NCERT SOLUTIONS

CLASS - 9th

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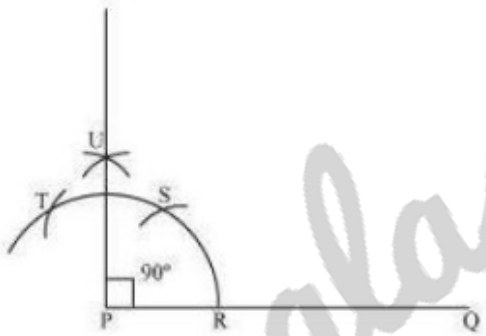
Class : 9th
Subject : Maths
Chapter : 11
Chapter Name : CONSTRUCTIONS

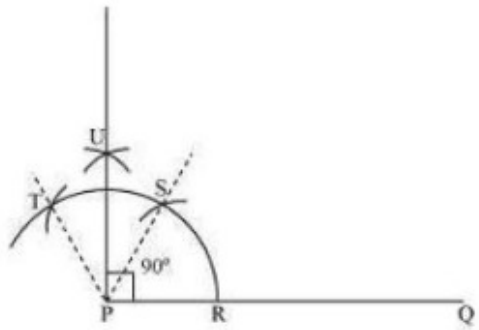
Exercise 11.1

Q1 Construct an angle of 900 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 90^0.
(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 att 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 PLJ, which is the required ray making 90^0 with the given ray PQ.



Justification of Construction:
We can justify the construction, if we can prove $\angle \mathrm{UPQ} = 90^\circ$
For this, join PS and PT.



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

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

Also, $\angle \mathrm{UPQ}=\angle \mathrm{SPQ}+\angle \mathrm{UPS}$

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

$=90^{\circ}$

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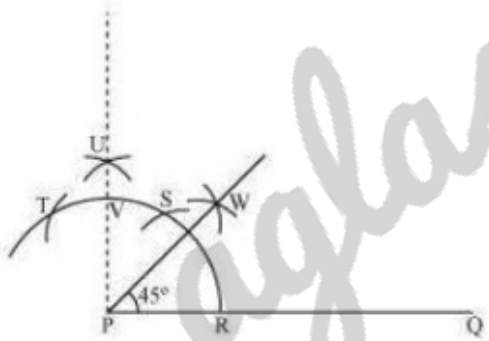
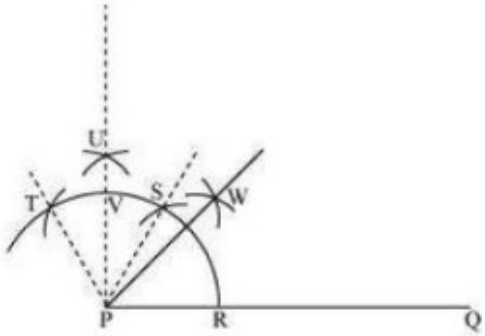
Q2 Construct an angle of 450 at the initial point of a given ray and justify the construction.

Answer. The below given steps will be followed to construct an angle of 45^0.
(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 1/2 RV to intersect each other at W. Join PW.
PW is the required ray making 45^0 with PQ.



Justification of Construction:
We can justify the construction, if we can prove $\angle \mathrm{WPQ}=45^{\circ}$
For this, join PS and PT.



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

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

$\text{Also, } \angle UPQ = \angle SPQ + \angle UPS$

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

$= 90^\circ$

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

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

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Q3 Construct the angles of the following measurements:

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

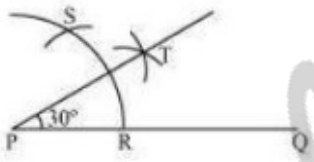
Answer. (i)30^0

The below given steps will be followed to construct an angle of 30^0.

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 2 RS, draw arcs to intersect each other at T. Join PT which is the required ray making 30^0 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).

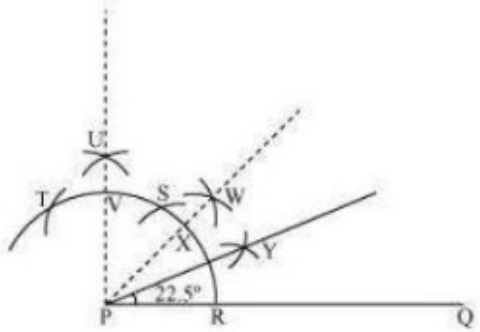
(4) Taking S and T as centre, draw an arc of same radius to intersect each other at U.

(5) Join 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 $22\frac{1}{2}\circ$ with the given ray PQ.



(iii) 15°

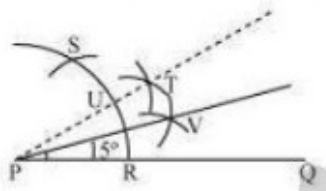
The below given steps will be followed to construct an angle of 15°.

Step I: Draw the given ray PQ. Taking P as centre and with some radius, draw an arc 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 Ill: Taking R and S as centre and with radius more than 1/2 RS, draw arcs to intersect each other at T. Join PT.

Step IV: Let it intersect the arc at U. Taking IJ and R as centre and with radius more than 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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Q4 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°.

