Class IX Chapter 11 – Constructions Maths

Exercise 11.1 Question

1:

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

Answer:

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

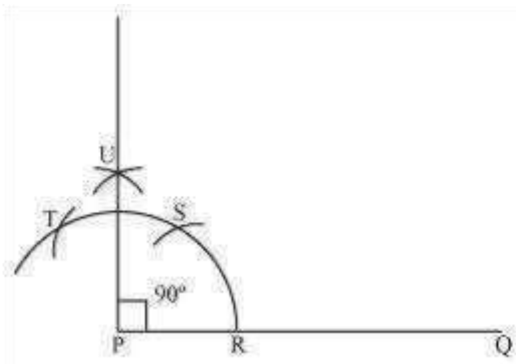
(i) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.

(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.

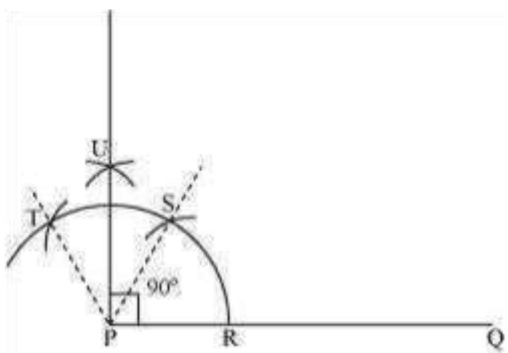
(v) Join PU, which is the required ray making 90° with the given ray PQ.



Justification of Construction:

We can justify the construction, if we can prove $\angle UPQ = 90^\circ$.

For this, join PS and PT.



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

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

Also, $\angle UPQ = \angle SPQ + \angle UPS$

$= 60^\circ + 30^\circ$

$= 90^\circ$

Question 2:

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

Answer:
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).

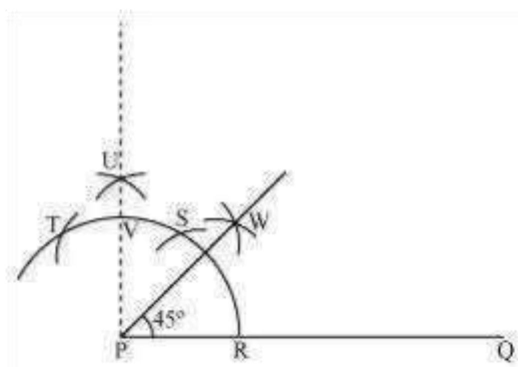
(iv) Taking S and T as centre, draw an arc of same radius to intersect each other at U.

(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.

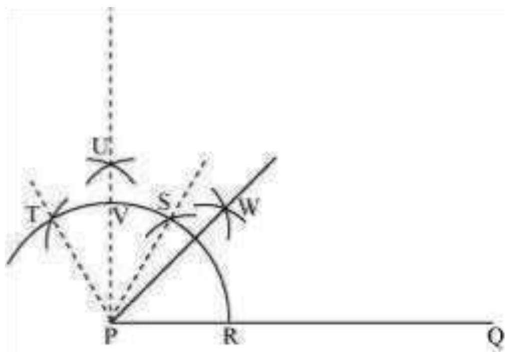
PW is the required ray making 45° with PQ.



Justification of Construction:

We can justify the construction, if we can prove $\angle$WPQ = 45°.

For this, join PS and PT.



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

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

Also, $\angle$UPQ = $\angle$SPQ + $\angle$UPS

= 60° + 30°

= 90°

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

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

Question 3:

Construct the angles of the following measurements:

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

(i)30°

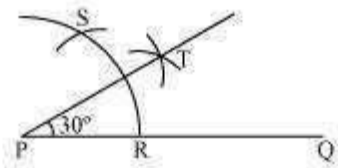
The below given steps will be followed to construct an angle of 30°.

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.



$22\frac{1}{2}°$
(ii)

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.

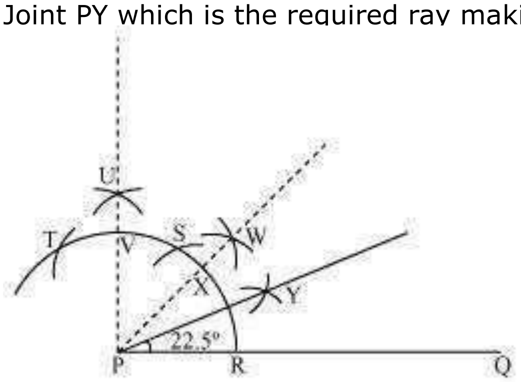
(6) From R and V, draw arcs with radius more than $\frac{1}{2}$ RV to intersect each other at W.

Join PW.

(7) Let it intersect the arc at X. Taking X and R as centre and radius more than $\frac{1}{2}$ of a circle which intersects PQ at R.

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.



