# **Study** Material

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# Exercise (11.1)

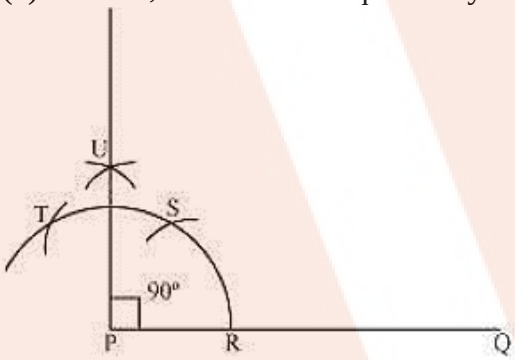
**Question 1:**

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

**Solution 1:**

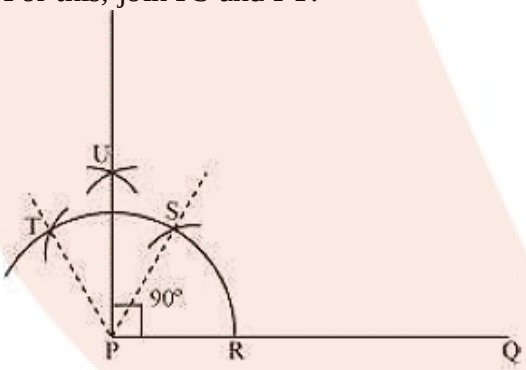
The below given steps will be followed to construct an angle of 90°.

(i) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.
(ii) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.
(iii) Taking S as centre and with the same radius as before, draw an arc intersecting the arc at T (see figure).
(iv) Taking S and T as centre, draw an arc of same radius to intersect each other at U.
(v) Join PU, which is the required ray making 90° with the given ray PQ.




**Justification of Construction:**

We can justify the construction, if we can prove ∠UPQ = 90°.
For this, join PS and PT.




We have, ∠SPQ = ∠TPS = 60°. In (iii) and (iv) steps of this construction, PU was drawn as the bisector of ∠TPS.

$$\therefore \angle UPS = \frac{1}{2}\angle TPS = \frac{1}{2}\times 60° = 30°$$

Also, ∠UPQ = ∠SPQ + ∠UPS
= 60° + 30°
= 90°

# Study Materials

**Question 2:**

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

**Solution 2:**

The below given steps will be followed to construct an angle of 45°.

(i) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.

(ii) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.

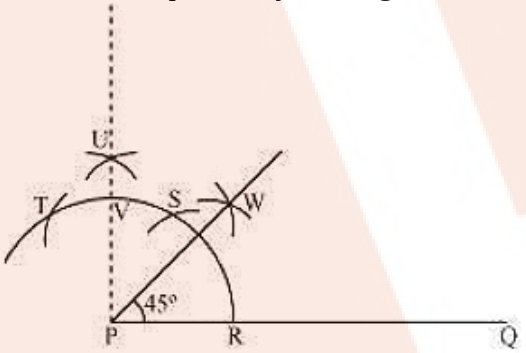
(iii) Taking S as centre and with the same radius as before, draw an arc intersecting the arc at T (see figure).

(iv) Taking S and T as centre, draw an arc of same radius to intersect each other at U.

(v) Join PU. Let it intersect the arc at point V.

(vi) From R and V, draw arcs with radius more than $\frac{1}{2}$RV to intersect each other at W. Join PW.

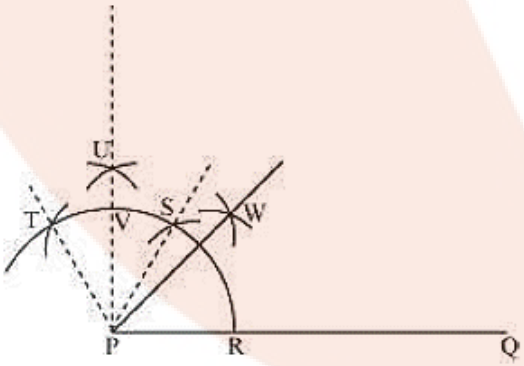
PW is the required ray making 45° with PQ.




**Justification of Construction:**

We can justify the construction, if we can prove ∠WPQ = 45°.

For this, join PS and PT.




