

Chapter 24

CONSTRUCTIONS

BASIC CONSTRUCTIONS USING RULER AND COMPASS

Construction 1

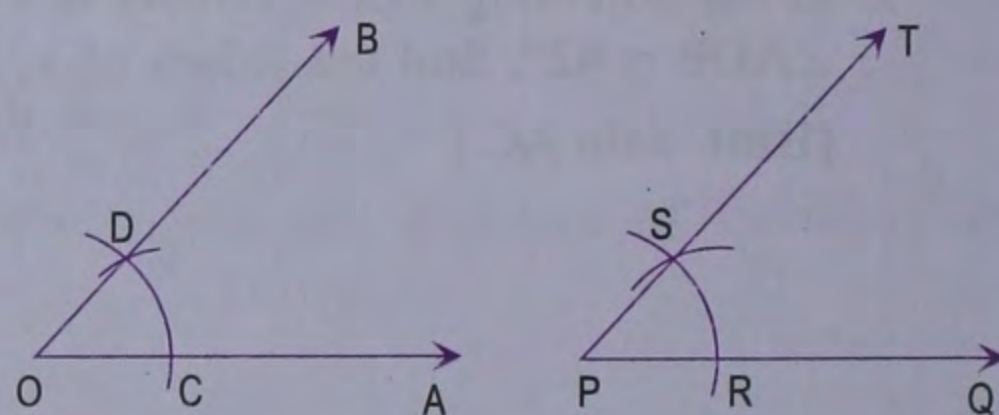
To construct an angle equal to a given angle.

Given. Any $\angle AOB$ and a point P.

Required. To construct an angle at P equal to $\angle AOB$.

Steps of construction

1. Through P draw a ray PQ.
2. With O as centre and any (suitable) radius, draw an arc to meet ray OA at C and ray OB at D.
3. Taking P as centre and same radius (as in step 2), draw an arc to meet PQ at R.
4. Measure the segment CD with compass.
5. With R as centre and radius equal to CD, draw an arc to meet the previous arc at S.
6. Join PS and produce it to form a ray OT, then $\angle QPT = \angle AOB$.



Construction 2

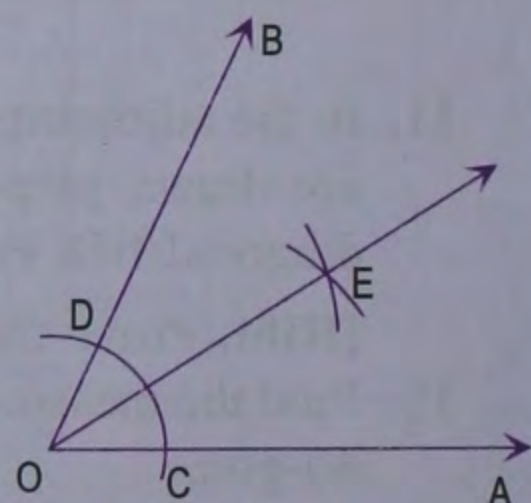
To bisect a given angle.

Given. Any $\angle AOB$.

Required. To bisect $\angle AOB$.

Steps of construction

1. With O as centre any (suitable) radius, draw an arc to meet ray OA at C and ray OB at D.
2. With C as centre and any suitable radius (not necessarily equal to radius of step 1 but $> \frac{1}{2} CD$), draw an arc. Also, with D as centre and same radius draw another arc to meet the previous arc at E.
3. Join OE and produce it to form a ray, then ray OE is the required bisector of $\angle AOB$.



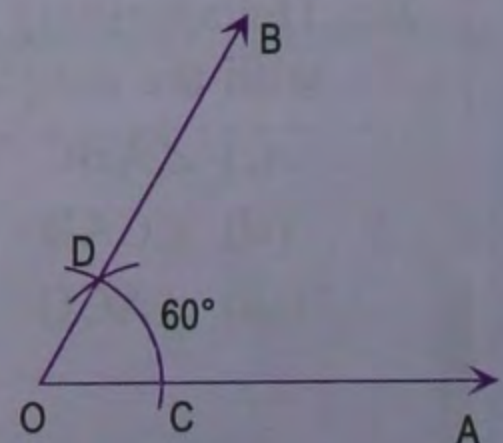
Construction 3

To construct angles of 60° , 30° , 120° , 90° and 45°

(i) **To construct an angle of 60°**

Steps of construction

1. Draw any ray OA.
2. With O as centre and any suitable radius, draw an arc to meet ray OA at C.
3. With C as centre and same radius (as in step 2), draw an arc to meet the previous arc at D.
4. Join OD and produce it to form ray OB, then $\angle AOB = 60^\circ$.

