construction

11 Chapter

Exercise (11.1)

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

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

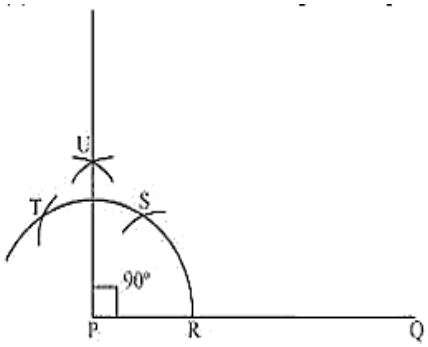
(i)Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.

(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).

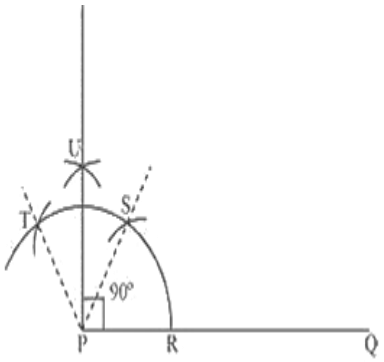
(iv)Taking S and T as centre, draw an arc of same radius to intersect each other at U.

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



Justification

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

$$\angle UPS = \frac{1}{2}\angle TPS$$

$$= \frac{1}{2} \times 60^o$$

$$= 30^o$$

Also,

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

$$= 60^o + 30^o$$

$$= 90^o$$

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

Ans: 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.

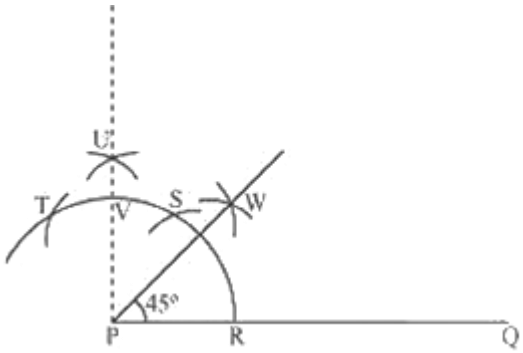
(ii) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.

(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.

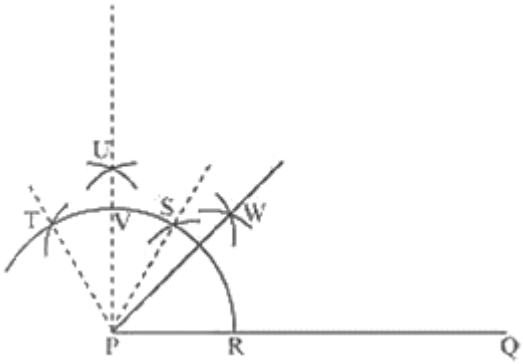
(v) Join PU. Let it intersect the arc at point V.

(vi) From R and V, draw arcs with radius more than 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, $\angle SPQ = \angle TPS = 60°$. In (iii) and (iv) steps of this construction, PU was drawn as the bisector of $\angle TPS$.

$$\angle UPS = \frac{1}{2}\angle TPS$$

$$= \frac{1}{2} \times 60^o$$

$$= 30^o$$

Also,

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

$$= 60^o + 30^o$$

$$= 90^o$$

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

$$\angle WPQ = \frac{1}{2}\angle UPQ$$
$$= \frac{1}{2} \times 90^o$$
$$= 45^o$$

3. Construct the angles of the following measurements:

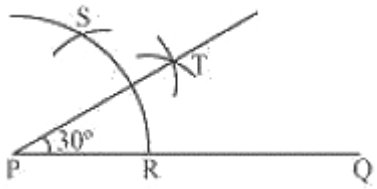
(i) 30°

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

(1) Draw the given ray PQ. Taking P as centre and with some radius, draw an arc of a circle 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 point S.

(3) 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.



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

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

(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).