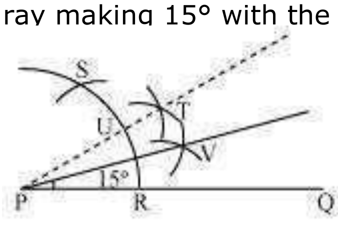
(iii) 15°

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
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 $\frac{1}{2}$

ray making 15° with the given ray PQ.



Question 4:
other at V. RU, draw an arc to intersect each
Join PV which is the required

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

(i) 75° (ii) 105° (iii) 135° Answer:

(i) 75°

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

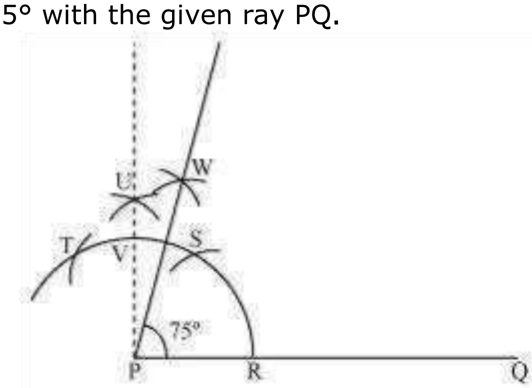
(1) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.

(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°.

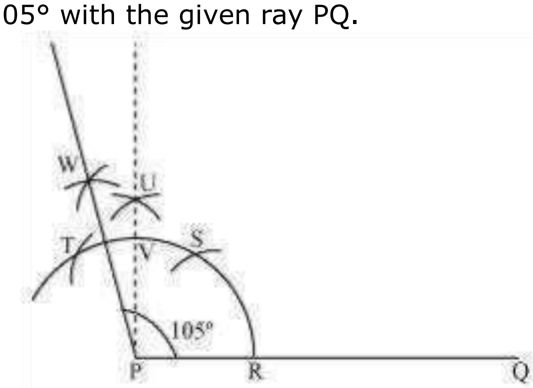
(1) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.

(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°

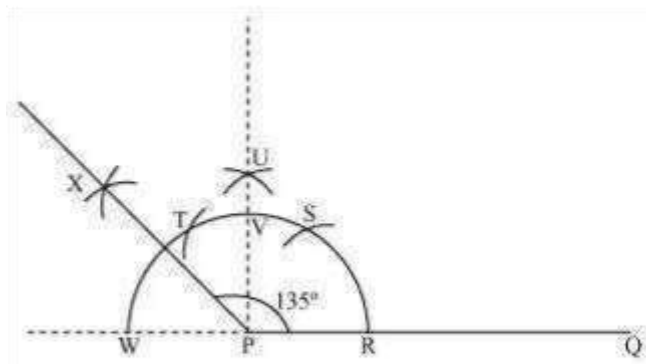
The below given steps will be followed to construct an angle of 135°.

(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.

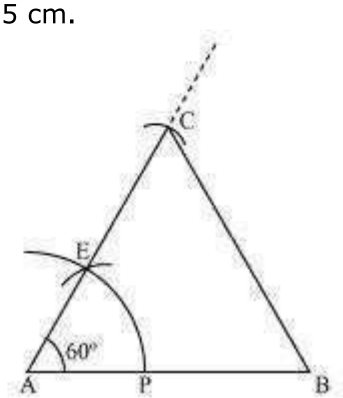
Question 5:

Construct an equilateral triangle, given its side and justify the construction Answer:

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. ΔABC 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 ΔABC, 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 ΔABC,

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

$60° + \angle C + \angle C = 180°$

$60° + 2\angle C = 180°$

$2\angle C = 180° - 60° = 120°$

$\angle C = 60°$

$\angle B = \angle C = 60°$

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

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

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

AB = BC = AC = 5 cm ... (2)

From equations (1) and (2), ΔABC is an equilateral triangle.

Exercise 11.2

Question 1:

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

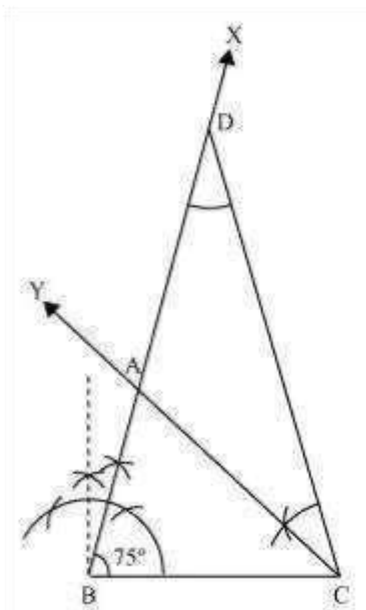
Answer:
The below given steps will be followed to construct the required triangle.

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.



