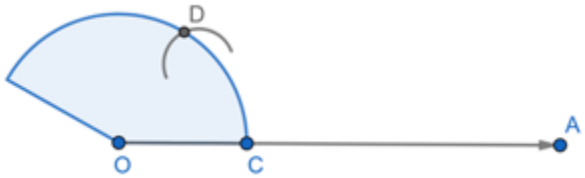
Answer : Steps of construction:

Step 1: Draw a ray OA.

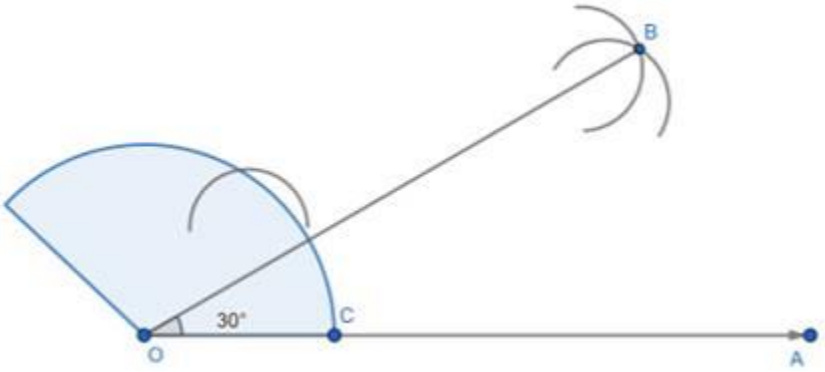
Step 2: With its initial point O as centre and any radius, draw an arc, cutting OA at C.



Step 3: With centre C and same radius (as in step 2). Draw an arc, cutting the arc of step 2 in D.



Step 4: With C and D as centres, and any convenient radius (more than $\frac{1}{2}$ CD), draw two arcs intersecting at B. join OB. Then ∠AOB = 30°



Verification:

On measuring ∠AOB, with the protractor,

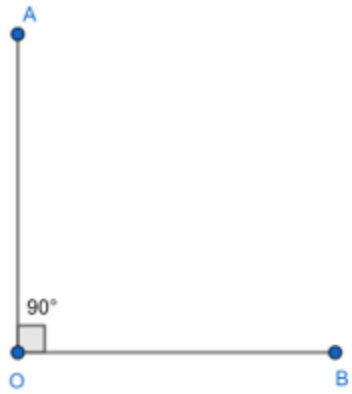
We find ∠ AOB = 30°.

Q. 2. B. Construct the following angles using ruler and compass and verify by measuring them by a protractor.

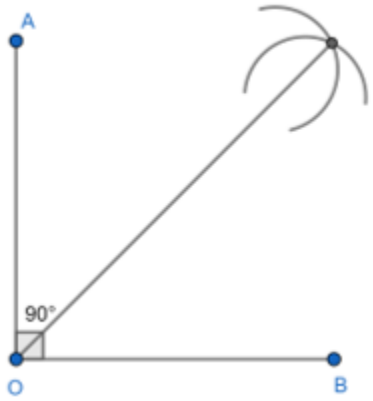
$$22\frac{1}{2}^{o}$$

Answer : Steps of construction:

Step 1: Draw an angle AOB = 90°

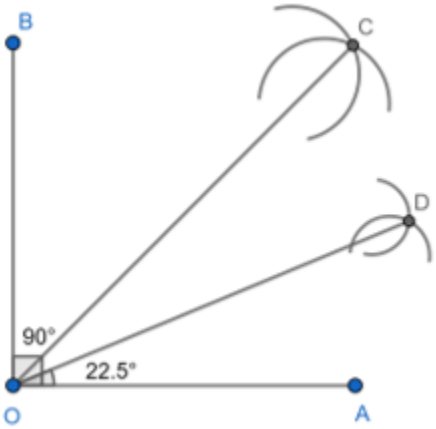


Step 2: Draw the bisector OC of ∠AOB, then ∠AOC = 45°



Step 3: Bisect ∠AOC, such that ∠AOD = ∠COD = 22.5°

Thus ∠AOD = 22.5°



Verification:

On measuring ∠AOD, with the protractor,

We find ∠ AOD = 22.5°.

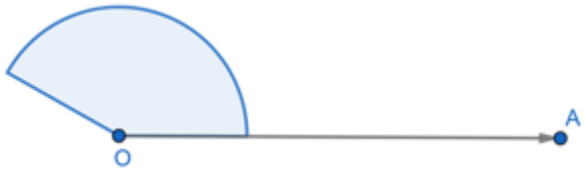
Q. 2. C. Construct the following angles using ruler and compass and verify by measuring them by a protractor.

15º

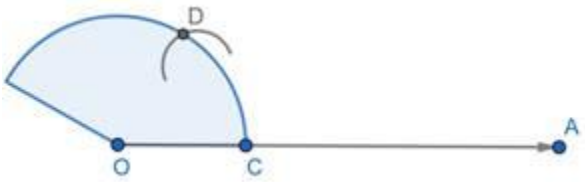
Answer : Steps of construction:

Step 5: Draw a ray OA.

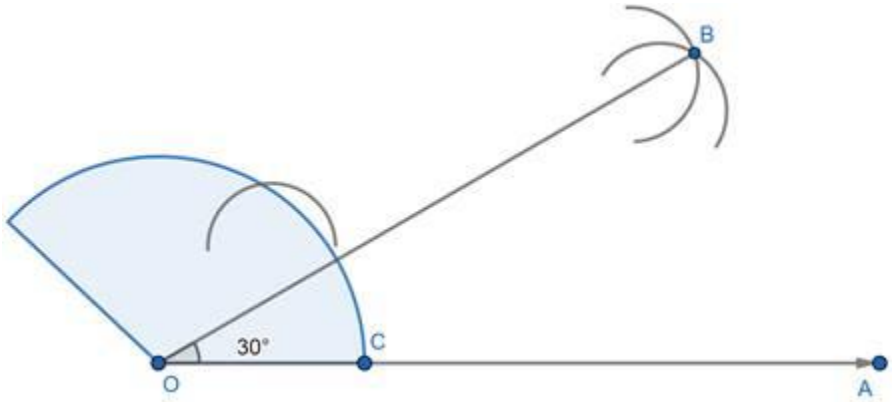
Step 6: With its initial point O as centre and any radius, draw an arc, cutting OA at C.



Step 7: With centre C and same radius (as in step 2). Draw an arc, cutting the arc of step 2 in D.

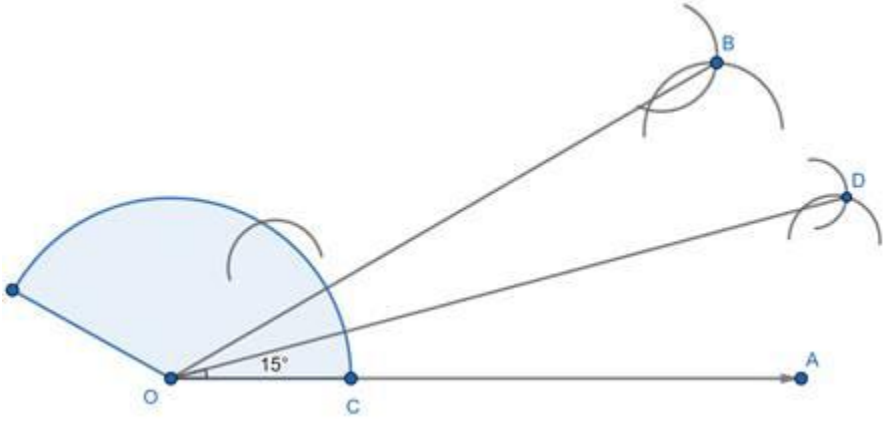


Step 8: With C and D as centres, and any convenient radius (more than $\frac{1}{2}$ CD), draw two arcs intersecting at B. join OB. Then ∠AOB = 30°



Step 9: Bisect ∠AOB intersecting at D.

