

Class IX Chapter 11 – Constructions

Maths

Exercise 11.1 Question

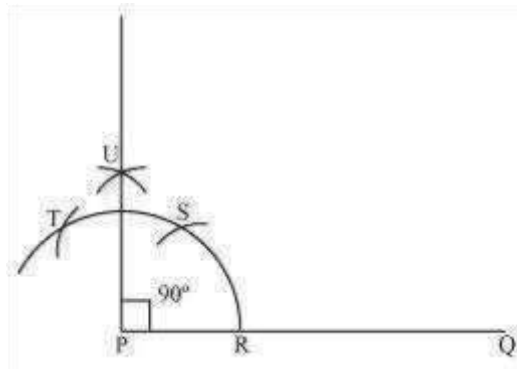
1:

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° .

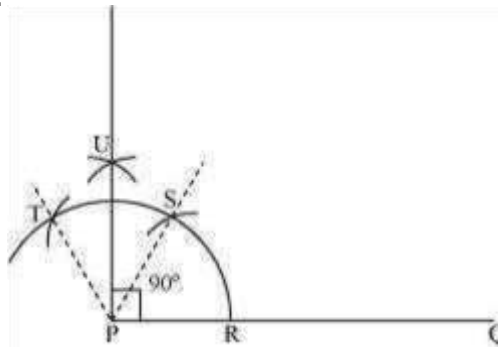
- (i) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.
- (ii) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.
- (iii) Taking S as centre and with the same radius as before, draw an 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:

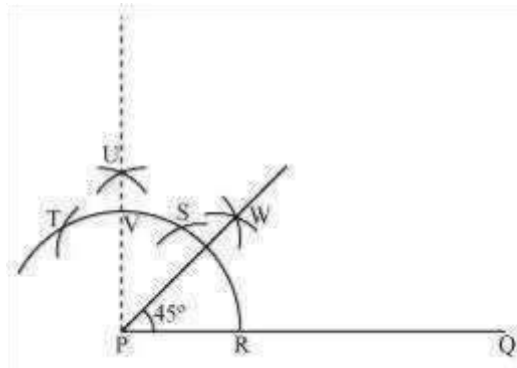
Construct an angle of 45° at the initial point of a given ray and justify the construction.

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.

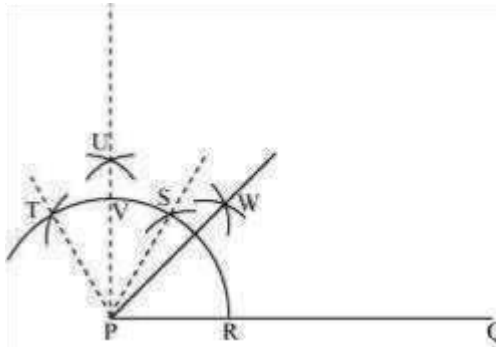
PW is the required ray making 45° with PQ.



Justification of Construction:

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

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 $\angle TPS$.

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

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

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

$$= 90^\circ$$

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

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

Question 3:

Construct the angles of the following measurements:

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

(i) 30°

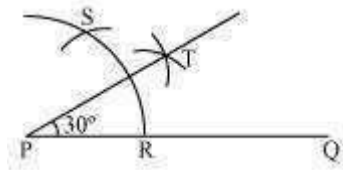
The below given steps will be followed to construct an angle of 30° .

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.



(ii) $22\frac{1}{2}^\circ$

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

- (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.

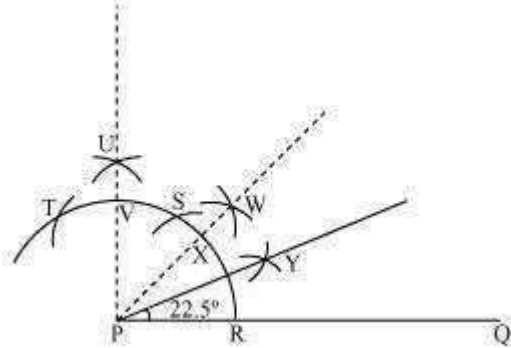
Join PW.

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

RX, draw arcs to intersect each other at Y.