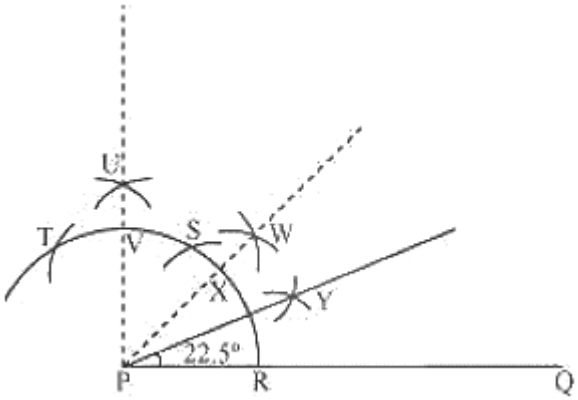
(4) Taking S and T as centre, draw an arc of same radius to intersect each other at U.

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

(6) From R and V, draw arcs with radius more than 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 RX, draw arcs to intersect each other at Y

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



(iii) 15°

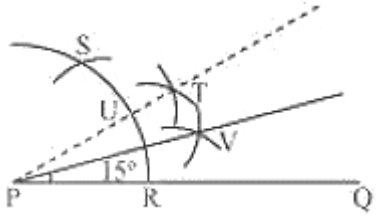
Ans: The below given steps will be followed to construct an angle of $15°$.

(1) Draw the given ray PQ. Taking P as centre and with some radius, draw an arc of a circle 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 point S.

(3) Taking R and S as centre and with radius more than RS, draw arcs to intersect each other at T. Join PT.

(4) Let it intersect the arc at U. Taking U and R as centre and with radius more than RU, draw an arc to intersect each other at V. Join PV which is the required ray making $15°$ with the given ray PQ.



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

(i) 75°

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

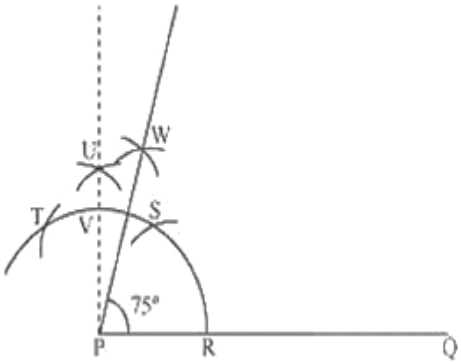
(1) Take the given ray PQ. Draw an arc of some radius taking point P as its centre, which intersects PQ at R.

(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 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°

Ans: 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.

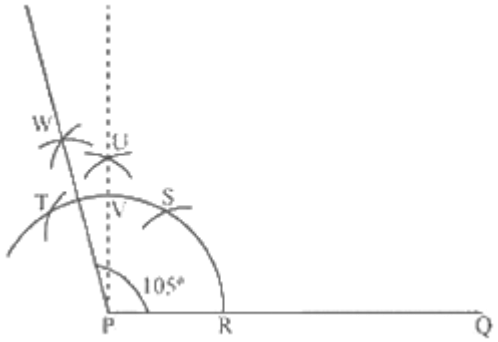
(2) Taking R as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at S.

(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 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) $135°$

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

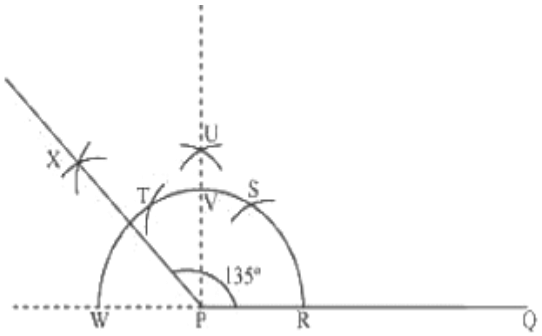
(1) Take the given ray PQ. Extend PQ on the opposite side of Q. Draw a semi-circle of some radius taking point P as its centre, which intersects PQ at R and W.

(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 $\frac{1}{2}$TV, 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 $135°$.

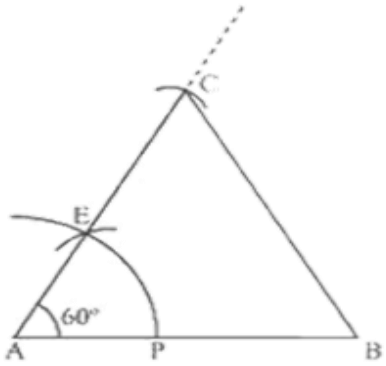
5. Construct an equilateral triangle, given its side and justify the construction.