Thus ∠ AOD is required angle.



Verification:

On measuring ∠AOB, with the protractor,

We find ∠ AOB = 15°.

Thus ∠AOD = 15°

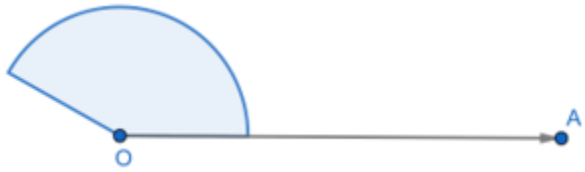
Q. 2. D. Construct the following angles using ruler and compass and verify by measuring them by a protractor.

75º

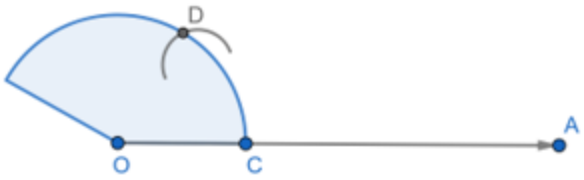
Answer : Step of construction:

Step 1: Draw a ray OA.

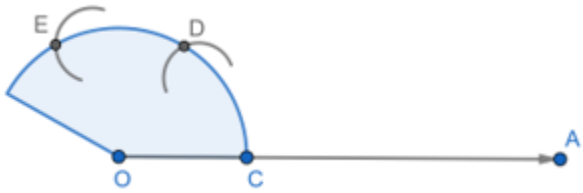
Step 2: With its initial point O as center and any radius, draw an arc, cutting OA at C.



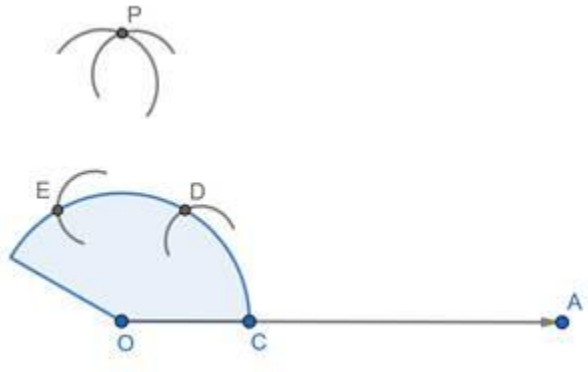
Step 3: With center c and same radius (as in step 2) draw an arc cutting arc at D.



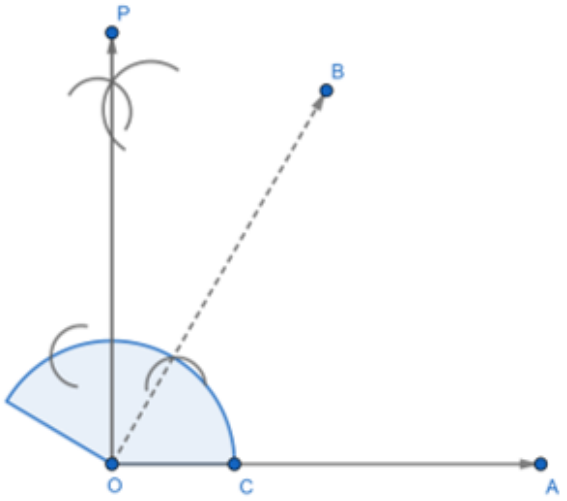
Step 4: With D as center and the same radius, draw an arc cutting the arc cutting at E.



Step 5: With D and E as centers and any convenient radius (more than $\frac{1}{2}$ DE). Draw to two arcs intersecting at P.



Step 6: Join OP. Then ∠AOP = 90°



Step 7: Bisect ∠BOP so that ∠BOQ = $\frac{1}{2}$ ∠BOP

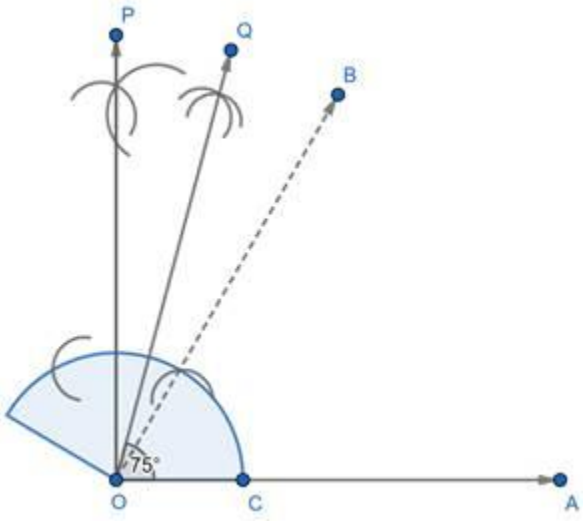
= $\frac{1}{2}$ (∠AOP - ∠AOB)

= $\frac{1}{2}$ (90° -60°) = $\frac{1}{2}$ × 30° = 15°

So, we obtain

∠AOQ = ∠AOB + ∠BOQ

= 60° + 15° = 75°



Verification:

On measuring ∠AOQ, with the protractor,

We find ∠ AOQ = 75°.

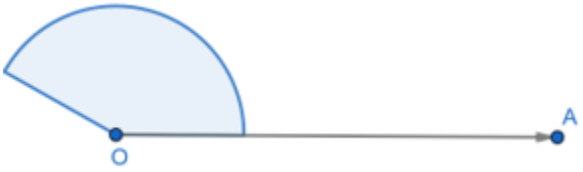
Q. 2. E. Construct the following angles using ruler and compass and verify by measuring them by a protractor.

105º

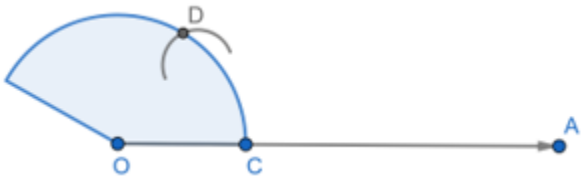
Answer : Steps of construction:

Step 1: Draw a ray OA.

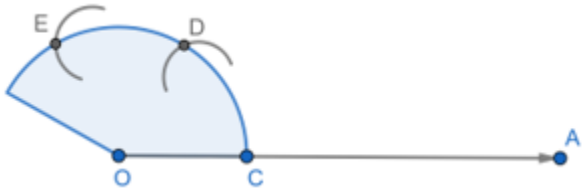
Step 2: With its initial point O as center and any radius, draw an arc, cutting OA at C.



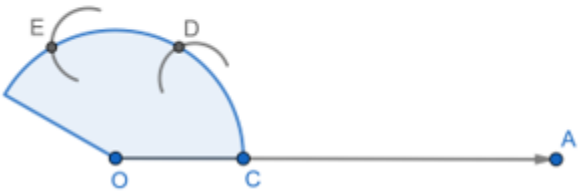
Step 3: With center c and same radius (as in step 2) draw an arc cutting arc at D.