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

Join PY which is the required ray making $22\frac{1}{2}^{\circ}$ 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.

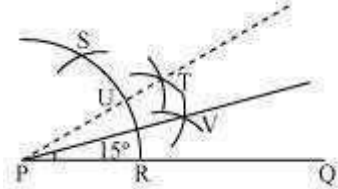
Step III: Taking R and S as centre and with radius more than $\frac{1}{2}RS$, draw arcs to intersect each other at T. Join PT.

Step IV: Let it intersect the arc at U. Taking U and R as centre and with radius more

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

than

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:

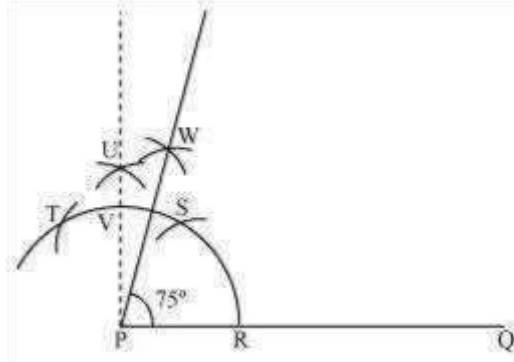
(i) 75° (ii) 105° (iii) 135° Answer:

(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.



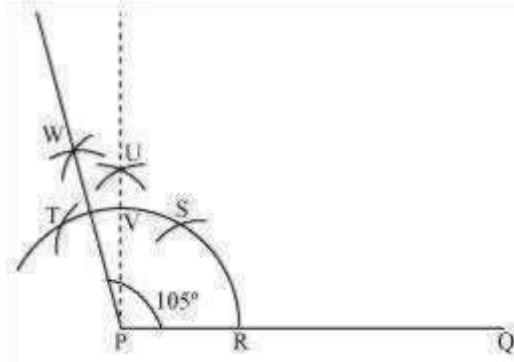
The angle so formed can be measured with the help of a protractor. It comes to be 75° .

(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 105° .

(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.

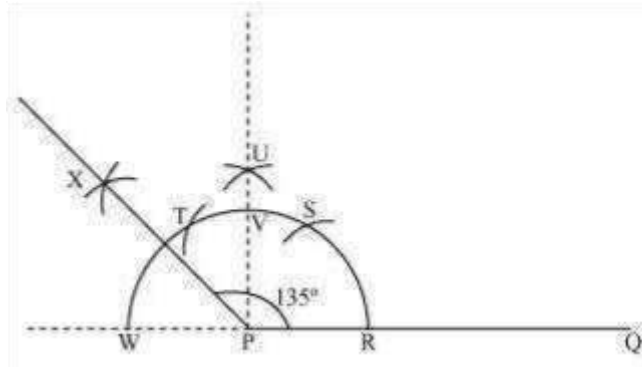
(3) Taking S as centre and with the same radius as before, draw an arc intersecting the arc at T (see figure).

(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

$\frac{1}{2}$

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 135° .

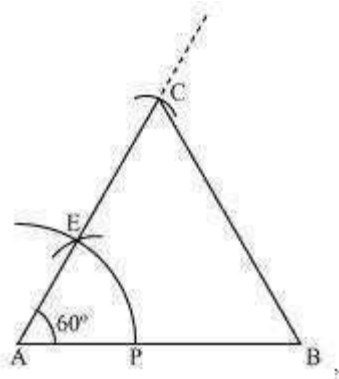
Question 5:

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 60° .

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. $\triangle ABC$ 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., $AB = BC = AC = 5 \text{ cm}$ and $\angle A = \angle B = \angle C = 60^\circ$.

In $\triangle ABC$, we have $AC = AB = 5 \text{ cm}$ and $\angle A = 60^\circ$.

Since $AC = AB$,

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

In $\triangle ABC$,

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

$60^\circ + \angle C + \angle C = 180^\circ$

$60^\circ + 2\angle C = 180^\circ$

$2\angle C = 180^\circ - 60^\circ = 120^\circ$

$\angle C = 60^\circ$

$\angle B = \angle C = 60^\circ$

We have, $\angle A = \angle B = \angle C = 60^\circ \dots (1)$

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

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

$AB = BC = AC = 5 \text{ cm} \dots (2)$

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

Exercise 11.2

Question 1:

Construct a triangle ABC in which $BC = 7$ cm, $\angle B = 75^\circ$ and $AB + AC = 13$ cm.