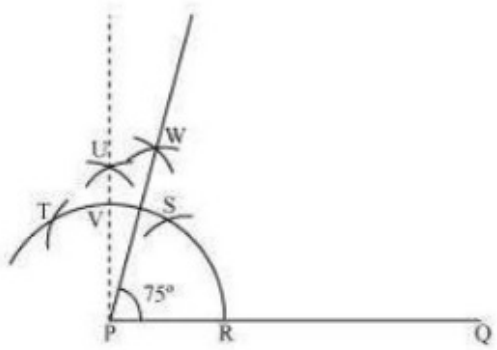
(1) Take the given ray PQ. Draw an arc of some radius taking point p as its centre, which intersects PQ at R.

(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).

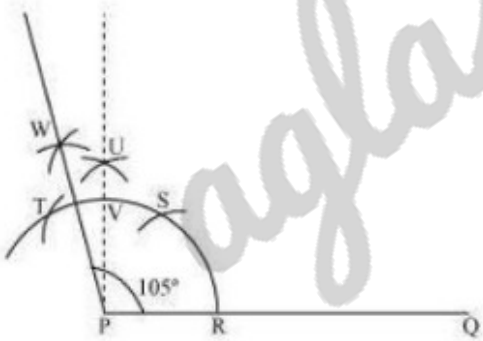
(4) Taking S and T as centre, draw an arc of same radius to intersect each other at U.

(5) Join PLI. Let it intersect the arc at V. Taking S and V as centre, draw arcs with radius more than 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°.

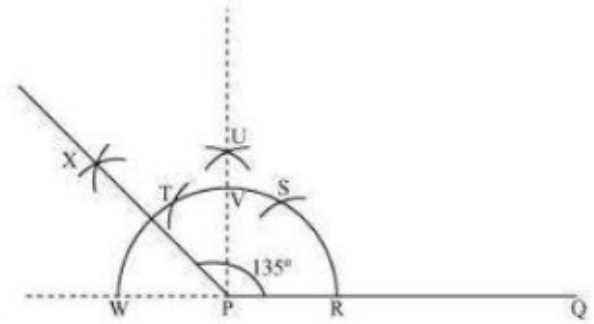
(ii) 105°
The below given steps will be followed to construct an angle of 105°
(1) Take the given ray PQ. Draw an arc of some radius taking point p as its centre, which intersects PQ at R.
(2) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at 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 PLI. Let it intersect the arc at V. Taking T and V as centre, draw arcs with radius more than 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 more than 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°.

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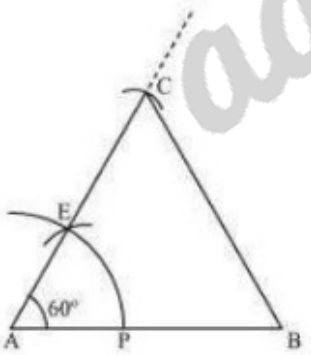
Q5 Construct an equilateral triangle, given its side and justify the construction.

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 Ill: 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 = $\mathrm{BC} = \mathrm{AC} = 5\mathrm{cm}$ and $\angle\mathrm{A} = \angle\mathrm{B} = \angle\mathrm{C} = 60^\circ$.

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

$\text{since } \mathrm{AC} = \mathrm{AB}$

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

$\text{In } \triangle ABC,$
$\angle A + \angle B + \square C = 180^\circ (\text{ Angle sum property of a triangle})$
$\square 60^\circ + \square C + \square C = 180^\circ$
$\square 60^\circ + 2\square C = 180^\circ$
$\square 2\square C = 180^\circ - 60^\circ = 120^\circ$
$\square\square C = 60^\circ$
$\square\square B = \square C = 60^\circ$
$\text{We have, } \square A = \square B = \square C = 60^\circ \ldots (1)$
$\square\square A = \square B \text{ and } \square A = \square C$
$\square \text{BC} = \text{AC and BC} = \text{AB} (\text{ Sides opposite to equal angles of a triangle})$
$\square \text{AB} = \text{BC} = \text{AC} = 5\text{cm} \ldots (2)$
from equations (1) and (2), $/Delta$ABC is an equilateral triangle.

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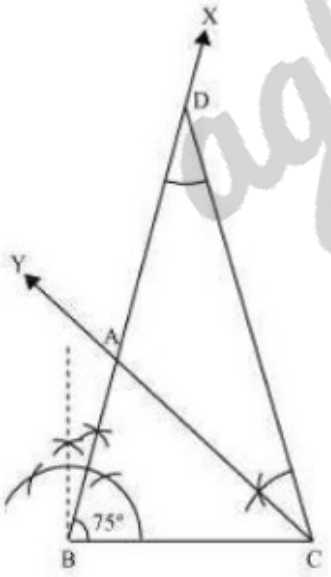
Exercise 11.2

Q1 Construct a triangle ABC in which BC = 7cm, ∠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 75^0, 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 3X at A. ΔABC is the required triangle.