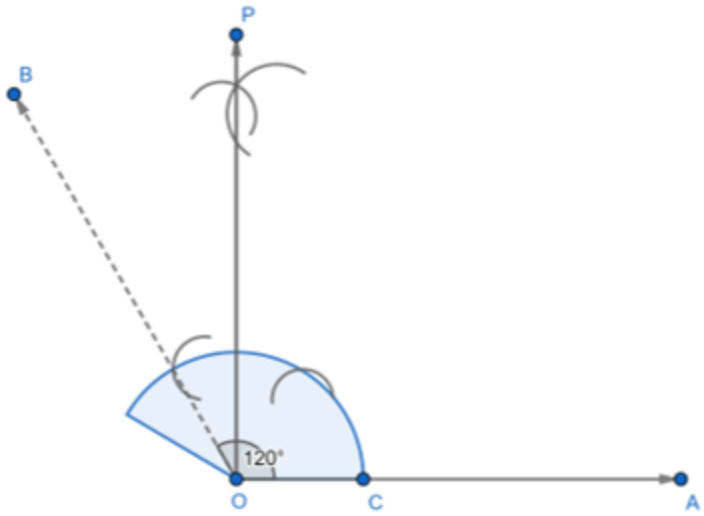
Step 4: With D as center and the same radius, draw an arc cutting the arc cutting at E.



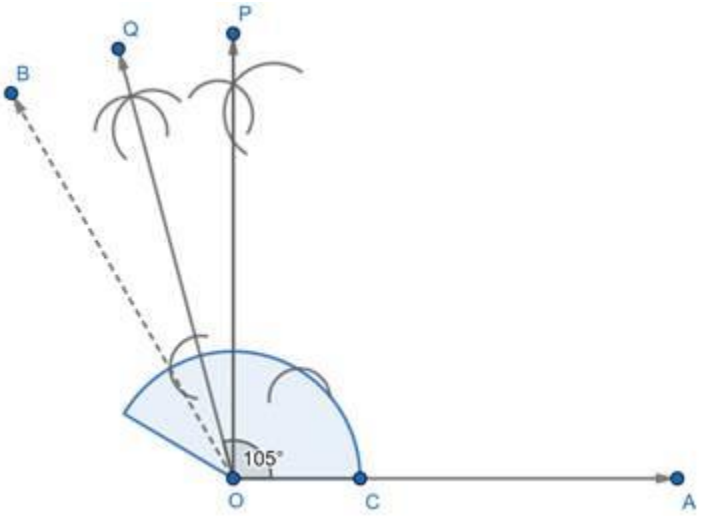
Step 5: With D and E as centers and any convenient radius (more than $\frac{1}{2}$ DE). Draw to two arcs intersecting at P.



Step 6: Draw ∠AOB = 120° and ∠POB = 90°



Step 7: Bisect angle POB,



Then ∠AOQ is the required angle of 105°.

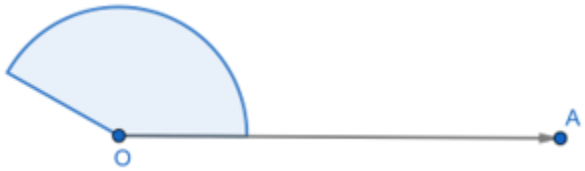
Q. 2. F. Construct the following angles using ruler and compass and verify by measuring them by a protractor.

135º

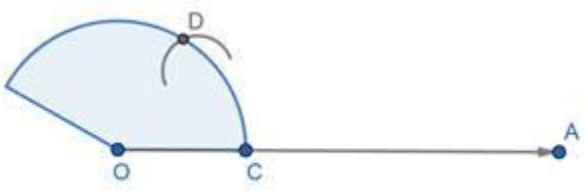
Answer : Step of construction:

Step 1: Draw a ray OA.

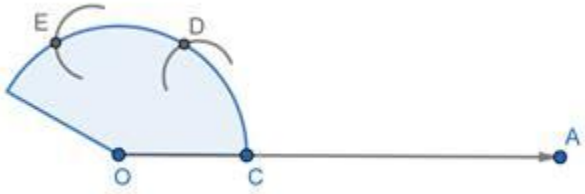
Step 2: With its initial point O as center and any radius, draw an arc, cutting OA at C.



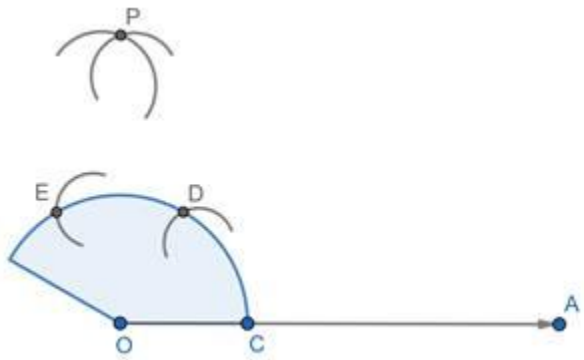
Step 3: With center c and same radius (as in step 2) draw an arc cutting arc at D.



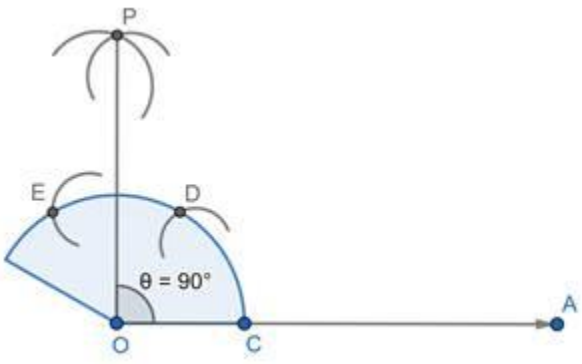
Step 4: With D as center and the same radius, draw an arc cutting the arc cutting at E.



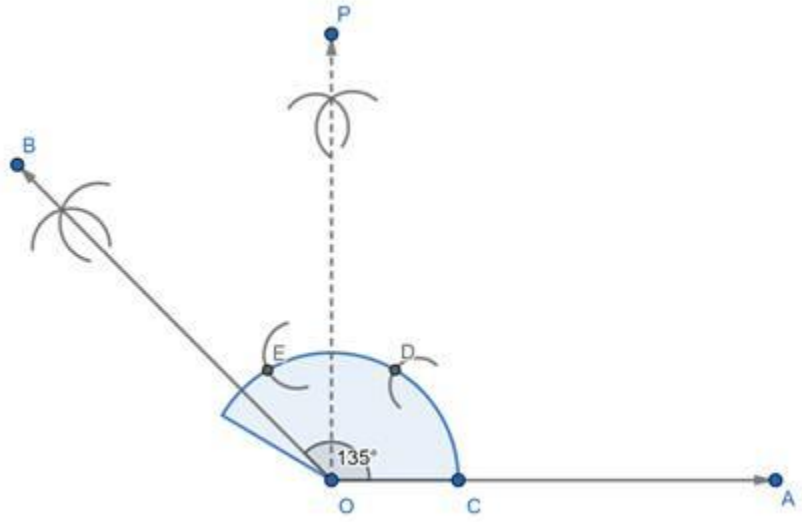
Step 5: With D and E as centers and any convenient radius (more than $\frac{1}{2}$ DE). Draw to two arcs intersecting at P.



Step 6: Join OP. Then ∠AOP = 90°



Step 7: Bisect ∠AOP towards 180°



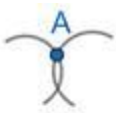
Q. 3. Construct an equilateral triangle, given its side of length of 4.5 cm and justify the construction.