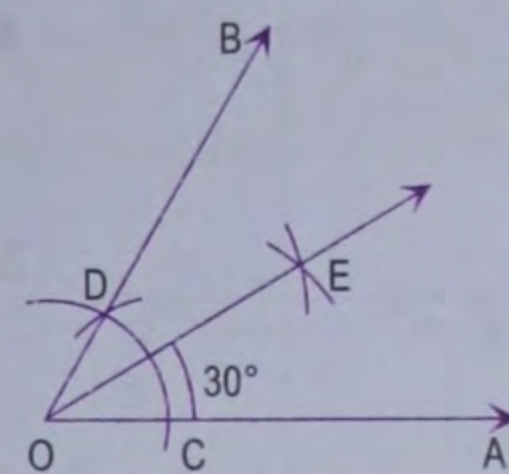


(ii) **To construct an angle of 30°**

Steps of construction

1. Construct $\angle AOB = 60^\circ$ (as above).
2. Bisect $\angle AOB$ (as in construction 2).

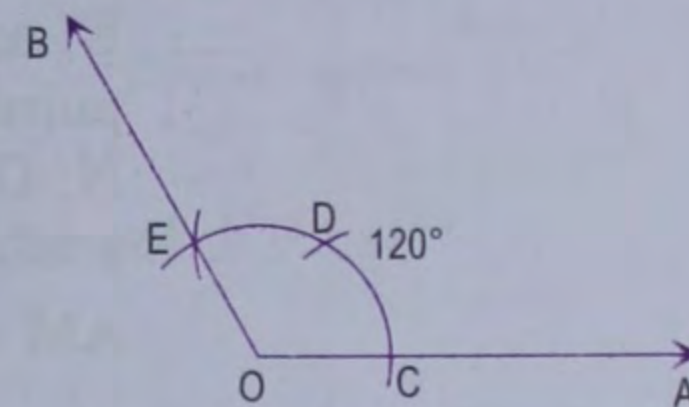
Let ray OE be the bisector of $\angle AOB$, then $\angle AOE = 30^\circ$.



(iii) **To construct an angle of 120°**

Steps of construction

1. Draw any ray OA.
2. With O as centre and any suitable radius, draw an arc to meet OA at C.
3. With C as centre and same radius (as in step 2), draw an arc to meet the previous arc at D. With D as centre and same radius, draw another arc to cut the first arc at E.
4. Join OE and produce it to form ray OB, then $\angle AOB = 120^\circ$.

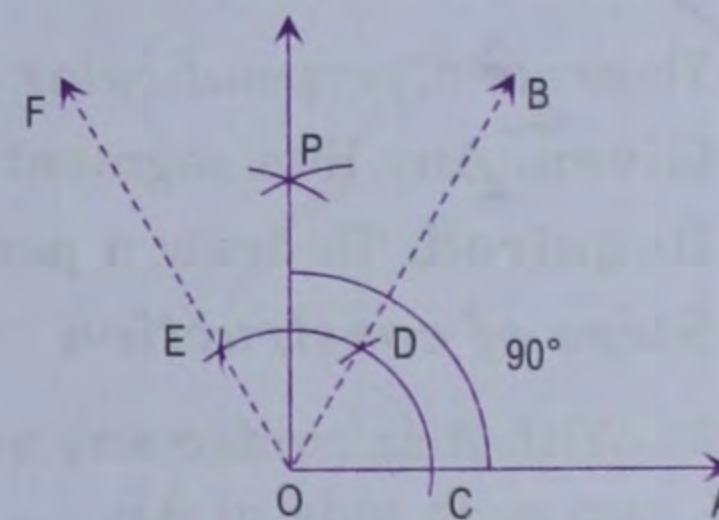


(iv) **To construct an angle of 90°**

Steps of construction

1. Construct $\angle AOB = 60^\circ$ (as in construction 3 (i)).
2. Construct $\angle AOF = 120^\circ$ (as above).
3. Bisect $\angle BOF$ (as in construction 2).

