11 Constructions

Lesson at a Glance

1. The bisector of an angle passes between the two arms of the angle.
2. Each point on the bisector of an angle is equidistant from the arms of the angle.
3. In the process of constructing the perpendicular bisector of a line segment, the radius of each arc must be greater than the half of the line segment.
4. Each point on the perpendicular bisector of a line segment is equidistant from the end points of the line segment.
5. To construct a triangle when the sum of the three sides and the two base angles are given, first we draw the line segment consisting the sum of the three sides and the two base angles.

TEXTBOOK QUESTIONS SOLVED

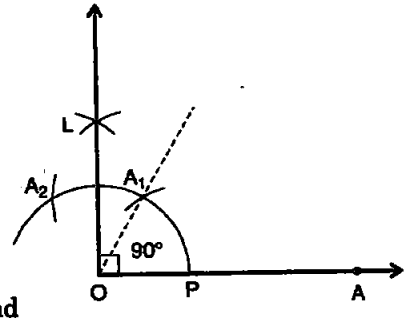
Exercise 11.1 *(Page – 191)*

1. *Construct an angle of 90° at the initial point of a given ray and justify the construction.*

Sol. Steps of construction:

(*i*) Let the given ray be OA with initial point O.

(*ii*) Taking O as centre and any suitable radius, draw an arc to intersect the ray at P.



(*iii*) Taking P as centreand the same radius, draw an arc to intersect the arc drawn in step (*ii*) at A_1.

(*iv*) Taking A_1 as centre and the same radius, draw an arc to cut the arc drawn in step (*ii*) at A_2.

(*v*) Taking A_1 and A_2 as centres and radius greater than $\frac{A_1A_2}{2}$, draw two arcs to intersect each other at L on the same side of the line segment A_1A_2.

(*vi*) Join OL and produce it along OL.

Hence, $\angle LOA = 90°$.

Justification: $\angle A_1OA = 60°$, and $\angle A_2OA_1 = 60°$.

Bisector of $\angle A_2OA_1 = \angle LOA_1 = \frac{60°}{2} = 30°$.

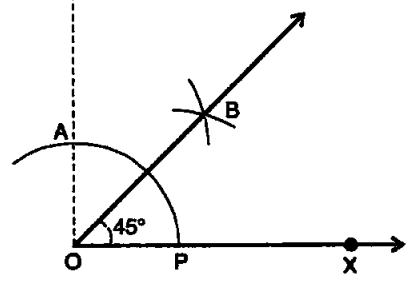
Then $\angle LOA = \angle LOA_1 + \angle A_1OA = 30° + 60° = 90°$.

2. *Construct an angle of 45° at the initial point of a given ray and justify the construction.*

Sol. Steps of construction:

(*a*) Draw an angle AOP = 90° as in Ans.1.

(*b*) Taking A and P as centres and radius greater than $\frac{AP}{2}$, draw two arcs to intersect each other at B as shown in the adjoining figure.



(*c*) Join OB and produce it.

Hence, acute $\angle BOX = 45°$.

Justification: $\angle AOP = 90°$

$\angle AOB + \angle BOP = 90°$ [$\because$ $\angle AOB = \angle BOP$]

$2\angle BOP = 90°$

$\angle BOP = 45°$.

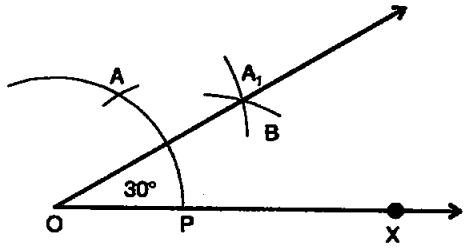
3. *Construct the angles of the following measurements:*

(*i*) *30°* (*ii*) $22\frac{1°}{2}$ (*iii*) *15°*.

Sol. (*i*) **Steps of construction:**

(*a*) Draw a ray OX with initial point O.

(*b*) Taking O as centre and suitable radius, draw an arc to cut OX at P.



(*c*) Taking P as centre and same radius draw an arc to cut the arc drawn in step (*b*) at A.