Answer : Let us draw an equilateral triangle of side 4.5 cm.

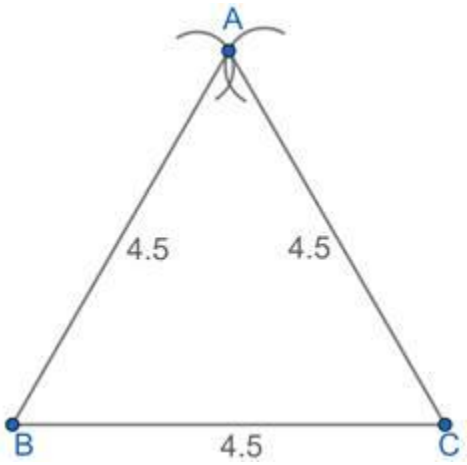
Step of construction:

Step 1: Draw BC = 4.5 cm

Step 2: With B and C as centres and radii equal to BC = 4.5 cm, draw two arcs on the same side of BC, intersecting each other at A.



Step 3: Join AB and AC.



ΔABC is the required equilateral triangle.

Justification:

Since by construction:

AB = BC = CA = 4.5 cm

Therefore ∆ ABC is an equilateral triangle.

Q. 4. Construct an isosceles triangle, given its base and base angle and justify the construction.

[Hint: You can take any measure of side and angle]

Answer : Let us assume the base to be 5.5cm and base angle to be 50°

∴, AB = 5.5 cm and ∠B = 50°

We know that,

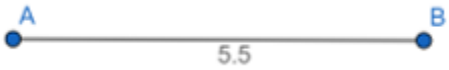
In an isosceles triangle, opposite sides are equal and opposite angles are equal.

So, ∠B = ∠A = 50°

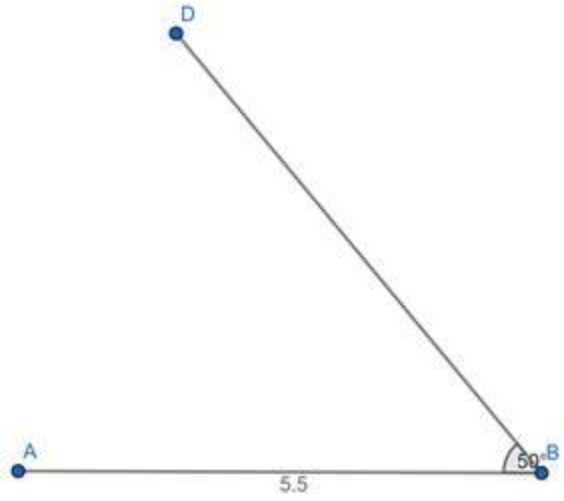
And AC = BC

<u>Steps of construction:</u>

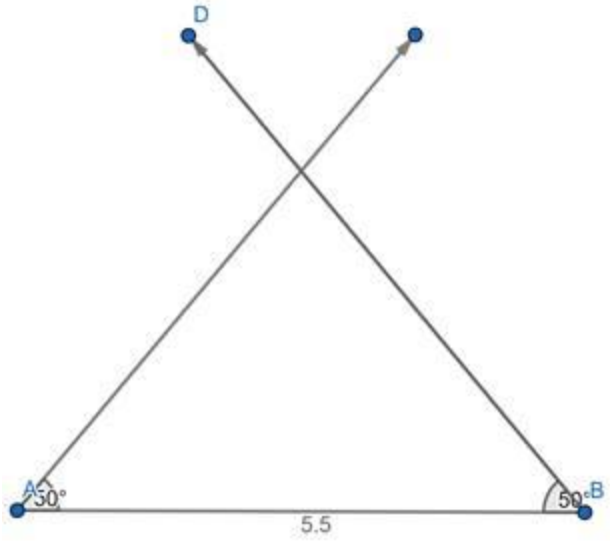
Step 1: Draw base AB = 5.5cm.



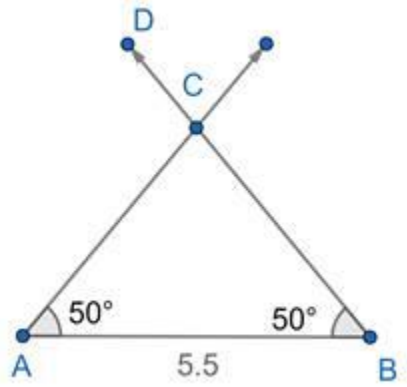
Step 2: At vertex B, Draw a ray constructing angle of 50°.



Step 3: Now draw another ray at A constructing an angle of 50°



Step 4: Mark the point of intersection as C.



ABC is the required triangle.

Exercise 13.2

Q. 1. Construct ∆ABC in which BC = 7 cm, ∠B = 75° and AB + AC = 12 m.

Answer : Given: base BC = 7cm, AB + AC = 12 cm and

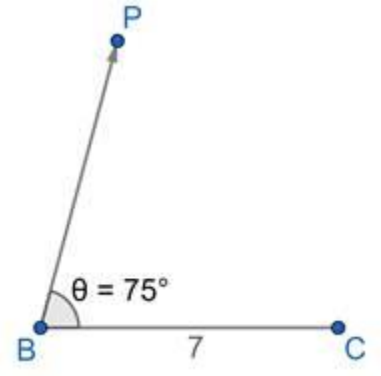
∠B = 75° of Δ ABC.

Required: To construct a ΔABC

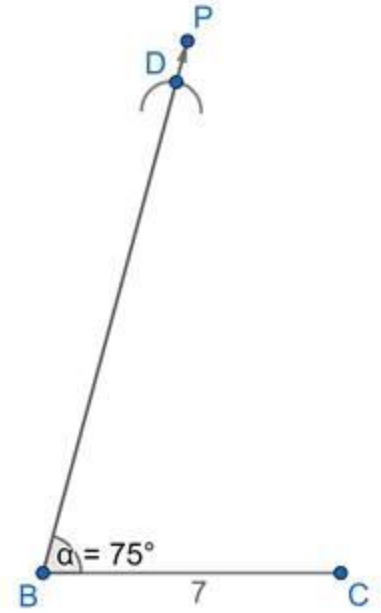
Steps of construction:

Step 1: Draw a segment BC of length of 7 c

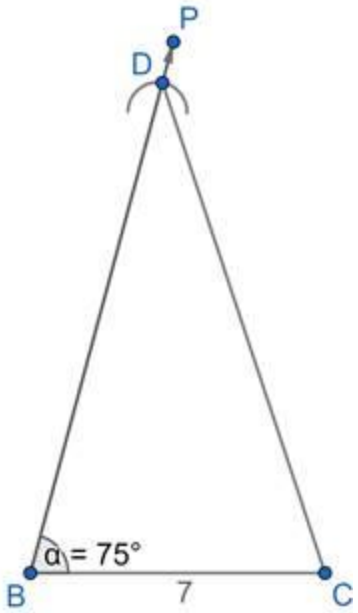
Step 2: At vertex B, construct ∠B = 75° and produce a ray BP.



