CHAPTER 18 - CONSTRUCTIONS

Question 1.
Given below are the angles x and y.

Without measuring these angles, construct:
(i) \( \angle ABC = x + y \)
Solution:

(i) Steps of Construction:
1. Draw a line segment BC of any suitable length.
2. With B as centre, draw an arc of any suitable radius. With the same radius, draw arcs with the vertices of given angles as centers. Let these arcs cut arc x at points P and Q and arms of angle y at points R and S.
3. From the arc, with centre B, cut DE = PQ arc of x and EF = RS arc of y.
4. Join BF and produce up to point A. Thus \( \angle ABC = x + y \)

(ii) \( \angle ABC = 2x + y \)

(ii) Steps of Construction:
Proceed in exactly the same way as in part (i).
(i) Takes DE = PQ = arc of x.
EF = PQ = arc of x and FG = RS = arc of y.
Join BG and produce it up to A.
Thus \( \angle ABC = x + x + y = 2x + y \)
(iii) \( \angle ABC = x + 2y \)
(ii) Steps of Construction:

Proceed in exactly the same way as in (ii)

Taking \( DE = PQ = \text{arc of } x \) and \( EF = RS = \text{arc of } y \) and \( FG = RS = \text{arc of } y \).

4. Join BF and produce up to point A.

Thus \( \angle ABC = x + y + y = x + 2y \)

**Question 2.**

Given below are the angles \( x, y \) and \( z \).

Without measuring these angles construct:

(i) \( \angle ABC = x + y + z \)

**Solution:**

(ii) Steps of Construction:

1. Draw line segment \( BC \) of any suitable length.

2. With \( B \) as centre, draw an arc of any suitable radius. With the same radius, draw arcs with the vertices of given angles as centers. Let these arcs cut arms of the angle \( x \) at the points \( P \) and \( Q \) and arms of the angle \( y \) at points \( R \) and \( S \) and arms of the angle \( z \) at the points \( L \) and \( M \).

3. From the arc, with centre \( B \), cut \( DE = PQ = \text{arc of } x \), \( EF = RS = \text{arc of } y \) and \( FG = LM = \text{arc of } z \)

4. Join \( BG \) and produce it up to \( A \). Then \( \angle ABC = x + y + z \)

(ii) \( \angle ABC = 2x + y + z \)
(ii) Proceed as in part (i) up to step 2.
3. From the arc, with centre B, cut

\[ DE = 2PQ = 2 \text{arc of } x \]
\[ EF = RS = \text{arc of } y \]
\[ FG = \angle M = \text{arc of } z \]

4. Join BG and produce it up to point A
Then \( \angle ABC = 2x + y + z \)

(iii) Proceed as in (i) up to step 2

3. Here cut arc \( DE = \text{arc PQ} = \text{arc of } x \) arc \( EF = 2\text{arc RS} = 2\text{arc of } Y \) arc \( FG = \text{arc LM} = \text{arc of } Z \).
4. Join BG and produce it up to A
5. Then \( \angle ABC = x + 2y + z \)

**Question 3.**
Draw a line segment BC = 4cm. Construct angle ABC = 60°.
**Solution:**
**Steps of Construction:**
1. Draw a line segment $BC = 4\text{cm}$
2. With B as centre, draw an arc of any suitable radius which cuts BC at the point D.
3. With D as centre, and the same radius as in step 2, draw one more arc which cuts the previous arc at point E.
4. Join BE and produce it to the point A. Thus $\angle ABC = 60^\circ$

**Question 4.**
Construct angle $\angle ABC = 45^\circ$ in which $BC = 5\text{cm}$ and $AB = 4.6\text{cm}$.

**Solution:**

**Steps of Construction:**

1. Draw a line segment $BC = 5\text{cm}$
2. Taking B as centre, draw an arc of any suitable radius, which cuts BC at the point D.
3. With D as centre and the same radius, as taken in step 2, draw an arc which cuts the previous arc at point E.
4. With E as centre and the same radius, draw one more arc which cuts the first arc at point F.
5. With E and F as centers and radii equal to more than half the distance between E at F, draw arc which cut each other at point P.
6. Join BP to meet EF at L and produce to point R. Then $\angle OBC = 90^\circ$
7. Draw BA, the bisector of angle OBC. [With D, L as centers and suitable radius draw two arc meeting each other at Q produced it to R]
   $\Rightarrow \angle ABC = 45^\circ \therefore BA$ is bisector of $\angle OBC \therefore \angle ABC = 45^\circ$
8. From BR cut arc $AB = 4.6\text{ cm}$

**Question 5.**
Construct angle $\angle ABC = 90^\circ$. Draw BP, the bisector of angle ABC. State the measure of angle PBC.

