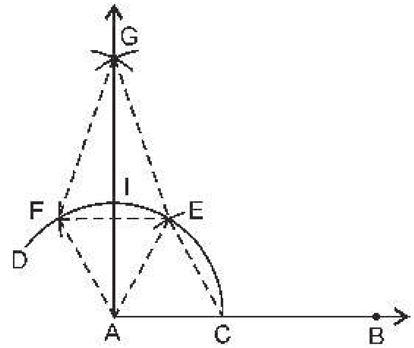
11 CONSTRUCTIONS

EXERCISE 11.1

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



Steps of Construction

(i) Let us take a ray AB with initial point A.

(ii) Taking A as centre and some radius, draw an arc of a circle, which intersects AB at C.

(iii) With C as centre and the same radius as before, draw an arc, intersecting the previous arc at E.

(iv) With E as centre and the same radius, as before, draw an arc, which intersects the arc drawn in step (ii) at F.

(v) With E as centre and some radius, draw an arc.

(vi) With F as centre and the same radius as before, draw another arc, intersecting the previous arc at G.

(vii) Draw the ray AG.

Then $\angle BAG$ is the required angle of 90°.

Justification : Join AE, CE, EF, FG and GE

AC = CE = AE [By construction]

$\Rightarrow \Delta ACE$ is an equilateral triangle

$\Rightarrow \angle CAE = 60°$ ... (i)

Similarly, $\angle AEF = 60°$ ... (ii)

From (i) and (ii), $FE \parallel AC$ ... (iii) [Alternate angles are equal]

Also, FG = EG [By construction]

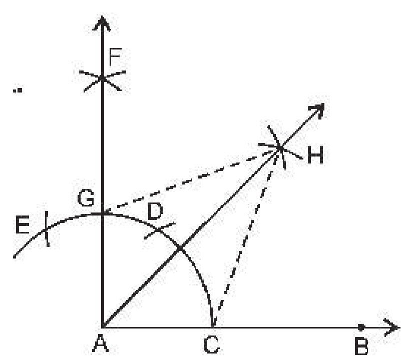
$\Rightarrow$ G lies on the perpendicular bisector of EF

$\Rightarrow \angle GIE = 90°$ ... (iv)

$\therefore \angle GAB = \angle GIE = 90°$ [Corresponding angles]

GF = GE [Arcs of equal radii]

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



Steps of Construction

(i) Let us take a ray AB with initial point A.

(ii) Draw $\angle BAF = 90°$, as discussed in Q. 1.

(iii) Taking C as centre and radius more than $\frac{1}{2}$ CG, draw an arc.

(iv) Taking G as centre and the same radius as before, draw another arc, intersecting the previous arc at H.

(v) Draw the ray AH. Then $\angle BAH$ is the required angle of 45°.

Justification : Join GH and CH.

In ΔAHG and ΔAHC, we have

HG = HC [Arcs of equal radii]

AG = AC [Radii of the same arc]

AH = AH [Common]

∴ ΔAHG ≅ ΔAHC [SSS congruence]

⇒ ∠HAG = ∠HAC [CPCT] ... (i)

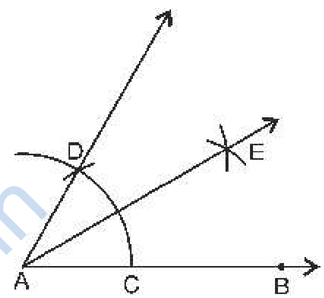
But ∠HAG + ∠HAC = 90° [By construction] ... (ii)

⇒ ∠HAG = ∠HAC = 45° [From (i) and (ii)]

Q.3. *Construct the angles of the following measurements.*

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

(i) Steps of Construction



(a) Draw a ray AB, with initial point A.

(b) With A as centre and some convenient radius, draw an arc, intersecting AB at C.

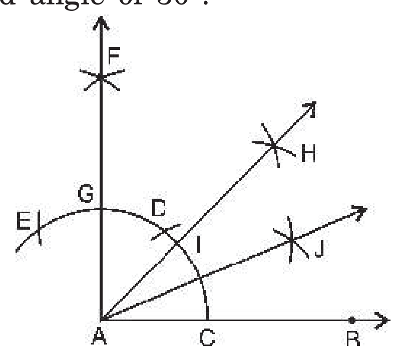
(c) With C as centre and the same radius as before, draw another arc, intersecting the previously drawn arc at D.

(d) Draw ray AD.

(e) Now, taking C and D as centres and with the radius more than $\frac{1}{2}$ DC, draw arcs to intersect each other at E.

(f) Draw ray AE. Then ∠BAE is the required angle of 30°.

(ii) Steps of Construction



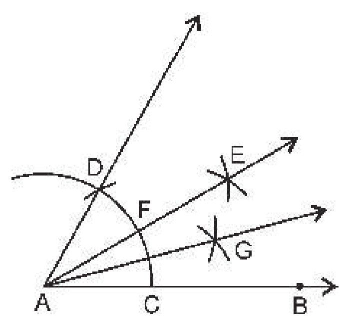
(a) Draw a ray AB with initial point A.

