NCERT Solutions for Class 9 Maths Chapter 11 – Constructions

Chapter 11 - Constructions Exercise Ex. 11.1

Solution 1

Following are the steps of construction:

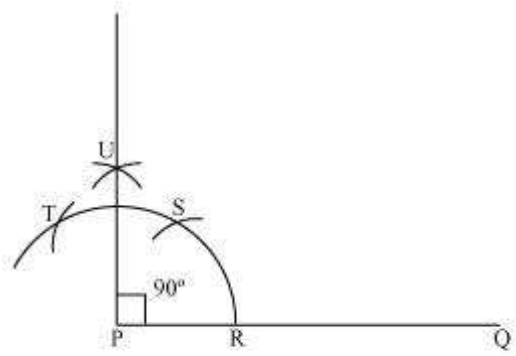
(i) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersect PQ at R.

(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, drawn an arc intersecting the arc at T (see figure)

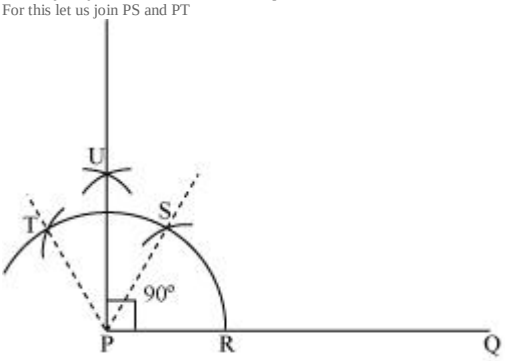
(iv) Taking S and T as centre, draw arc of same radius to intersect each other at U.

(v) Join PU, which is the required ray making 90° with given ray PQ.



Justification of Construction:

We can justify the construction, if we can prove $\angle UPQ = 90^\circ$.
For this let us join PS and PT



We have $\angle SPQ = \angle TPS = 60^\circ$. In (iii) and (iv) steps of this construction, we have drawn PU as the bisector of $\angle TPS$.

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

$$\begin{aligned} \text{Now, } \angle UPQ &= \angle SPQ + \angle UPS \\ &= 60^\circ + 30^\circ \\ &= 90^\circ \end{aligned}$$

Solution 2

The steps of construction are as follows:

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

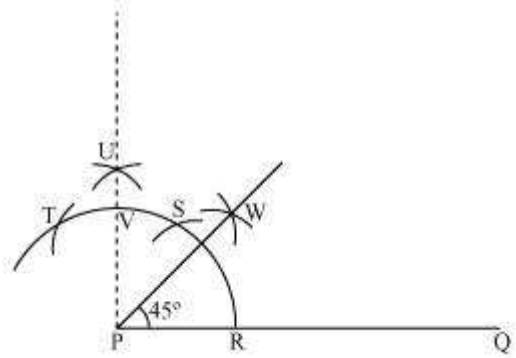
(iii)Taking S as centre and with the same radius as before, drawn an arc intersecting the arc at T (see figure)

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

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

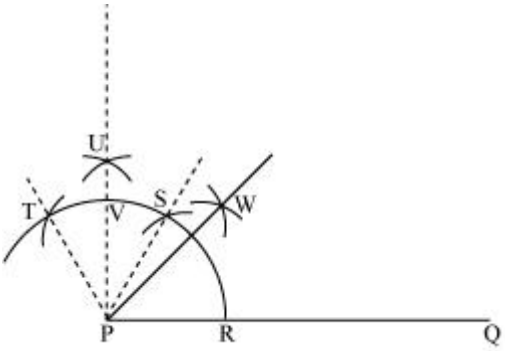
$$\frac{1}{2}$$

(vi) Now from R and V draw arcs with other at W with radius more than RV to intersect each other. PW is the required ray making 45° with PQ.