**Solution:**

1. Draw $\angle ABC = 90^\circ$ (as in Ques. 4)
2. Draw bisector of \( \angle ABC \)

Then \( \angle PBC = \frac{1}{2} (90°) = 45° \)

**Question 6.**

6. Draw angle ABC of any suitable measure.
   (i) Draw BP, the bisector of angle ABC.
   (ii) Draw BR, the bisector of angle PBC and draw BQ, the bisector of angle ABP.
   (iii) Are the angles ABQ, QBP, PBR and RBC equal?
   (iv) Are the angles ABR and QBC equal?

**Solution:**

**Steps of Construction:**

1. Construct any angle ABC
2. With B as centre, draw an arc EF meeting BC at E and AB at F.
3. With E, F as centers draw two arcs of equal radii meeting each other at the point P
4. Join BP. Then BP is the bisector of \( \angle ABC = \angle ABP = \angle PBC = \frac{1}{2} \angle ABC \)
5. Similarly draw BR, the bisector of \( \angle PBC \) and draw BQ as the bisector of \( \angle ABP \) [With the same method as in steps 2,3]
6. Then \( \angle ABQ = \angle QBP = \angle PBR = \angle RBO \)
7. \( \angle ABR = \frac{3}{4} \angle ABC \) and \( \angle QBC = \frac{3}{4} \angle ABC = \angle ABR = \angle OBC \)

**Question 7.**

Draw a line segment AB of length 5.3 cm. using two different methods bisect AB.

**Solution:**

**Steps of Construction:**

1. Draw a line segment AB = 5.3cm
2. With A as centre and radius equal to more than half of AB, draw arcs on both sides of AB.
3. With B as centre and with the same radius as taken in step 2, draw arcs on both the sides of AB.
4. Let the arcs intersect each other at points P and Q.
5. Join P and Q.
6. The line PQ cuts the given line segment AB at the point O. Thus, PQ is a bisector of AB such that OA = OB = \( \frac{1}{2} \) AB

**Second Method**
**Steps of Construction:**
1. Draw the given line segment \( AB = 5.3 \text{ cm} \).
2. At \( A \), construct \( \angle PAB \) of any suitable measure. Then \( \angle PAB = 60^\circ \) construct \( \angle QBA = 60^\circ \)
3. From \( AP \), cut \( AR \) of any suitable length and from \( BQ \); cut \( BS = AR \).
4. Join \( R \) and \( S \)
5. Let \( RS \) cut the given line segment \( AB \) at the point \( O \).
   Thus \( RS \) is a bisector of \( AB \) such that \( OA = OB = \frac{1}{2}AB \)

**Question 8.**
Draw a line segment \( PQ = 4.8 \text{ cm} \). Construct the perpendicular bisector of \( PQ \).
**Solution:**
Steps of Construction:

![Diagram of Steps of Construction for Question 8](image)

1. Draw a line segment \( PQ = 4.8 \text{ cm} \).
2. With \( P \) as centre and radius equal than half of \( PQ \), draw arc on both the \( PQ \).
3. With \( Q \) as centre and the same radius as taken in step 2, draw arcs on both sides of \( PQ \).
4. Let the arcs intersect each other at point \( A \) and \( B \)
5. Join \( A \) and \( B \).
6. The line \( AB \) cuts the line segment \( PQ \) at the point \( O \). Here \( OP = OQ \) and \( \angle AOB = 90^\circ \) Then the line \( AB \) is perpendicular bisector of \( PQ \).