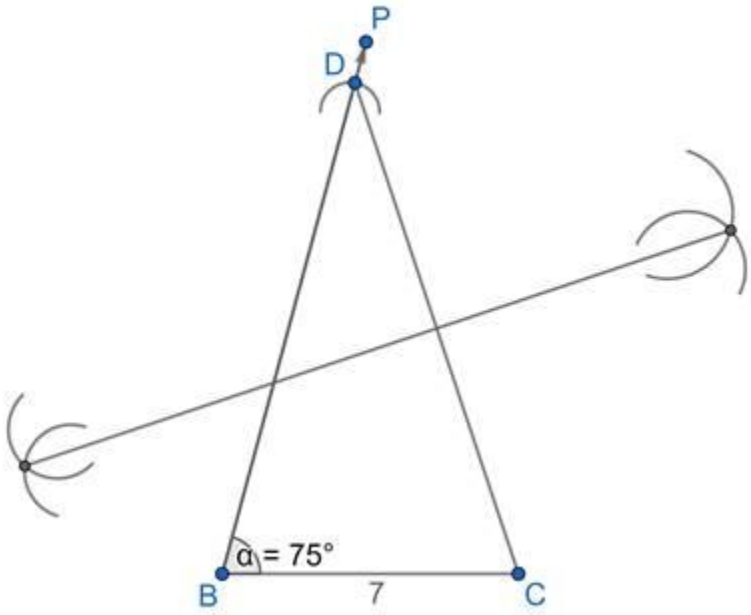
Step 3: Mark an arc on ray BP cutting at D such that BD = 12cm.



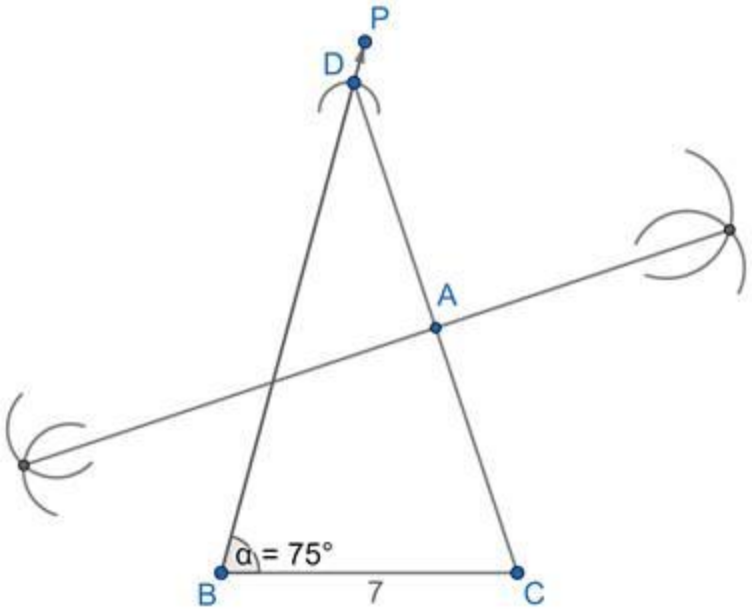
Step 4: Draw segment CD.



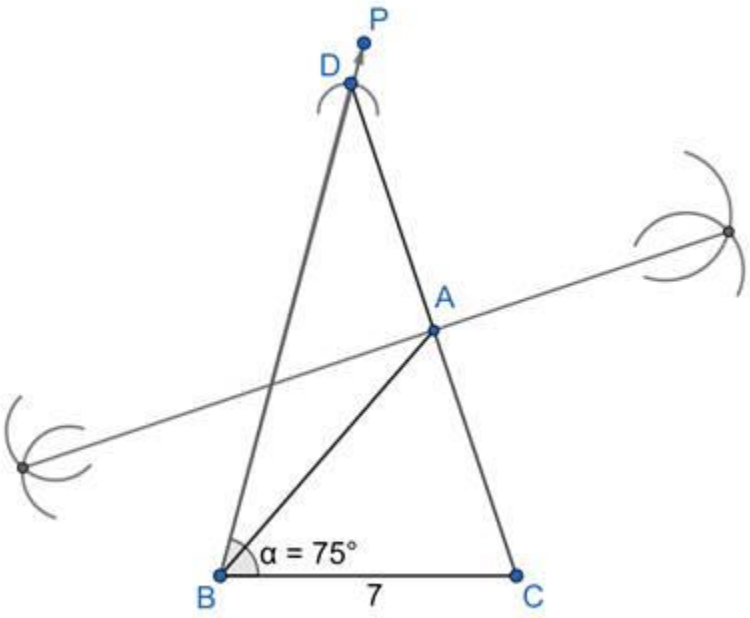
Step 5: Construct the perpendicular bisector of segment CD.



Step 6: Name the point of intersection of ray BP and the perpendicular bisector of CD as A.



Step 7: Draw segment AB.



ΔABC is the required triangle.

Q. 2. Construct PQR in which QR = 8 cm, ∠Q = 60° and PQ - PR = 3.5 cm.

Answer : Given: Base QR = 8 cm, PQ-PR = 3.5cm and

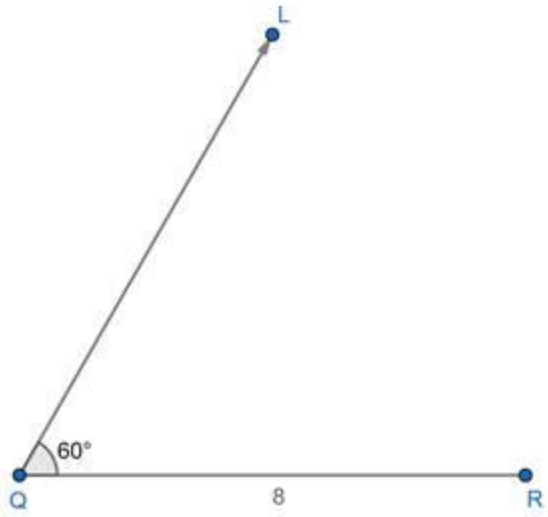
∠Q = 60° of Δ PQR.

Required: To construct a triangle PQR.

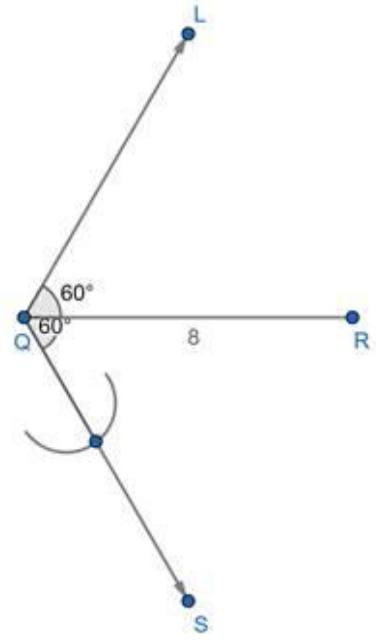
Steps of construction:

Step 1: Draw a segment QR of length 8cm.