Justification of Construction:

To justify the construction, we have to prove $\angle WPQ = 45^\circ$. Join PS and PT



We have $\angle SPQ = \angle TPS = 60^\circ$. In (iii) and (iv) steps of this construction, we have drawn PU as the bisector of $\angle TPS$.

$$\therefore \angle UPS = \frac{1}{2}\angle TPS = \frac{60^0}{2} = 30^0$$

Now, $\angle UPQ = \angle SPQ + \angle UPS$
$= 60^\circ + 30^\circ$
$= 90^\circ$

In step (vi) of this construction, we constructed PW as the bisector of $\angle UPQ$

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

Solution 3
(i) 30°

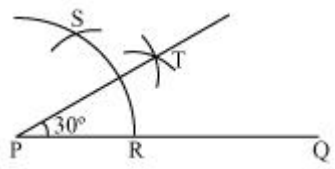
The steps of construction are as follows:

Step I: Draw the given ray PQ. Now 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.

$$\frac{1}{2}$$

Step III: Now taking R and S as centre and with radius more than RS draw arcs to intersect each other at T. Join PT which is the required ray making 30° with the given ray PQ.



$\frac{1^\circ}{2}$

(ii) 22

The steps of construction are as follows:

(i) Take the given ray PQ. Draw an arc of some radius, taking point P as its centre, which intersect 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, drawn an arc intersecting the arc at T (see figure)

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

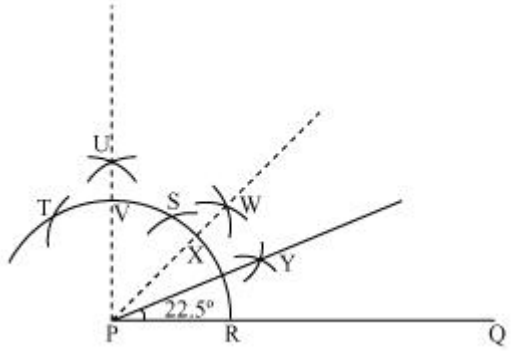
(v) Join PU. Let it intersect arc at point V.

$\frac{1}{2}$

(vi) Now from R and V draw arcs with radius more than RV to intersect each other at W. Join PW.

$\frac{1}{2}$ $\frac{1^\circ}{2}$

(vii) Let it intersects the arc at X. Taking X and R as centre and radius more than RX draw arcs to intersect each other at Y. Joint PY which is the required ray making 22 with the given ray PQ.



(iii) 15^0

The steps of construction are as follows:

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

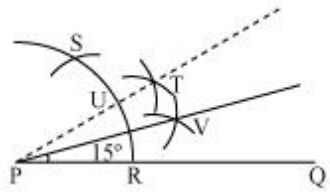
Step II: Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at point S.

$\frac{1}{2}$

Step III: Now taking R and S as centre and with radius more than RS draw arcs to intersect each other at T. Join PT

$\frac{1}{2}$

Step IV: Let is intersects the arc at U. Now taking U and R as centre and with radius more than RU draw arc to intersect each other at V. Join PV which is the required ray making 15^o with given ray PQ.



Solution 4

(A) 75°
The steps of construction are as follows:

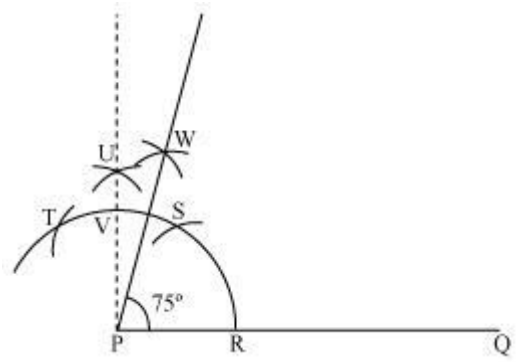
(i) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersect PQ at R.

(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, drawn an arc intersecting the arc at T (see figure)

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

(v) Join PU. Let it intersects the arc at V. Now 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.



Now, we can measure the angle so formed with the help of a protractor. It comes to be 75°.

(B) 105°

The steps of construction are as follows:

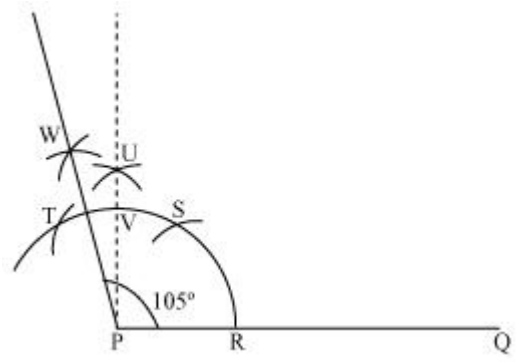
(i) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersect PQ at R.