Question 2:

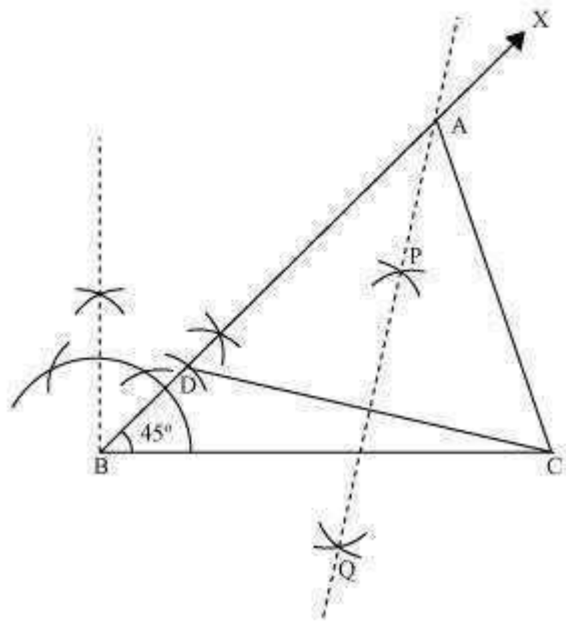
Construct a triangle ABC in which BC = 8 cm, ∠B = 45° and AB − AC = 3.5 cm.

Answer:

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.



Question 3:

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

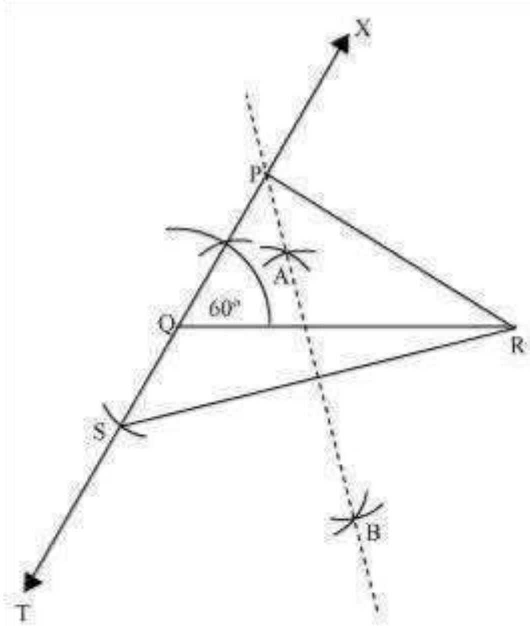
Answer:

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.



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

Answer:

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.

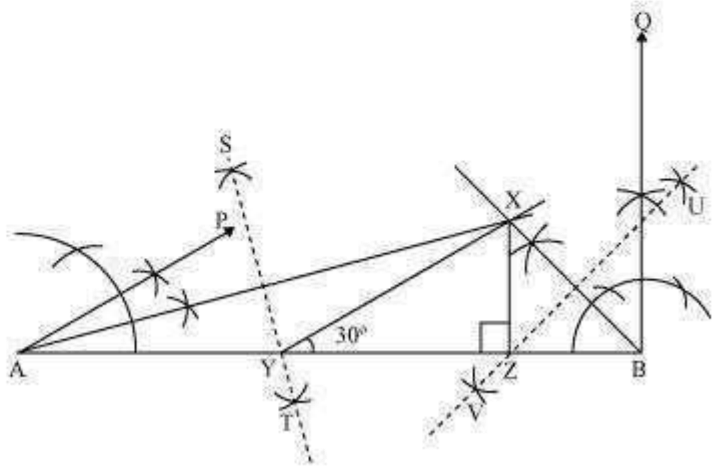
Step III: Bisect ∠PAB and ∠QBA. Let these bisectors intersect each other at point X.

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.

ΔXYZ is the required triangle.



Question 5:

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

Answer:

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

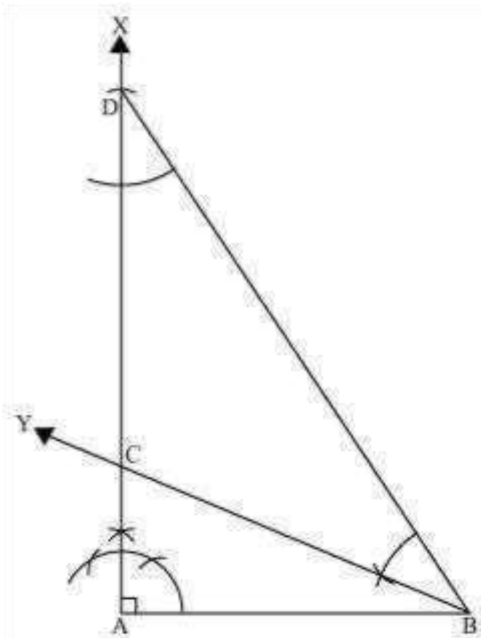
Step I: Draw line segment AB of 12 cm. Draw a ray AX making 90° with AB. Step II:

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.

ΔABC is the required triangle.


X
D
Y
C
A
B