Ans: Let us draw an equilateral triangle of side 5cm. We know that all sides of an equilateral triangle are equal. Therefore, all sides of the equilateral triangle will be $5cm$. 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 $5cm$ side.

Step I: Draw a line segment AB of $5cm$ 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 $5cm$ radius, which intersects extended line segment AE at C. Join AC and BC. ΔABC is the required equilateral triangle of side $5cm$.



Justification of Construction:

We can justify the construction by showing ABC as an equilateral triangle i.e.,

$AB = BC = AC = 5cm$

and $\angle A = \angle B = \angle C = 60^{\circ}$.

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

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

In ΔABC,

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

$\Rightarrow 60^{\circ} + \angle C + \angle C = 180^{\circ}$

$\Rightarrow 60^{\circ} + 2\angle C = 180^{\circ}$

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

$\Rightarrow \angle C = 60^{\circ}$

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

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

$\angle A = \angle B$ 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)

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

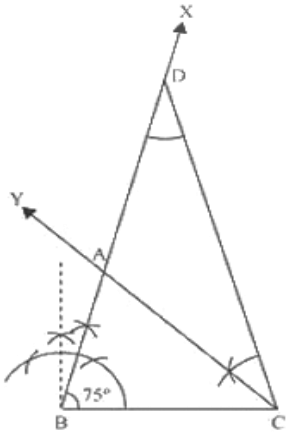
Ans: The below given steps will be followed to construct the required triangle.

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. ΔABC is the required triangle.



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

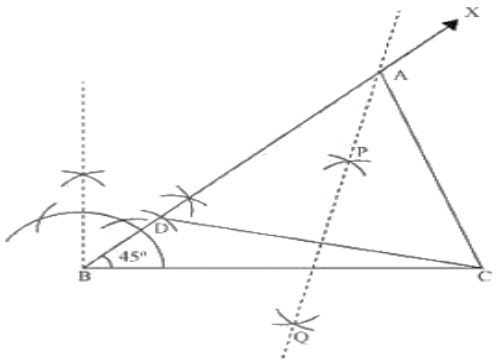
Ans: The below given steps will be followed to draw the required triangle.

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. ΔABC is the required triangle.



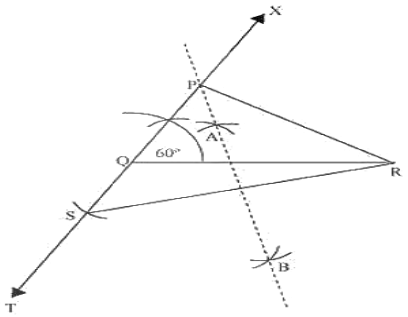
3. Construct a triangle PQR in which QR = 6 cm, $\angle Q = 60°$ and PR − PQ = 2 cm

Ans: 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. ΔPQR is the required triangle.



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

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

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

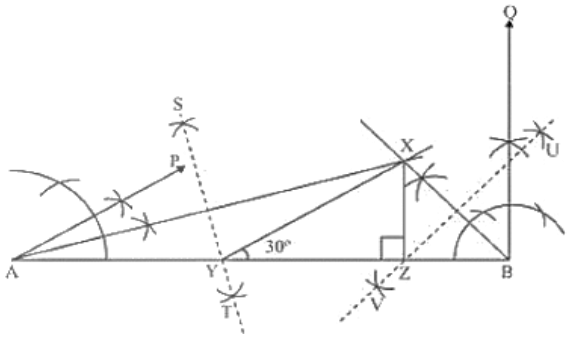
Step II: Construct an angle, $\angle PAB$, of 30° at point A and an angle, $\angle QBA$, of 90° at point B.

Step III: Bisect $\angle PAB$ and $\angle QBA$. Let these bisectors intersect each other

at point $\angle QBA$.

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.



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

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

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

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

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.