Let ray OP be the bisector of $\angle BOF$, then $\angle AOP = 90^\circ$.

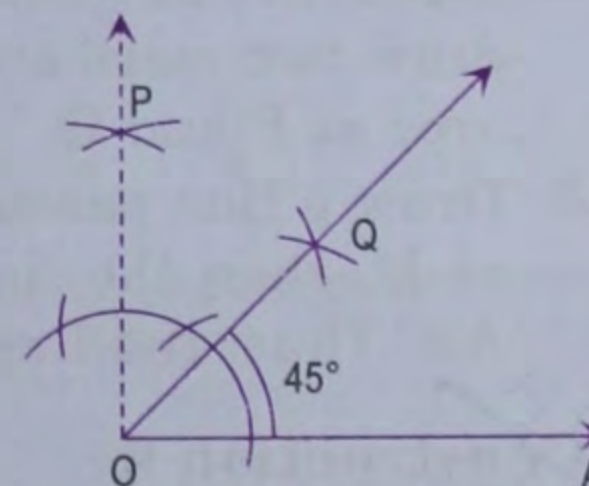


(v) **To construct an angle of 45°**

Steps of construction

1. Construct $\angle AOP = 90^\circ$ (as above).
2. Bisect $\angle AOP$ (as in construction 2).

Let ray OQ be the bisector of $\angle AOP$, then $\angle AOQ = 45^\circ$.



Construction 4

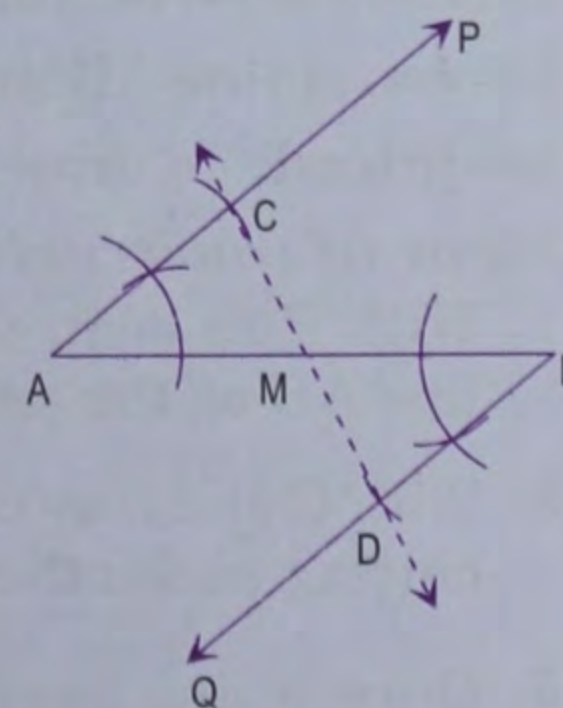
(i) *To bisect a given line segment.*

Given. Any line segment AB.

Required. To bisect line segment AB.

Steps of construction

1. At A, construct any suitable angle PAB.
2. At B, construct $\angle ABQ = \angle PAB$ on the other side of the line AB.
3. With A as centre and any suitable radius, draw an arc to meet AP at C.
4. From BQ, cut off $BD = AC$.
5. Draw a line passing through points C and D to meet AB at M, then the line CD is a bisector of the line segment AB and M is mid-point of AB.