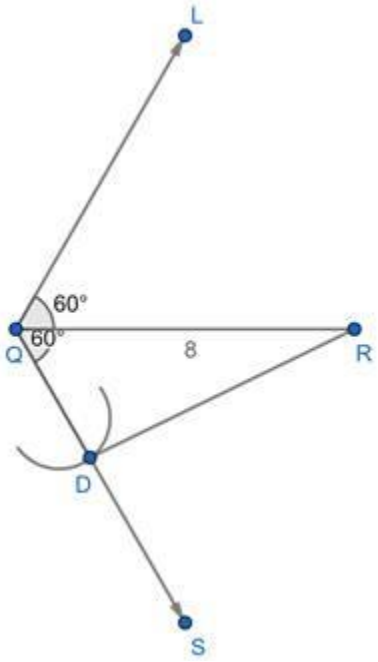
Step 2: Draw ray QL such that ∠Q = 60°



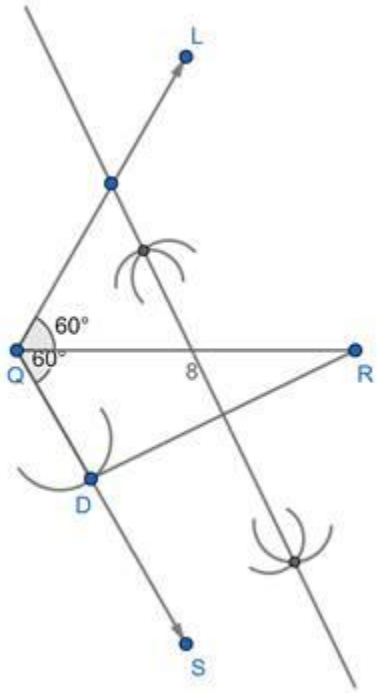
Step 3: Mark an arc on opposite ray QL i.e. QS cutting at D such that QD = 3.5cm.



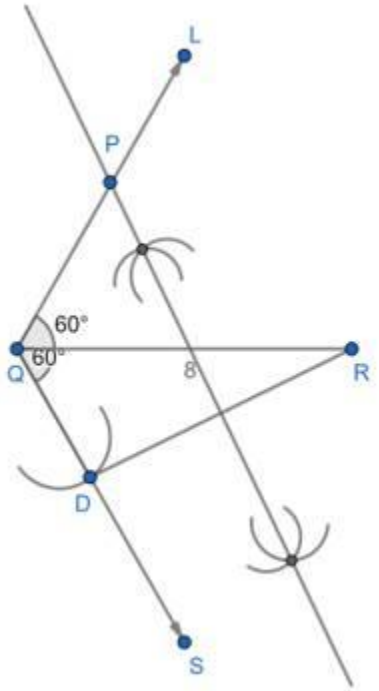
Step 4: Draw segment RD.



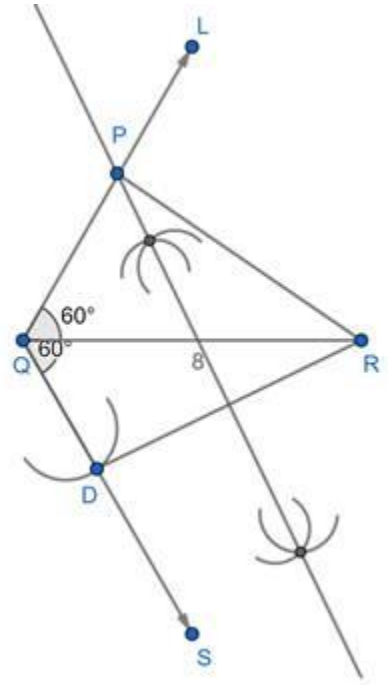
Step 5: Construct the perpendicular bisector of segment RD.



Step 6: Name the point of intersection of ray QL and the perpendicular bisector of RD as P.



Step 7: Draw segment PR.



ΔPQR is the required triangle.

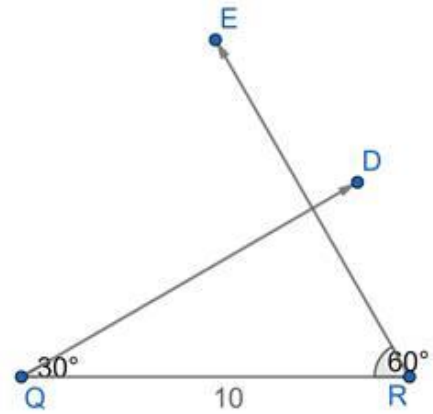
Q. 3. Construct ∆XYZ in which ∠Y = 30°, ∠Z = 60° and XY + YZ + ZX = 10 cm.

Answer : Given: ∠Y = 30°, ∠Z = 60° and perimeter of ΔXYZ = 10 cm

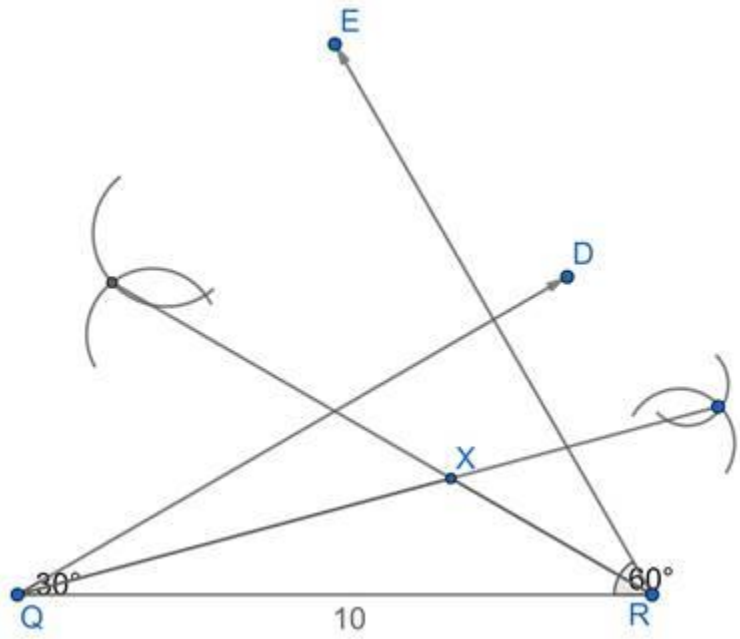
Steps of construction:

Step 1: Step 1: raw a line segment QR of 10.5cm.

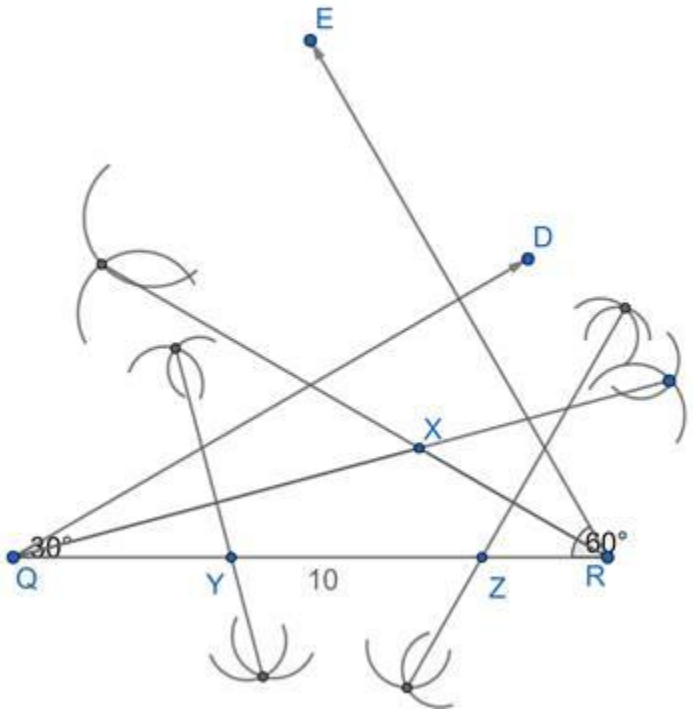
Step 2: From point Q draw a ray QD at 30° and from R draw a ray RE at 60°.