**Question 9.**
In each of the following, draw perpendicular through point \( P \) to the line segment \( AB \):

(i) 

**Solution:**
(i) Steps of Construction:
1. With P as centre, draw an arc of a suitable radius which cuts AB at points C and D.
2. With C and D as centres, draw arcs of equal radii and let these arcs intersect each other at the point O. [The radius of these arcs must be more than half of CD and both the arcs must be drawn on the other side.
3. Join P and Q
4. Let PQ cut AB at the point O.
Thus, OP is the required perpendicular clearly, \(\angle AOP = \angle BOP = 90^\circ\)

(ii) Steps of Construction:

1. With P as centre, draw an arc of any suitable radius which cuts AB at points C and D.
2. With C and D as centres, draw arcs of equal radii. Which intersect each other at point O. [This radius must be more than half of CD and let these arc intersect each other at the point O]
3. Join P and O. Then OP is the required perpendicular.
\(\angle OPA = \angle OPB = 90^\circ\)

(iii) Steps of Construction:
1. With P as centre, draw an arc of any suitable radius which cuts AB at points C and D
2. With C and D as centre, draw arcs of equal radii [The radius of these arcs must be more than half of CD and both the arcs must be drawn on the other side.] and let these arcs intersect each other at the point O.
3. Join Q and P. Let QP cut AB at the point O. Then OP is the required perpendicular.

Question 10:
Draw a line segment A B=5.5 cm Mark a point P, such that P A=6 cm and P B=4.8 cm. From the point P draw perpendicular to AB.

Solution:
Step of Construction:

1. Draw a line segment AB=5.5 cm
2. With A as centre and radius =6 cm draw an arc.
3. With B as centre and radius =4.8 cm draw another arc.
4. Let these arcs meet each other at the point P. PA=6 cm, PB=4.8
5. With P as centre and some suitable radius draw an arc meeting AB at the points C and D.
6. With C as centre and radius more than half of CD draw an arc.
7. With D as centre and same radius as in step 6, draw an arc.
8. Let these arcs meet each other at the point Q.
9. Join PQ.
10. The PQ meet AB at point O.

Then PO ⊥ AB i.e; ∠AOP=90° =∠POB

Question 11.
Draw a line segment AB=6.2 cm. Mark a point P in AB such that BP=4 cm. Through point P draw perpendicular to AB.

Solution:
Steps of Construction:
1. Draw a line segment AB=6.2 cm
2. Cut off BP=4 cm
3. With P as centre and some radius draw arc meeting AB at the points C,D.
4. With C,D as centers and equal radii [each is more than half of CD] draw two arcs, meeting each other at the point 0.
5. Join OP. Then OP is perpendicular for AB.
Question 12.
Draw a line AB=6cm. Mark a point P anywhere outside the line AB. Through the point P, construct a line parallel to AB.
Solution:
Steps of construction:
1. Draw a line AB=6cm
2. Take any point Q on the line AB and join it with the given point P.
3. At point P, construct ∠CPQ=∠PQB
4. Produce CP up to any point D.
Thus, CPD is the required parallel line.

Question 13.
Draw a line Mn=5.8cm.locate point A which is 4.5cm from M and 5cm from N. Through A draw a line parallel to line MN.
Solution:
Steps of construction:
1. Draw a line MN =5.8cm
2. With M as centre and radius =4.5cm,
   Draw an arc.
3. With N as centre draw another arc of radius 5cm. These arcs intersect each other at A.
4. Join AM and AN.
5. At point A, draw ∠DAN=∠ANM
6. Produce DA to any point C.  
Thus CAD is the required parallel line.

**Question 14.**
Draw a straight line AB=6.5cm. Draw another line which is parallel to AB at a distance of 2.8cm from it.  

**Solution:**
Steps of construction:

1. Draw a straight line AB=6.5cm  
2. Taking point A as centre, draw an arc of radius 2.8cm.  
3. Taking B as centre, drawn another arc of radius 2.8cm.  
4. Draw a line CD which touches the two arcs drawn.  
Thus CD is the required parallel line.

**Question 15.**
Construct an angle PQR=80°. Draw a line parallel to PQ at a distance of 3cm from it and another line parallel to QR at a distance of 3.5cm from it. Mark the point of intersection of these parallel lines as A.  

**Solution:**
Steps of construction:
1. Draw \( \angle PQR = 80° \)

2. With P as center draw an arc of radius 2cm.  
3. Again with Q as centre, draw another arc of radius 2cm. Then BM is a line which touches the two arcs. Then BM is a line parallel to PQ.  
4. With Q as centre, draw an arc of radius 3.5cm. With R as centre draw another arc of radius 3.5cm. Draw a line HC which touches these two arcs. Let these two parallel line intersect at A.