(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, drawn an arc intersecting the arc at T (see figure)

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

(v) Join PU. Let it intersects the arc at V. Now 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.



Now, we can measure the angle so formed with the help of a protractor. It comes to be 105°.

(C) 135°
The steps of construction are as follows:

(i) Take the given ray PQ. Extend PQ on opposite side of Q. Draw a semicircle of some radius taking point P as its centre, which intersect PQ at R and W.

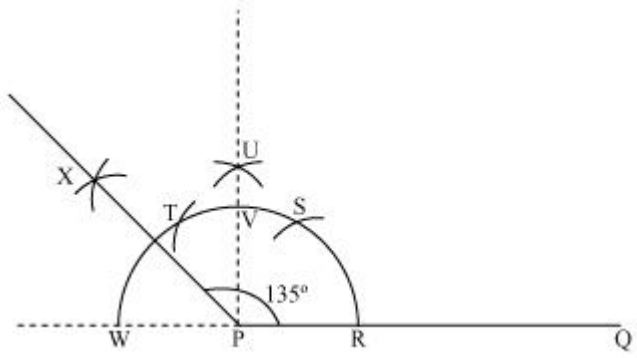
(ii) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.

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

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

$\frac{1}{2}$

(v) Join PU. Let it intersect the arc at V. Now taking V and W as centre and with radius more than VW draw arcs to intersect each other at X. Join PX which is the required ray making 135° with the given line PQ.



Now, we can measure the angle so formed with the help of a protractor. It comes to be 135°.

Solution 5

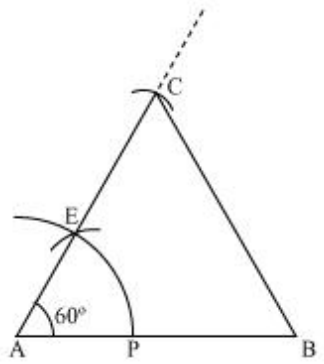
We know that all sides of an equilateral triangle are equal. So, all sides of this equilateral triangle will be 5 cm.
Also, each angle of an equilateral triangle is 60.

The steps of construction are as follows:

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: Now 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. ABC is the required equilateral triangle of side 5 cm.



Justification of Construction:

To justify the construction, we have to prove that ABC is an equilateral triangle i.e.AB = BC = AC = 5 cm and A = B = C = 60°.

Now, in ABC, we have AC = AB = 5 cm and A = 60°
Since, AC = AB, we have

B = C (angles opposite to equal sides of a triangle)

Now, in ABC

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

$\Rightarrow$ 60° + C + C = 180°

$\Rightarrow$ 60° + 2 C = 180°

$\Rightarrow$ 2 C = 180° - 60° = 120°

$\Rightarrow$ C = 60°

$\therefore \angle B = \angle C = 60°$

Now, we have A = B = C = 60^o ... (1)

$\Rightarrow$ A = B and A = C

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

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

$\triangle$

Equations (1) and (2) show that the ABC is an equilateral triangle.

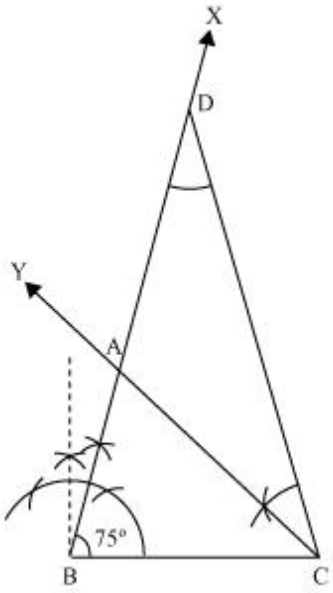
Chapter 11 - Constructions Exercise Ex. 11.2

Solution 1

The steps of construction for the required triangles are as follows:

Step I: Draw a line segment BC of 7 cm. At point B draw an angle of 75^o 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



$\triangle$

Step IV: Let CY intersects BX at A. ABC is the required triangle.