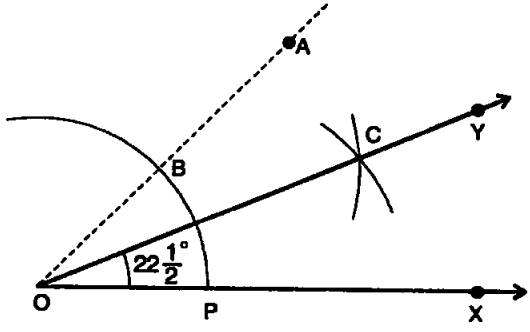
(*d*) Taking P and A as centres and radius greater than $\frac{AP}{2}$, draw two arcs to intersect each other at A_1.

(*e*) Join OA_1 and produce it along OA_1.

Hence, acute angle $A_1OX = 30°$.

(*ii*) **Steps of construction:**

(*a*) Draw an angle of 45° on a ray OX such that $\angle AOX = 45°$ as in Q. 2.



(*b*) Taking B and P as centres and radius greater than $\frac{BP}{2}$, draw arcs to intersect each other at C.

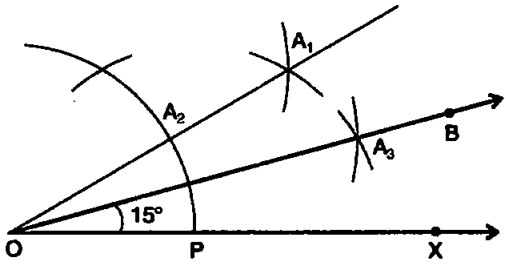
(*c*) Join OC and produce it to Y.

Hence, acute $\angle XOY = 22\frac{1}{2}^\circ$.

(*iii*) **Steps of construction:**

(*a*) Draw an $\angle A_1OX = 30^\circ$ on a ray OX as in Part (*i*).

(*b*) Taking A_2 and P as centres and radius greater than $\frac{A_2P}{2}$, draw two arcs to intersect each other at A_3.



(*c*) Join OA_3 and produce it to B.

Hence, acute angle BOX = 15°.

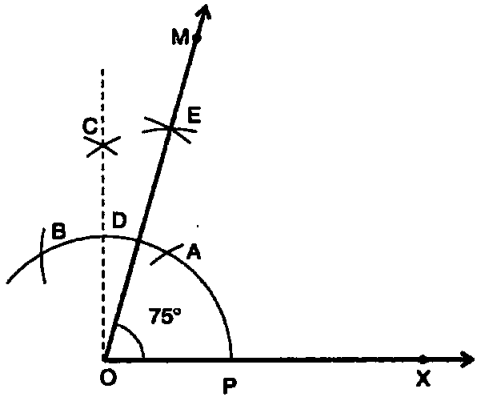
4. *Construct the following angles and verify by measuring them by a protractor.*

(*i*) *75°* (*ii*) *105°* (*iii*) *135°*.

Sol. (*i*) **Steps of construction:**

(*a*) Draw a ray OX with initial point O.

(*b*) Taking O as centre and suitable radius, draw an arc to intersect OX at P.



(*c*) Taking P as centre and same radius, draw an arc to intersect the arc drawn in step (*b*) at A.

(*d*) Taking A as centre and same radius, draw an arc to intersect the arc drawn in step (*b*) at B.

(*e*) Taking A and B as centres and radius greater than $\frac{AB}{2}$, draw two arcs to intersect each other at C.

(*f*) Join OC to intersect the arc drawn in step (*b*) at D.

(*g*) Taking A and D as centres and radius greater than $\frac{AD}{2}$, draw two arcs to intersect each other at E.

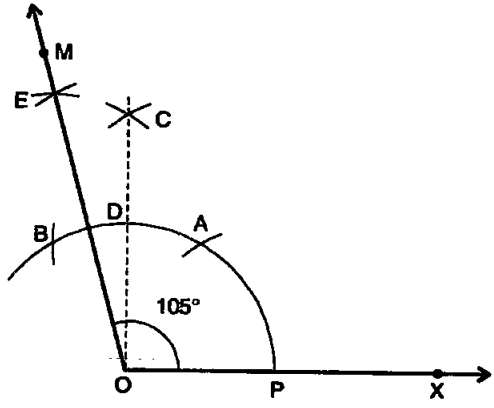
(*h*) Join OE and produce it to M.

Hence, acute angle MOX = 75°.

Verification:

On measuring by a protractor, we get ∠MOX = 75°.

(*ii*) **Steps of construction:**



(*a*) Draw a ray OX with initial point O.

(*b*) Taking O as centre and any suitable radius, draw an arc to intersect OX at P.