(ii) *To divide a given line segment in a number of equal parts.*

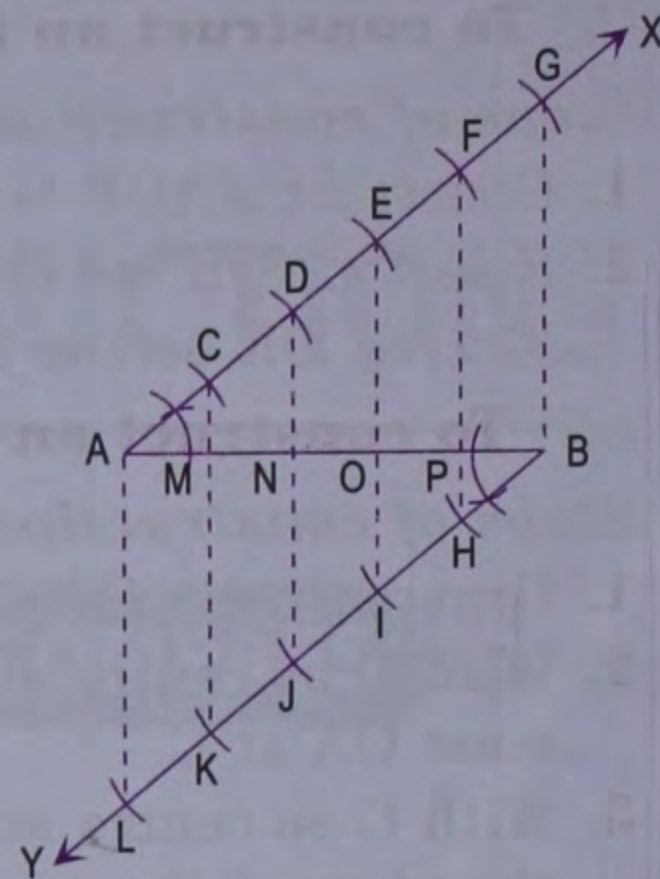
Example.

Divide a line segment AB of length 7.5 cm into 5 equal parts.

Steps of construction

1. Draw line segment $AB = 7.5$ cm.
2. At A, construct any suitable angle XAB.
3. At B, construct $\angle YBA = \angle XAB$ on the other side of the line AB.

4. From AX, cut off 5 equal distances at the points C, D, E, F and G such that $AC = CD = DE = EF = FG$.
5. With the same radius, cut off 5 equal distances along BY at the points H, I, J, K and L such that $BH = HI = IJ = JK = KL$.
6. Join AL, CK, DJ, EI, FH and GB. Let CK, DJ, EI and FH meet the line segment AB at the points M, N, O and P respectively. Then, M, N, O and P are the points of division of AB such that
 $AM = MN = NO = OP = PB$.



Construction 5

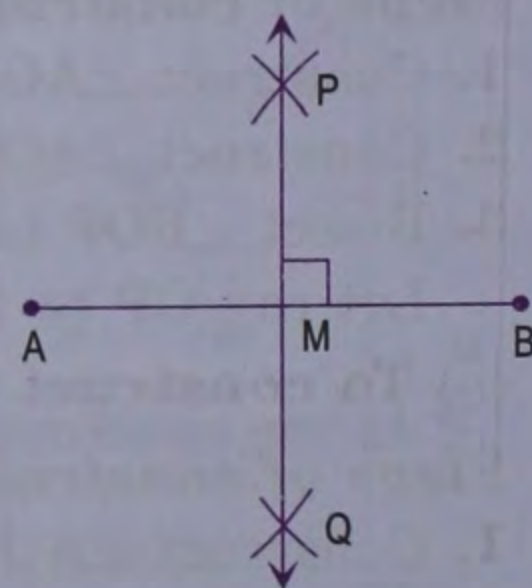
To draw a perpendicular bisector of a line segment.

Given. Any line segment AB.

Required. To draw a perpendicular bisector of line segment AB.

Steps of construction

1. With A as centre any suitable radius $\left(> \frac{1}{2} AB \right)$, draw two arcs, one on each side of AB.
2. With B as centre and same radius (as in step 1), draw two more arcs, one on each side of AB cutting the previous arcs at P and Q.
3. Draw a line passing through points P and Q to meet the line AB at M, then the line PQ bisects AB at M and is perpendicular to AB. Thus, the line PQ is the required perpendicular bisector of AB.



Construction 6

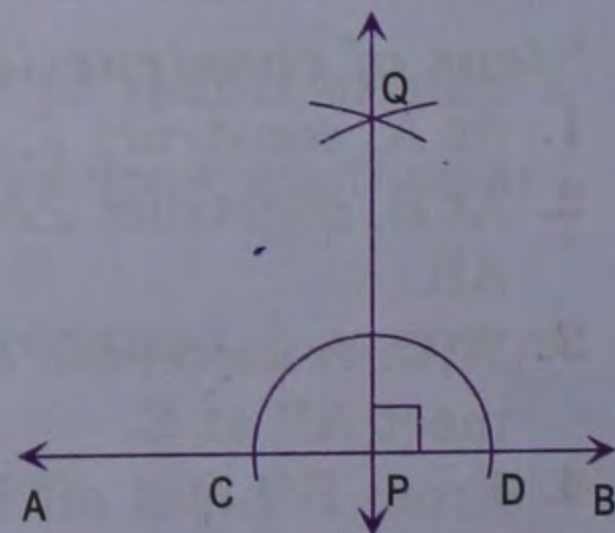
To draw a perpendicular to a line at a point on the line.