We have, ∠SPQ = ∠TPS = 60°. In (iii) and (iv) steps of this construction, PU was drawn as the bisector of ∠TPS.

$$\therefore \angle UPS = \frac{1}{2}\angle TPS = \frac{1}{2}\times 60° = 30°$$

Also, ∠UPQ = ∠SPQ + ∠UPS
= 60° + 30°
= 90°
In step (vi) of this construction, PW was constructed as the bisector of ∠UPQ.

$\therefore \angle WPQ = \frac{1}{2}\angle UPQ = \frac{90°}{2} = 45°$

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**Question 3:**

Construct the angles of the following measurements:

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

**Solution 3 :**

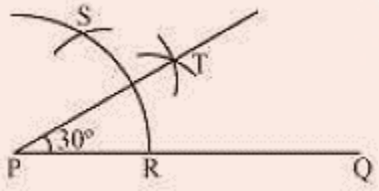
(i) 30°

The below given steps will be followed to construct an angle of 30°.

***Step* I:** Draw the given ray PQ. Taking P as centre and with some radius, draw an arc of a circle which intersects PQ at R.

***Step* II:** Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at point S.

***Step* III:** Taking R and S as centre and with radius more than $\frac{1}{2}$RS, draw arcs to intersect each other at T. Join PT which is the required ray making 30° with the given ray PQ.




(ii) $22\frac{1}{2}°$

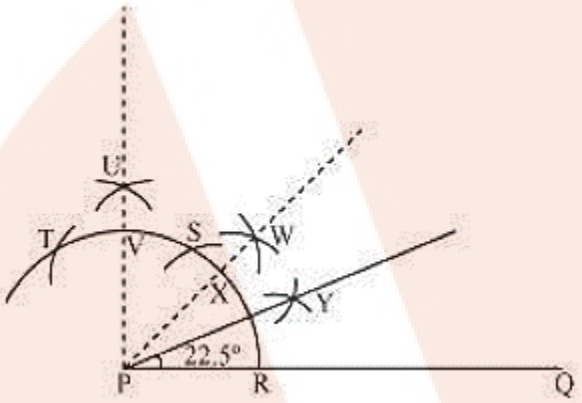
The below given steps will be followed to construct an angle of $22\frac{1}{2}°$.

(1) Take the given ray PQ. Draw an arc of some radius, taking point P as its centre, which intersects PQ at R.
(2) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.
(3) Taking S as centre and with the same radius as before, draw an arc intersecting the arc at T (see figure).
(4) Taking S and T as centre, draw an arc of same radius to intersect each other at U.
(5) Join PU. Let it intersect the arc at point V.

(6) From R and V, draw arcs with radius more than $\frac{1}{2}$RV to intersect each other at W. Join PW.

(7) Let it intersect the arc at X. Taking X and R as centre and radius more than $\frac{1}{2}$RX, draw arcs to intersect each other at Y.

Joint PY which is the required ray making $22\frac{1}{2}°$ with the given ray PQ.




(iii) 15°

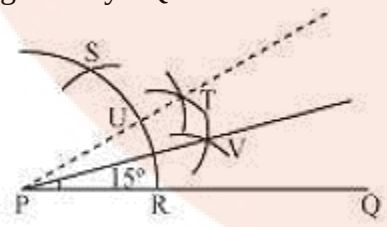
The below given steps will be followed to construct an angle of 15°.

*Step* I: Draw the given ray PQ. Taking P as centre and with some radius, draw an arc of a circle which intersects PQ at R.

*Step* II: Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at point S.

*Step* III: Taking R and S as centre and with radius more than $\frac{1}{2}$RS, draw arcs to intersect each other at T. Join PT.

*Step* IV: Let it intersect the arc at U. Taking U and R as centre and with radius more than $\frac{1}{2}$RU, draw an arc to intersect each other at V. Join PV which is the required ray making 15° with the given ray PQ.

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**Question 4:**

Construct the following angles and verify by measuring them by a protractor:

(i) 75° (ii) 105° (iii) 135°

**Solution 4:**

(i) 75°

The below given steps will be followed to construct an angle of 75°.

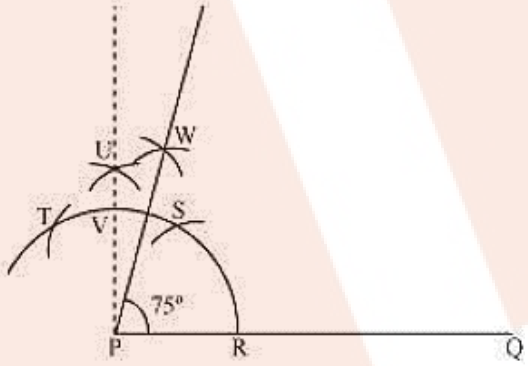
(1) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.