Answer:

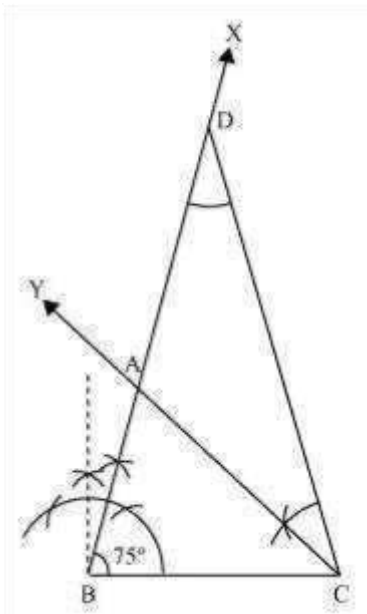
The below given steps will be followed to construct the required triangle.

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

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 $\angle BDC$.

Step IV: Let CY intersect BX at A. $\triangle ABC$ is the required triangle.



Question 2:

Construct a triangle ABC in which $BC = 8$ cm, $\angle B = 45^\circ$ and $AB - AC = 3.5$ cm.

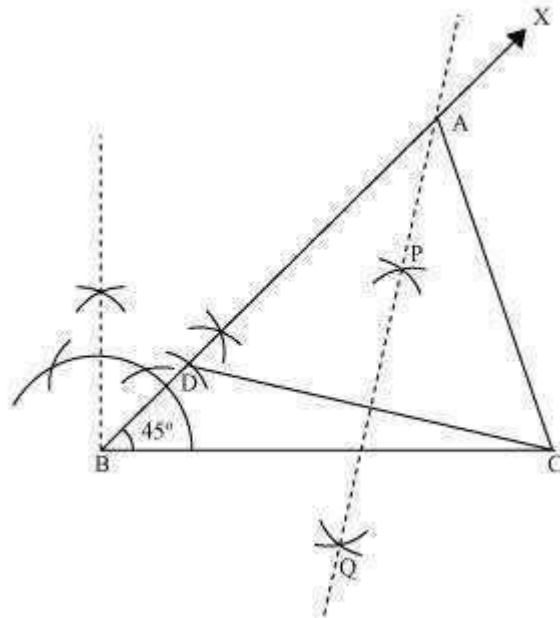
Answer:

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 $\angle XBC$.

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 . $\triangle ABC$ is the required triangle.



Question 3:

Construct a triangle PQR in which $QR = 6$ cm, $\angle Q = 60^\circ$ and $PR - PQ = 2$ cm

Answer:

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

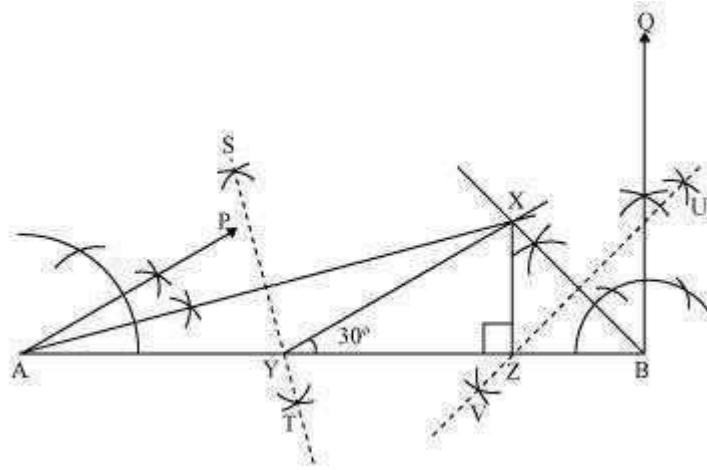
Step I: Draw line segment QR of 6 cm. At point Q , draw an angle of 60° , say $\angle XQR$.

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 .

$\triangle PQR$ 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.

$\triangle ABC$ is the required triangle.