(*c*) Taking P as centre and same radius, draw an arc to intersect the arc drawn in step (*b*) at A.

(*d*) Taking A as centre and same radius, draw an arc to intersect the arc in step (*b*) at B.

(*e*) Taking A and B as centres and radius greater than $\frac{AB}{2}$, draw two arcs to intersect each other at C.

(*f*) Join OC to intersect the arc drawn in step (*b*) at D.

(*g*) Taking B and D as centres and any suitable radius greater than $\frac{BD}{2}$, draw two arcs to intersect each other at E.

(*h*) Join OE and produce it to M.

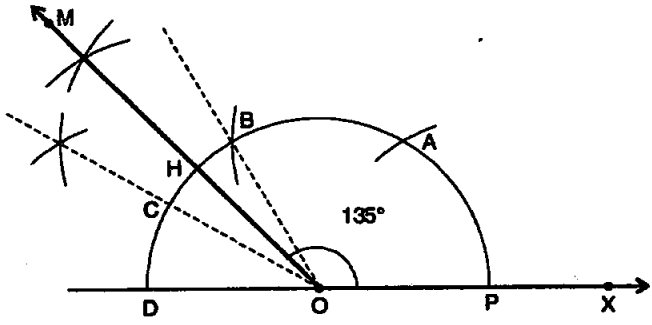
Hence, obtuse $\angle MOX = 105°$.

Verification: On measuring by a protractor, we find $\angle MOX = 105°$.

(*iii*) **Steps of construction:**

(*a*) Draw a ray OX with initial point O.

(*b*) Taking O as centre and any suitable radius, draw an arc to intersect the ray OX at P and XO produced at D.



(*c*) Taking P as centre and same radius, draw an arc to intersect the arc drawn in step (*b*) at A.

(*d*) Taking A as centre and same radius, draw

another arc to intersect the arc drawn in step (*b*) at B.

(*e*) Draw the angle bisector of ∠DOB, which intersects the arc drawn in step (*b*) at C.

(*f*) Again, draw the angle bisector of ∠COB, which intersects the arc drawn in step (*b*) at H.

(*g*) Join OH and produce it to M.

Hence, obtuse angle MOX = 135°.

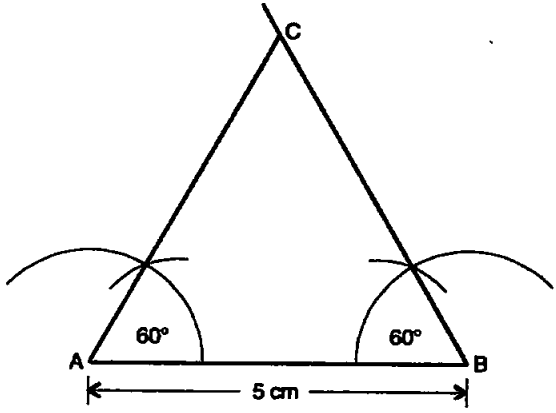
Verification: On measuring by the protractor, ∠MOX is of measure 135°.

5. *Construct an equilateral triangle, given its side and justify the construction.*

Sol. Let the given side of an equilateral triangle is of length 5 cm.

Steps of construction:

(*i*) Draw a line segment AB of length 5 cm.



(*ii*) Draw two angles BAC and ABC, each of measure 60°, on the same side of AB at the points A and B respectively such that their non-common arms intersect each other at C.

Hence, ΔABC is an equilateral triangle.

Justification: ∠ABC = ∠BCA = ∠CAB [Each 60°]

⇒ AC = AB = BC.

[Sides opposite to equal angles are equal.]