(2) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.

(3) Taking S as centre and with the same radius as before, draw an arc intersecting the arc at T (see figure).

(4) Taking S and T as centre, draw an arc of same radius to intersect each other at U.

(5) Join PU. Let it intersect the arc at V. Taking S and V as centre, draw arcs with radius more than $\frac{1}{2}$ SV. Let those intersect each other at W. Join PW which is the required ray making 75° with the given ray PQ.




The angle so formed can be measured with the help of a protractor. It comes to be 75º.

(ii) 105°

The below given steps will be followed to construct an angle of 105°.

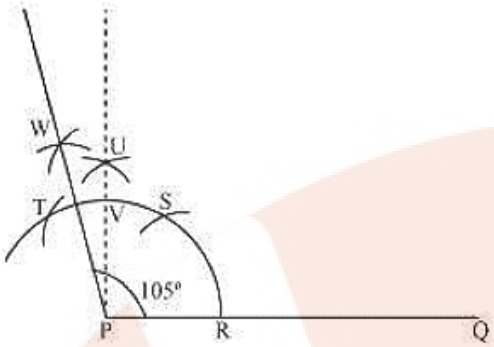
(1) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.

(2) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.

(3) Taking S as centre and with the same radius as before, draw an arc intersecting the arc at T (see figure).

(4) Taking S and T as centre, draw an arc of same radius to intersect each other at U.

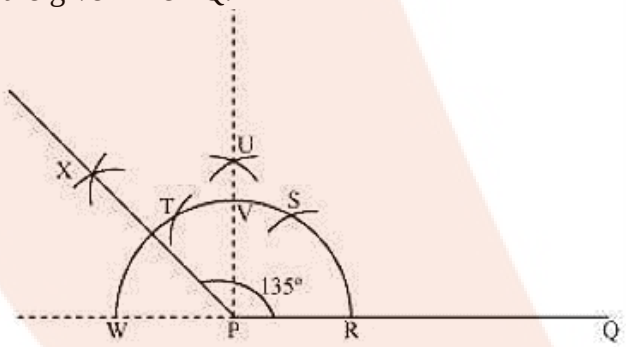
(5) Join PU. Let it intersect the arc at V. Taking T and V as centre, draw arcs with radius more than $\frac{1}{2}$ TV. Let these arcs intersect each other at W. Join PW which is the required ray making 105° with the given ray PQ.




The angle so formed can be measured with the help of a protractor. It comes to be 105º.

(iii) 135°

The below given steps will be followed to construct an angle of 135°.
(1) Take the given ray PQ. Extend PQ on the opposite side of Q. Draw a semi-circle of some radius taking point P as its centre, which intersects PQ at R and W.
(2) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.
(3) Taking S as centre and with the same radius as before, draw an arc intersecting the arc at T (see figure).
(4) Taking S and T as centre, draw an arc of same radius to intersect each other at U.
(5) Join PU. Let it intersect the arc at V. Taking V and W as centre and with radius more than $\frac{1}{2}$ VW, draw arcs to intersect each other at X. Join PX, which is the required ray making 135° with the given line PQ.




The angle so formed can be measured with the help of a protractor. It comes to be 135º.

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

**Solution 5:**

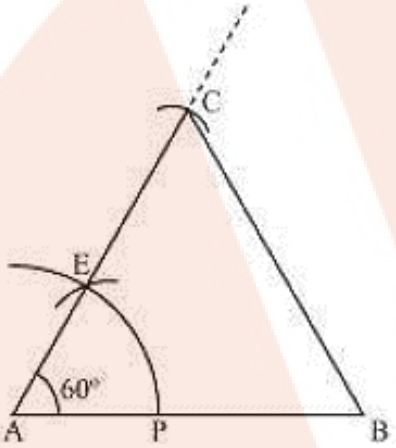
Let us draw an equilateral triangle of side 5 cm. We know that all sides of an equilateral triangle are equal. Therefore, all sides of the equilateral triangle will be 5 cm. We also know that each angle of an equilateral triangle is 60º.

The below given steps will be followed to draw an equilateral triangle of 5 cm side.

***Step* I:** Draw a line segment AB of 5 cm length. Draw an arc of some radius, while taking A as its centre. Let it intersect AB at P.