(b) Draw ∠BAH = 45° as discussed in Q. 2.

(c) Taking I and C as centres and with the radius more than $\frac{1}{2}$ CI, draw arcs to intersect each other at J.

(d) Draw ray AJ. Then ∠BAJ is the required angle of $22\frac{1}{2}^\circ$.

(iii) Steps of Construction



(a) Draw ∠BAE = 30° as discussed in part (i).

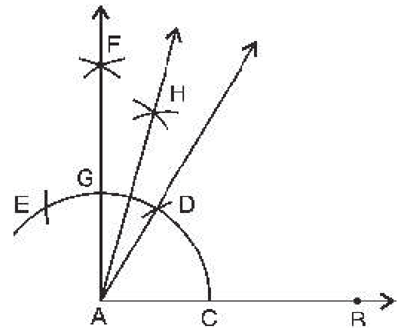
(b) Taking C and F as centres and with the radius more than $\frac{1}{2}$ CF, draw arcs to intersect each other at G.

(c) Draw ray AG. Then ∠BAG is the required angle of 15°.

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

(i) 75° *(ii)* 105° *(iii)* 135°

(i) Steps of Construction



(a) Draw a ray AB with initial point A.

(b) With A as centre and any convenient radius, draw an arc, intersecting AB at C.

(c) With C as centre and the same radius, draw an arc, cutting the previous arc at D.

(d) With D as centre and the same radius, draw another arc, cutting the arc drawn in step (b) at E.

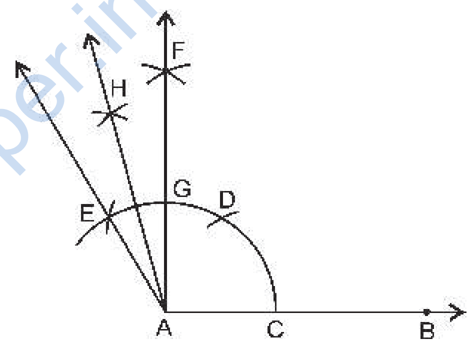
(e) With D and E as centres and some radius, draw arcs to intersect each other at F.

(f) Draw ray AF and AD.

(g) With D and G as centres, and radius more than $\frac{1}{2}$GD, draw arcs to intersect. each other at H.

(h) Draw ray AH. Then ∠BAH is the required angle of 75°.
On measuring using a protractor, we find that ∠BAH = 75°.

(ii) Steps of Construction



(a) At A, draw an ∠BAF = 90°, as discussed in Q. 1.

(b) With A as centre and some convenient radius, draw an arc, intersecting AB at C.

(c) With C as centre and the same radius, draw an arc, which cuts the precious arc at D.

(d) With D as centre and the same radius, draw an arc, which cuts the arc drawn in step (b) at E.

(e) Draw ray AE.

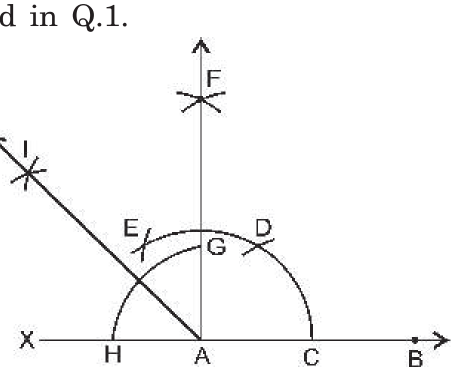
(f) With G and E as centres and radius more than $\frac{1}{2}$GE, draw arcs to intersect each other at H.

(g) Join AH. Then ∠BAH is the required angle of 105°.
On measuring using a protractor, we find that ∠BAH = 105°.

(iii) Steps of Construction

(a) At A, draw angle BAF = 90°, as discussed in Q.1.

(b) Produce BA to X.

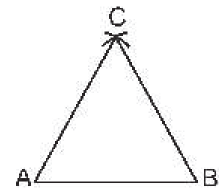


(c) With A as centre and some convenient radius, draw an arc, which cuts AF and AX at G and H respectively.

(d) With G and H as centres and radius more than $\frac{1}{2}$GH, draw arcs to intersect each other at I.

(e) Draw ray AI. Then ∠BAI is the required angle of 135°.
On measuring using a protractor, we find that ∠BAI = 135°.

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



(i) Steps of Construction

(i) Draw a line segment AB of given length.

(ii) With A and B as centres and radius equal to AB, draw arcs to intersect each other at C.

(iii) Join AC and BC. Then ABC is the required equilateral triangle.

Justification : AB = AC [By construction]

AB = BC [By construction]

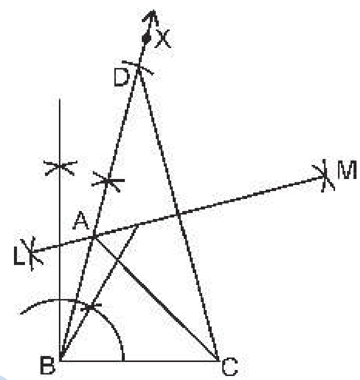
$\Rightarrow$ AB = AC = BC

Hence, ΔABC is an equilateral triangle.