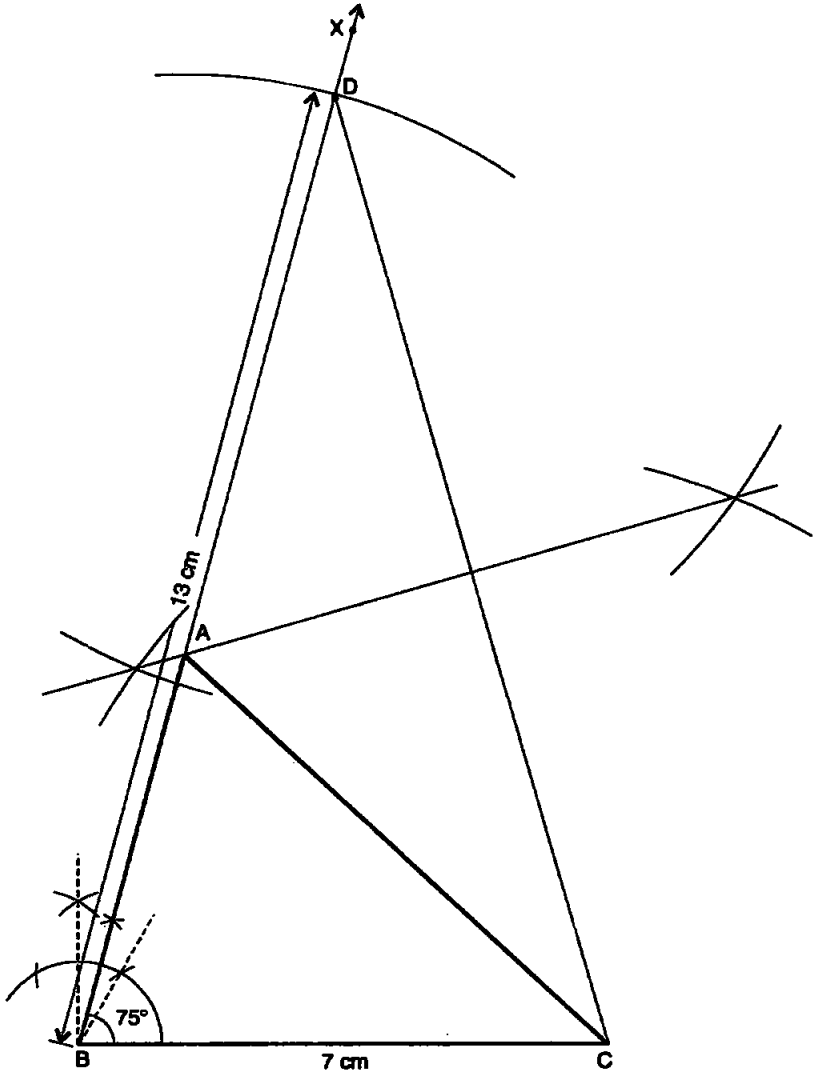
Exercise 11.2 *(Page – 195)*

1. *Construct a triangle ABC in which BC = 7 cm, ∠B = 75° and AB + AC = 13 cm.*

Sol. Steps of construction:

(*i*) Draw a line segment BC of length 7 cm.

(*ii*) Draw an angle, say XBC, of measure 75° at the end B of BC.



(*iii*) Cut a line segment BD = 13 cm from the ray BX.

(*iv*) Join DC and draw the perpendicular bisector of it to intersect BD at A.

(*v*) Join AC.

Then, ΔABC is the required triangle.

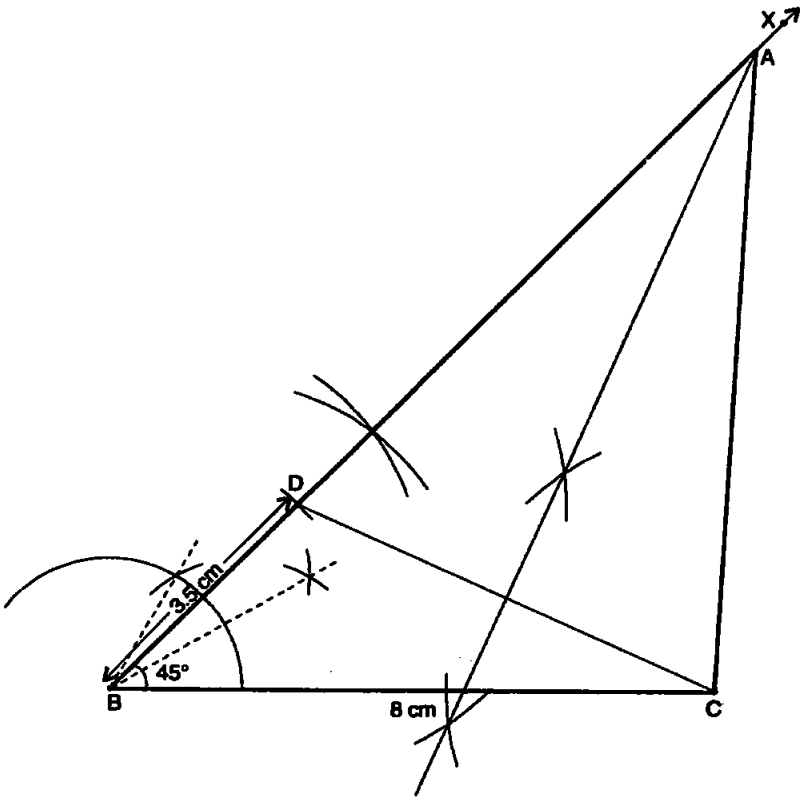
2. *Construct a triangle ABC in which BC = 8 cm, ∠B = 45° and AB – AC = 3.5 cm.*