***Step* II:** Taking P as centre, draw an arc to intersect the previous arc at E. Join AE.

***Step* III:** Taking A as centre, draw an arc of 5 cm radius, which intersects extended line segment AE at C. Join AC and BC. $\Delta ABC$ is the required equilateral triangle of side 5 cm.




**Justification of Construction:**

We can justify the construction by showing ABC as an equilateral triangle i.e., AB = BC = AC = 5 cm and $\angle A = \angle B = \angle C = 60°$.

In $\Delta ABC$, we have AC = AB = 5 cm and $\angle A = 60°$.

Since AC = AB,

$\angle B = \angle C$ (Angles opposite to equal sides of a triangle)

In $\Delta ABC$,

$\angle A + \angle B + \angle C = 180°$ (Angle sum property of a triangle)

$60° + \angle C + \angle C = 180°$

$60° + 2\angle C = 180°$

$2\angle C = 180° - 60° = 120°$

$\therefore \angle C = 60°$

$\angle B = \angle C = 60°$

We have, $\angle A = \angle B = \angle C = 60°$ ... (1)

$\angle A = \angle B$ and $\angle A = \angle C$

$\angle BC = AC$ and $BC = AB$ (Sides opposite to equal angles of a triangle)

$\angle AB = BC = AC = 5$ cm ... (2)

From Equations (1) and (2), $\Delta ABC$ is an equilateral triangle.

**Question 1:**

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

**Solution 1:**

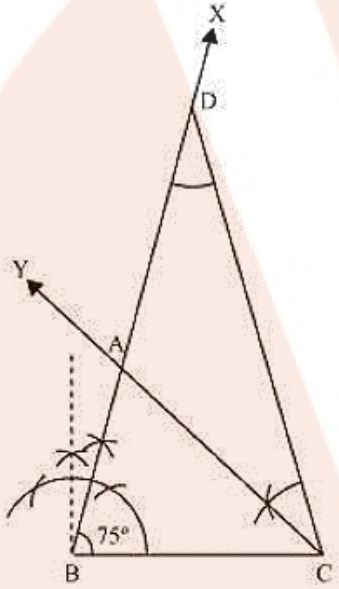
The below given steps will be followed to construct the required triangle.

**Step I:** Draw a line segment BC of 7 cm. At point B, draw an angle of 75°, say ∠XBC.

**Step II:** Cut a line segment BD = 13 cm (that is equal to AB + AC) from the ray BX.

**Step III:** Join DC and make an angle DCY equal to ∠BDC.

**Step IV:** Let CY intersect BX at A. ΔABC is the required triangle.

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**Question 2:**

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

**Solution 2:**

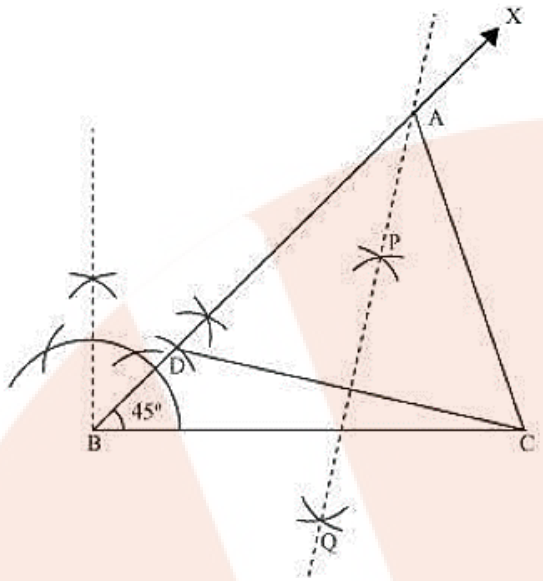
The below given steps will be followed to draw the required triangle.