11 CONSTRUCTIONS

EXERCISE 11.2

Q.1. *Construct a triangle ABC in which BC = 7 cm, ∠B = 75° and AB + AC = 13 cm.*



Steps of Construction

(i) Draw a line segment BC = 7 cm.
(ii) At B, draw ∠CBX = 75°.
(iii) Cut a line segment BD = 13 cm from BX.
(iv) Join DC
(v) Draw the perpendicular bisector LM of CD, which intersects BD at A.
(vi) Join AC. Then ABC is the required triangle.

Justification : In ΔACD, we have

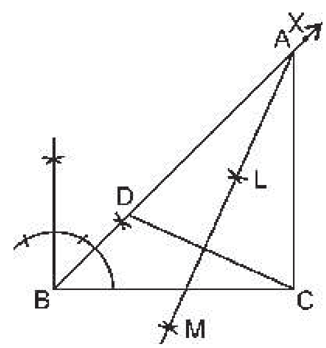
AC = AD [A lies on the perpendicular bisector of DC.]

AB = BD – AD

= BD – AC

⇒ AB + AC = BD

Q.2. *Construct a triangle ABC, in which BC = 8 cm, ∠B = 45° and AB – AC = 3.5 cm.*



Steps of Construction

(i) Draw a line segment BC = 3.5 cm
(ii) At B, draw ∠CBX = 45°.
(iii) From BX, cut off BD = 3.5 cm.
(iv) Join DC.
(v) Draw the perpendicular bisector LM of DC, which intersects BX at A. (vi) Join AC. Then ABC is the required triangle.

Justification : In ΔADC,

AD = AC [A lies on the perpendicular bisector of DC]

BD = AB – AD

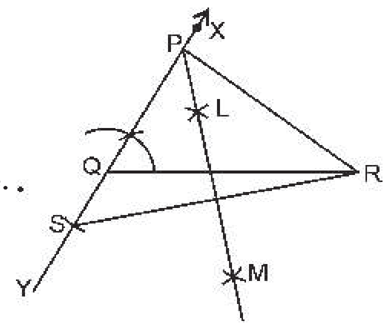
⇒ BD = AB – AC

Q.3. *Construct a triangle PQR in which QR = 6 cm, ∠Q = 60° and PR – PQ = 2 cm.*

Steps of Construction

(i) Draw a line segment QR = 6 cm
(ii) At Q, draw ∠RQX = 60°.

(iii) Produce XQ to Y.
(iv) Cut off QS = 2 cm from QY.
(v) Join SR.
(vi) Draw the perpendicular bisector LM of SR, which intersect QX at P.
(vii) Join PR. Then PQR is the required triangle.



Justification : In ΔPSR, we have

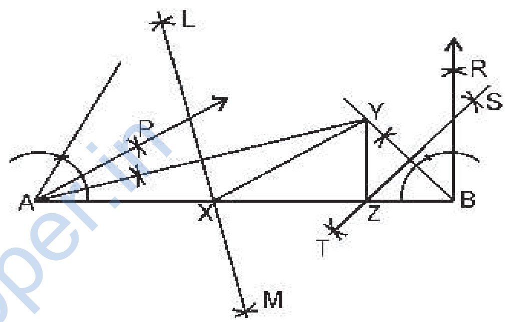
SP = PR [P lies on the perpendicular bisector of SR]

QS = PS – PQ
= PR – PQ

Q.4. *Construct a ΔXYZ in which ∠X = 30°, ∠Z = 90° and XY + YZ + ZX = 11 cm.*

Steps of Construction

(i) Draw a line segment AB = 11 cm
(ii) At A, draw ∠BAP = 30° and at B, draw ∠ABR = 90°
(iii) Draw the bisector of ∠BAP and ∠ABR, which intersect each other at Y.
(iv) Join AY and BY.
(v) Draw the perpendicular bisectors LM and ST of AY and BY respectively. LM and ST intersect AB at X and Z respectively.
(vi) Join XY and YZ. Then XYZ is the required triangle.



Justification : In ΔAXY, we have

AX = XY [X lies on the perpendicular bisector of AY] ...(i)

Similarly, ZB = YZ ... (ii)

∴ XY + YZ + ZX = AX + ZB + ZX [From (i) and (ii)]
= AB

From (i), AX = AY

⇒ ∠XAY = ∠XYA [Angles opposite to equal sides are equal] ... (iii)

In ΔAXY, ∠YXZ = ∠XAY + ∠XYA [Exterior angle is equal to sum of interior opposite angles]

⇒ ∠YXZ = 2∠XAY [From (iii)]

⇒ ∠YXZ = ∠XAP [∵ AY bisects ∠XAP]

Similarly, ∠YZX = ∠ZBR.

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

Steps of Construction

(i) Draw a line segment AB = 12 cm.
(ii) At A, draw ∠BAX = 90°.
(iii) From AX, cut off AD = 18 cm.
(iv) Join DB.
(v) Draw the perpendicular bisector LM of BD, which intersects AD at C.
(vi) Join BC. Then ΔABC is the required triangle.