Solution 2

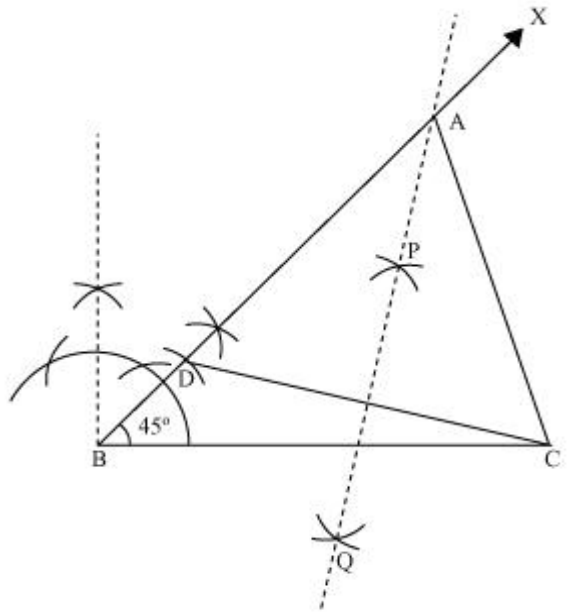
The steps of construction for the required triangles are as follows:

Step I: Draw the line segment BC = 8 cm and at point B make an angle of 45^o 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.

$\triangle$

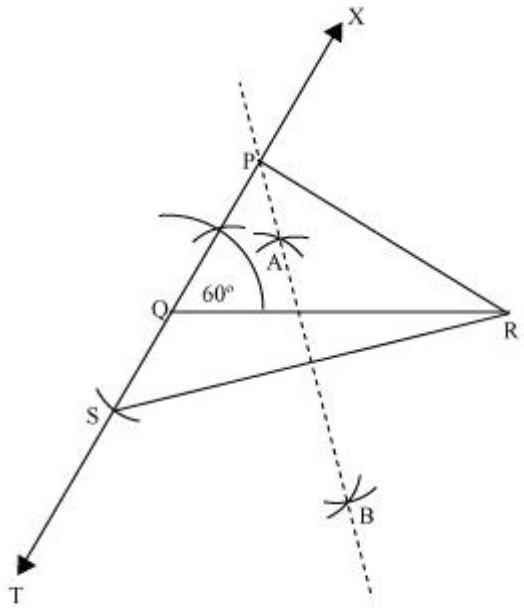
Step IV: Let it intersect BX at point A. Join AC. ABC is the required triangle.



Solution 3
The steps of construction for the required triangles are as follows:

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 an opposite side of line segment XQ. (As PR> PQ and PR - PQ = 2cm). Join SR.

Step III: Draw perpendicular bisector AB of line segment SR. Let it intersect QX at point P. Join PQ, PR. PQR is the required triangle.



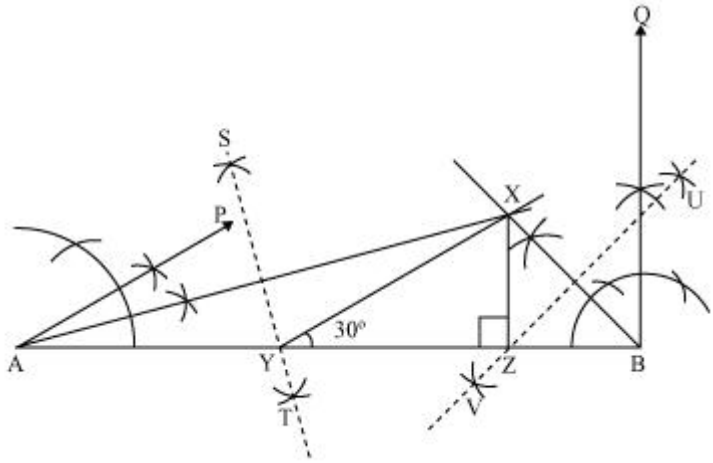
Solution 4
The steps of construction for the required triangles are as follows:

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 intersects AB at Y and UV intersects AB at Z.Join XY, XZ. XYZ is the required triangle.



Solution 5

The steps of construction for the required triangles are as follows:

Step I: Draw line segment AB of 12 cm. Draw a ray AX making 90^{o} with AB.

Step II: Cut a line segment AD of 18 cm. (As sum of other two side is 18) from ray AX.

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

△

Step IV: Let BY intersects AX at C. Join AC, BC. ABC is the required triangle.