**Step I:** Draw the line segment BC = 8 cm and at point B, make an angle of 45°, say ∠XBC.

**Step II:** Cut the line segment BD = 3.5 cm (equal to AB − AC) on ray BX.

**Step III:** Join DC and draw the perpendicular bisector PQ of DC.

**Step IV:** Let it intersect BX at point A. Join AC. ΔABC is the required triangle.

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**Question 3:**

Construct a triangle PQR in which QR = 6 cm, ∠Q = 60° and PR − PQ = 2 cm

**Solution 3:**

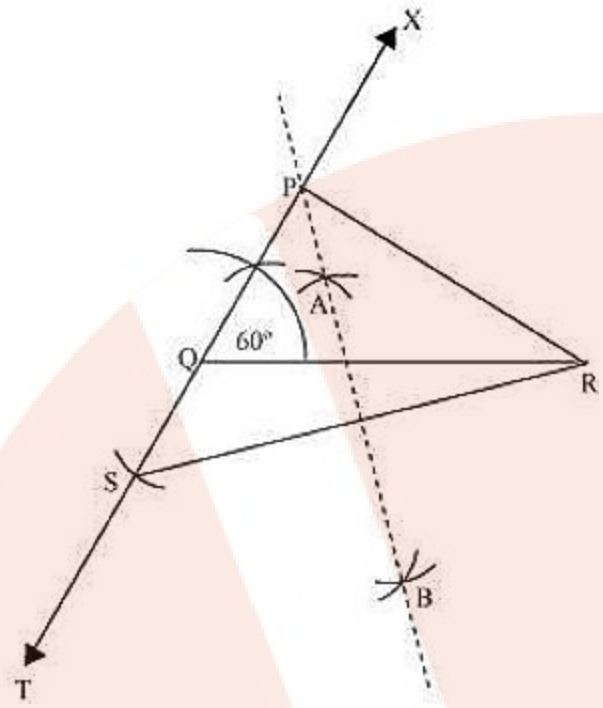
The below given steps will be followed to construct the required triangle.

**Step I:** Draw line segment QR of 6 cm. At point Q, draw an angle of 60°, say ∠XQR.

**Step II:** Cut a line segment QS of 2 cm from the line segment QT extended in the opposite side of line segment XQ. (As PR > PQ and PR − PQ = 2 cm). Join SR.

**Step III:** Draw perpendicular bisector AB of line segment SR. Let it intersect QX at point P. Join PQ, PR.

ΔPQR is the required triangle.




**Question 4:**

Construct a triangle XYZ in which ∠Y = 30°, ∠Z = 90° and XY + YZ + ZX = 11 cm.

**Solution 4:**

The below given steps will be followed to construct the required triangle.

**Step I:** Draw a line segment AB of 11 cm.
(As XY + YZ + ZX = 11 cm)

**Step II:** Construct an angle, ∠PAB, of 30° at point A and an angle, ∠QBA, of 90° at point B.

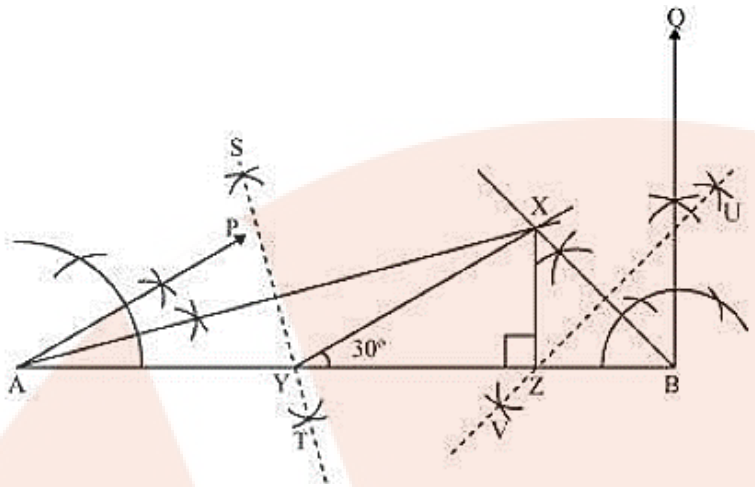
**Step III:** Bisect ∠PAB and ∠QBA. Let these bisectors intersect each other at point X.

**Step IV:** Draw perpendicular bisector ST of AX and UV of BX.

**Step V:** Let ST intersect AB at Y and UV intersect AB at Z.

Join XY, XZ.

$\Delta XYZ$ is the required triangle.

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**Question 5:**

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

**Solution 5:**

The below given steps will be followed to construct the required triangle.

**Step I:** Draw line segment AB of 12 cm. Draw a ray AX making 90° with AB.

**Step II:** Cut a line segment AD of 18 cm (as the sum of the other two sides is 18) from ray AX.

**Step III:** Join DB and make an angle DBY equal to ADB.

**Step IV:** Let BY intersect AX at C. Join AC, BC.

$\Delta$ABC is the required triangle.