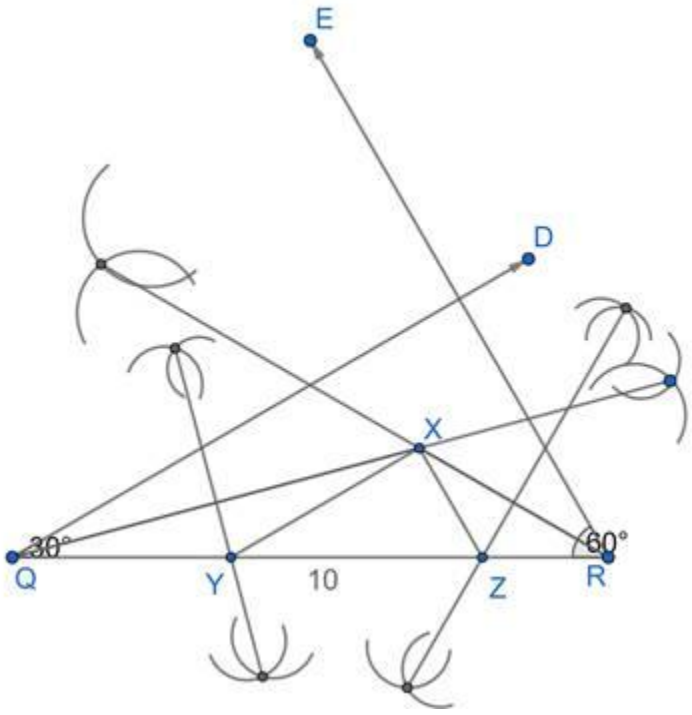
Step 3: Draw an angle bisector of Q and R, two angle bisectors intersect each other at point X.



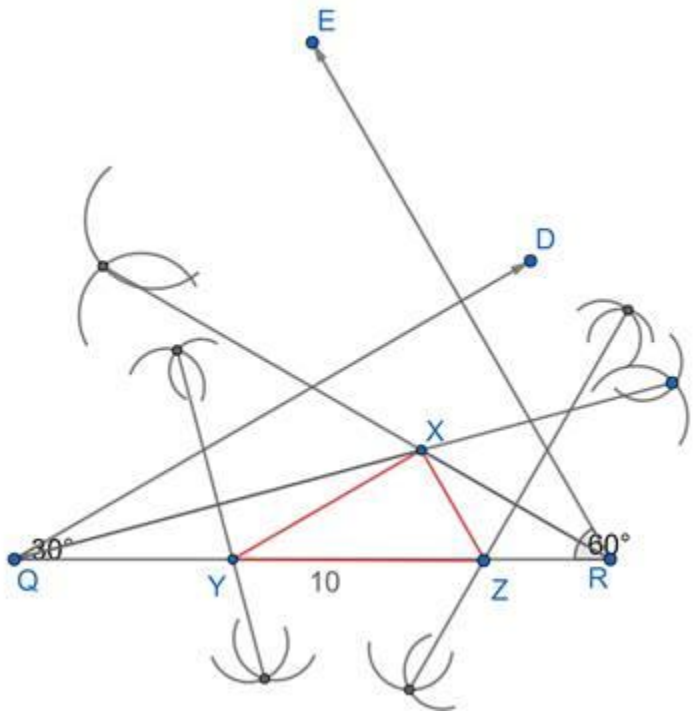
Step 4: Draw a line bisector of QX and XR respectively these two-line bisectors intersect at point Y and Z



Step 5: Join XY AND XZ.



Step 6: Δ XYZ is required triangle.



Q. 4. Construct a right triangle whose base is 7.5cm and sum of its hypotenuse and other side is 15cm.

Answer : Given base(BC) = 7.5cm and AB + AC = 15cm and ∠B = 90°

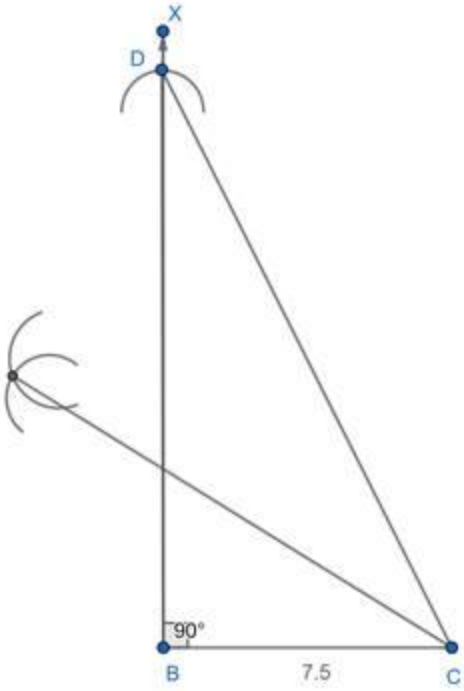
Steps of construction:

Step 1: Draw the base BC = 7.5cm

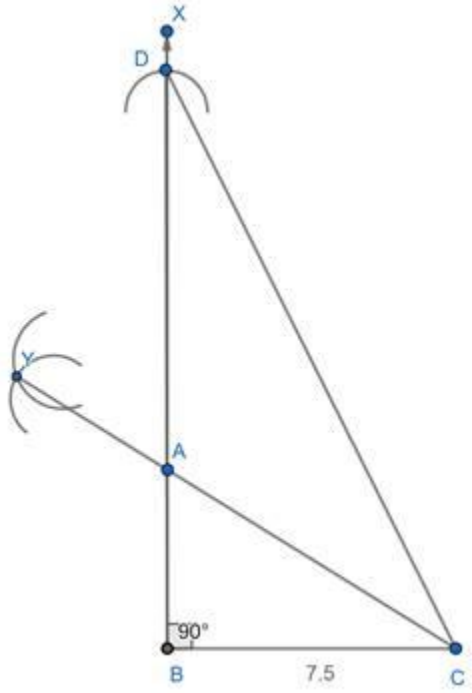
Step 2: Make an ∠XBC = 90° at the point B of base BC.

Step 3: Cut the line segment BD equals to AB + AC i.e. 15cm from the ray XB.

Step 4: Join DC and make an angle bisector of ∠DCB.



Step 5: Let Y intersect BX at A.



Thus, ΔABC is the required triangle.

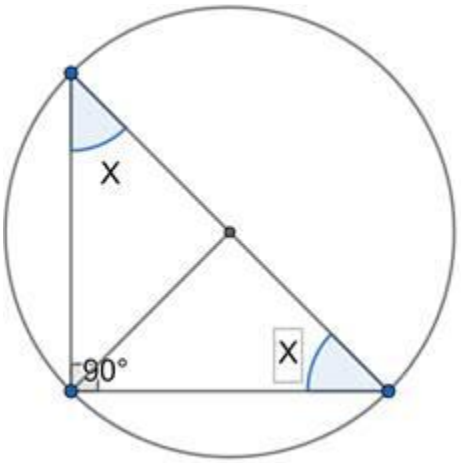
Q. 5. A. Construct a segment of a circle on a chord of length 5cm. containing the following angles.