Sol. Steps of construction:

(*i*) Draw a line segment BC of length 8 cm.

(*ii*) Make an angle, say XBC, of measure 45° at the end B of BC.

(*iii*) Cut a line segment BD of length 3.5 cm from the ray BX.



(*iv*) Join CD and draw the perpendicular bisector of it to intersect BX at A.

(*v*) Join AC.

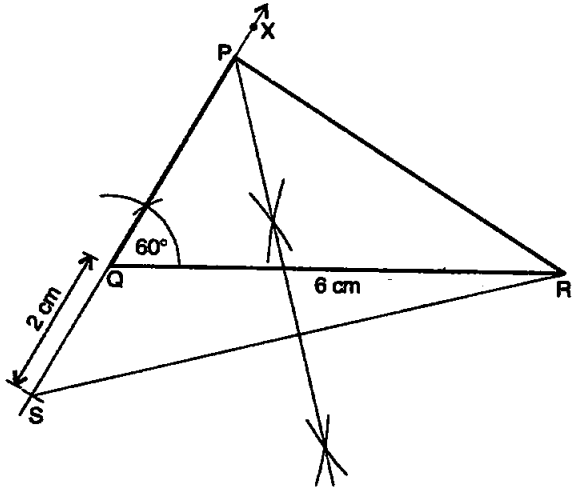
Then, ΔABC is the required triangle.

3. *Construct a triangle PQR in which QR = 6 cm, $\angle Q$ = 60° and PR – PQ = 2 cm.*

Sol. Steps of construction:

(*i*) Draw a line segment QR of length 6 cm.

(*ii*) Make an angle, say XQR, of measure 60° at the end Q of QR



(*iii*) Cut a line segment QS of length 2 cm from PQ produced.

(*iv*) Join SR and draw the perpendicular bisector of it to intersect the QX at P.

(*v*) Join PR.

Then, ΔPQR is the required triangle.

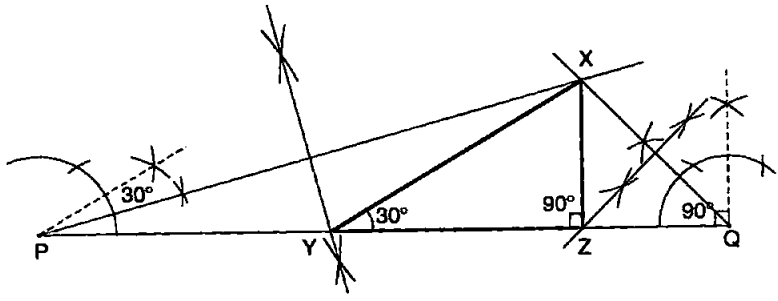
4. *Construct a triangle XYZ in which $\angle Y$ = 30°, $\angle Z$ = 90° and XY + YZ + ZX = 11 cm.*

Sol. Steps of construction:

(*i*) Draw a line segment PQ of length 11 cm.

(*ii*) Draw angles of 30° at P and 90° at Q on the same side of PQ.

(*iii*) Bisect these angles. Let the bisectors intersect each other at a point X.



(*iv*) Draw perpendicular bisectors of PX and QX. Let these bisectors intersect the line segment PQ at Y and Z respectively.

(*v*) Join XY and XZ.

Then, ΔXYZ is the required triangle.

5. *Construct a right triangle whose base is 12 cm and sum of its hypotenuse and other side is 18 cm.*

Sol. Steps of construction:

(*i*) Draw a line segment BC of length 12 cm.

(*ii*) Make an angle BCD of 90° at C.

(*iii*) Cut a line segment CE of length 18 cm.

(*iv*) Join BE and draw the perpendicular bisector of it. Let the bisector intersect CE at A.

(*v*) Join AB.

Then, ΔABC is the required triangle.