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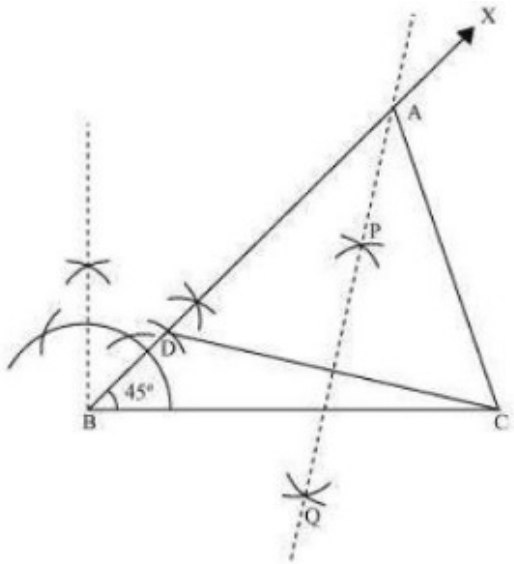
Q2 Construct a triangle ABC in which BC = 8cm, ∠B = 45° and AB – AC = 3.5 cm.

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 45^0, say □XBC.
Step II: Cut the line segment BD 3.5 cm (equal to AB - AC) on ray BX.
Step Ill: 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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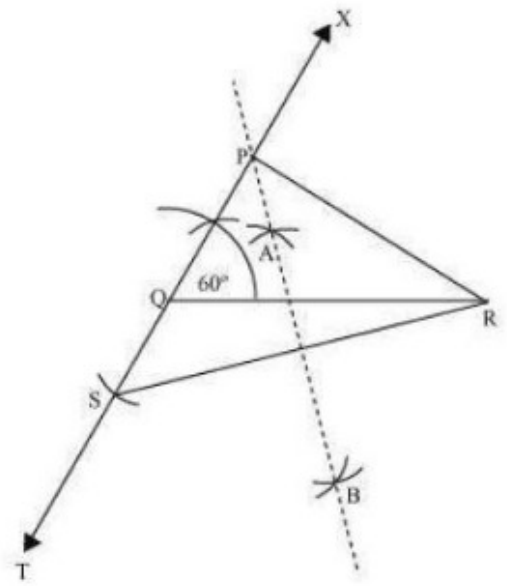
Q3 Construct a triangle PQR in which QR = 6cm, ∠Q = 60° and PR – PQ = 2cm.

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 60^0, say ΔXQR.
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 Ill: Draw perpendicular bisector AB of line segment SR. Let it intersect QX at point P. Join PQ, PR.
ΔPQR is the required triangle.



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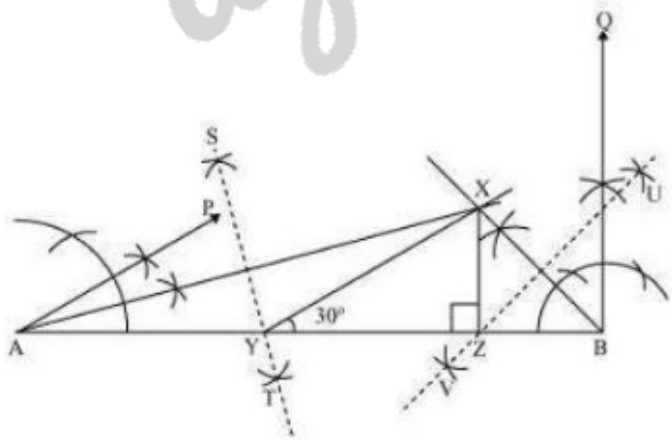
Q4 Construct a triangle XYZ in which ∠Y = 30°, ∠Z = 90° and XY + YZ + ZX = 11 cm.

Answer. The below given steps will be followed to construct the required triangle.
Step I: Draw a line segment AB of tl cm.
(As XY + YZ + ZX = 11 cm)
Step II: Construct an angle, □PAB, of 30^0 at point A and an angle, □QBA, of 90^0 at point 3.
Step Ill: 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 Ad at Y and UV intersect AB at Z.
W, XZ.
ΔXYZ is the required triangle.



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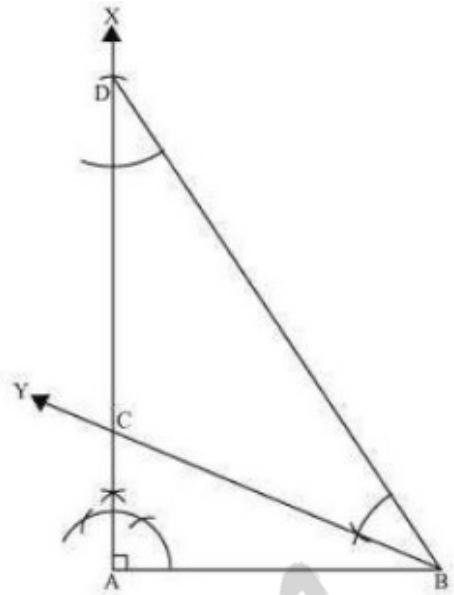
Q5 . Construct a right triangle whose base is 12cm and sum of its hypotenuse and other side is 18 cm.

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 90^0 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.
△ABC is the required triangle.



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