90°

Answer : Given an angle of 90° and chord 5cm

Steps of construction:

Rough image:



Explanation:

x + x + 90° = 180°

[Using sum of all angles in a triangle = 180°]

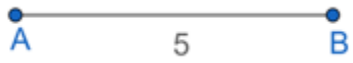
⇒ 2x + 90° = 180°

⇒ 2x = 180° - 90°

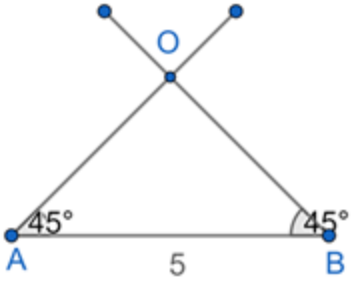
⇒ 2x = 900°

$\Rightarrow x = \frac{90^\circ}{2} = 45^\circ$

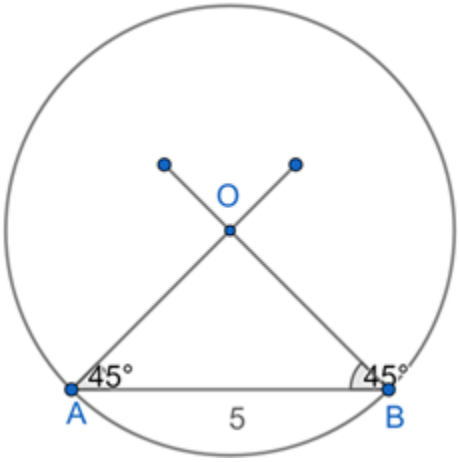
Step 1: Draw a line segment AB = 5cm



Step 2: Draw an angle of 45° on point A and B to intersect at O.

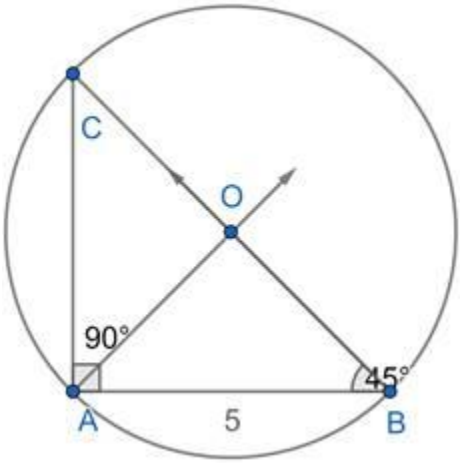


Step 3: With centre ‘O’ and radius OA and OB, draw the circle.



Step 4: Mark a point ‘C’ on the arc of the circle. Join AC and BC.

We get ∠CAB = 90°.



Thus, ACB is the required circle segment.

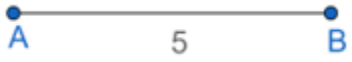
Q. 5. B. Construct a segment of a circle on a chord of length 5cm. containing the following angles.

45°

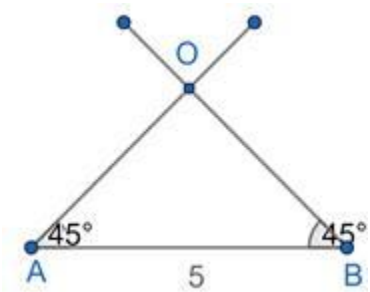
Answer : Given an angle of 45° and chord 5cm

Steps of construction:

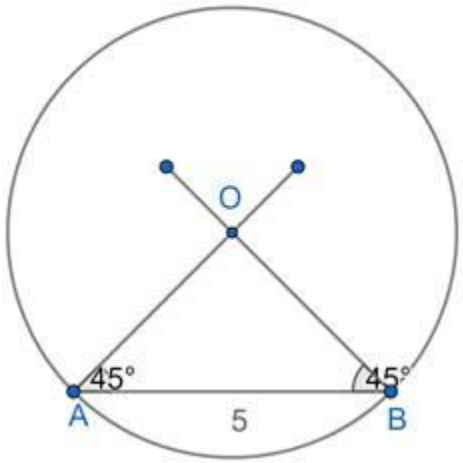
Step 1: Draw a line segment AB = 5cm



Step 2: Draw an angle of 45° on point A and B to intersect at O.

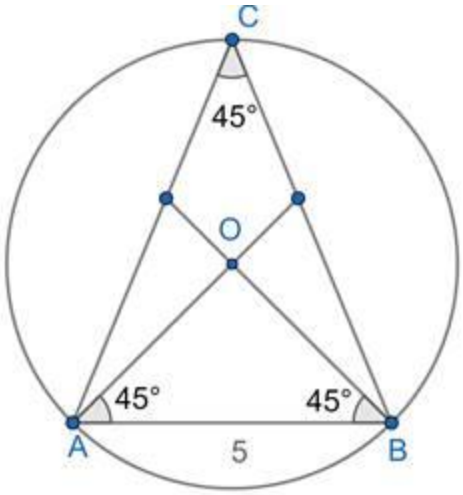


Step 3: With centre ‘O’ and radius OA and OB, draw the circle.



Step 4: Mark a point ‘C’ on the arc of the circle. Join AC and BC.

We get ∠ACB = 45°.



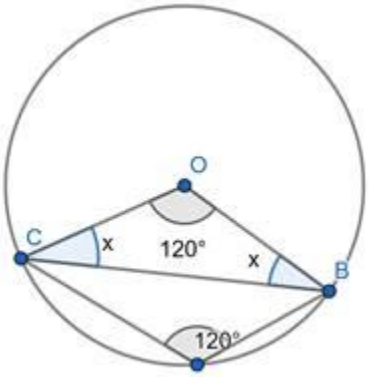
Thus, ACB is the required circle segment.

Q. 5. C. Construct a segment of a circle on a chord of length 5cm. containing the following angles.

120°

Answer : Given an angle of 120° and chord 5cm

Rough Image :



Explanation:

x + x + 120° = 180°

[Using sum of all angles in a triangle = 180°]

⇒ 2x + 120° = 180°

⇒ 2x = 180° - 120°

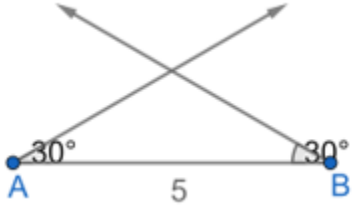
$\Rightarrow 2x = 60°$

$\Rightarrow x = \frac{60°}{2} = 30°$

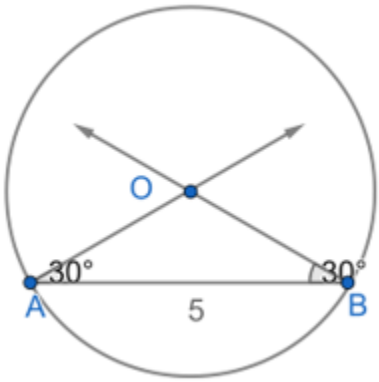
Steps of construction:

Step 1: Draw a line segment AB = 5cm

Step 2: Draw an angle of 30° on point A and B to intersect at O.

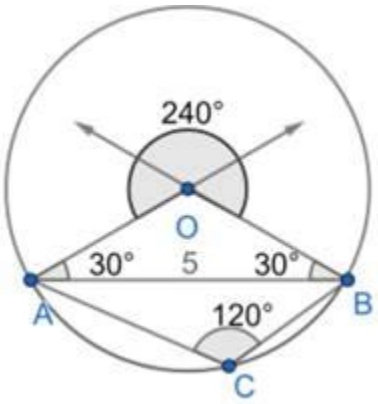


Step 3: With centre ‘O’ and radius OA and OB, draw the circle.



Step 4: Mark a point ‘C’ under the chord AB and on the arc of the circle . Join AC and BC.

We get M∠A0B = 240°.



Thus, ACB is the required circle segment.