Given. A line AB and a point P on it.

Required. To draw a perpendicular to AB at the point P.

Steps of construction

1. With P as centre any suitable radius, draw an arc to cut the line AB at the points C and D.
2. With C and D as centres, draw two arcs of equal radius $\left(> \frac{1}{2} CD \right)$ cutting each other at Q.
3. Draw a line passing through points P and Q, then QP is the required line perpendicular to the line AB at the point P.



Construction 7

To draw a perpendicular to a line from a point outside the line.

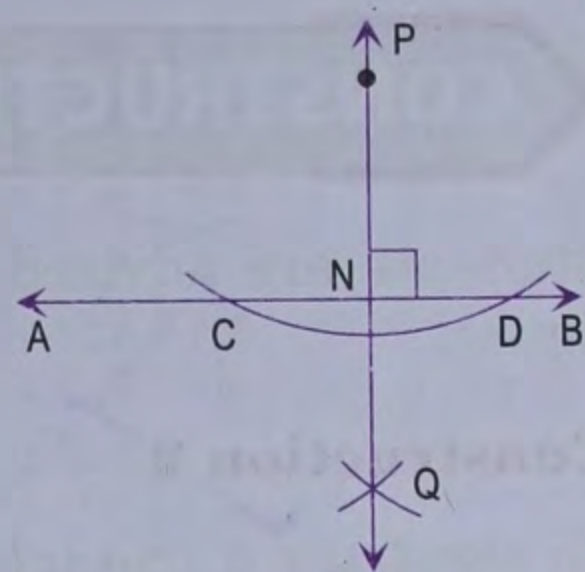
Given. A line AB and a point P outside AB.

Required. To draw a perpendicular to AB from the point P.

Steps of construction

1. With P as centre and any suitable radius, draw an arc to cut the line AB at points C and D.

- With C and D as centres, draw two arcs of equal radius $\left(> \frac{1}{2} CD \right)$ cutting each other at Q on the other side of AB.
- Draw a line through points P and Q to meet the line AB at N, then segment PN is the required perpendicular from the point P to the line AB.



Construction 8

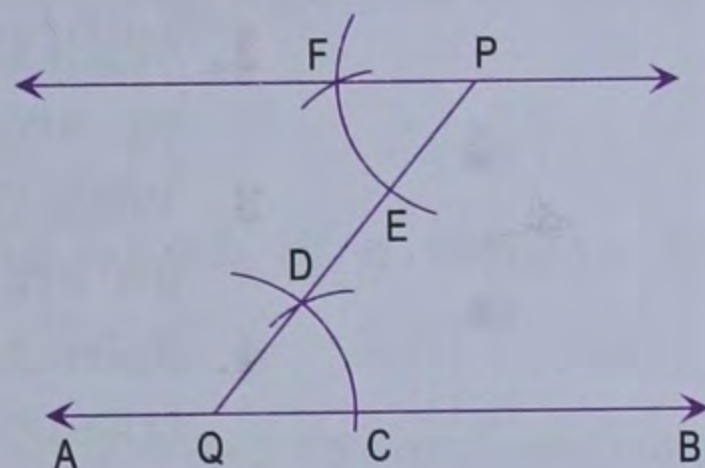
To draw a line parallel to a given line through a given point.

Given. Any line AB and a point P outside AB.

Required. To draw a line parallel to AB and passing through the point P.

Steps of construction

- Take any point Q on AB. Join P and Q.
- With Q as centre and any suitable radius, draw an arc to meet AB at C and QP at D.
- With P as centre and same radius (as in step 2), draw an arc to meet PQ at E.
- With E as centre and radius equal to CD, draw an arc to cut the previous arc at F.
- Draw a line through points P and F, then PF is the required line parallel to the line AB and passing through P.



Note. In the above construction, we have drawn $\angle QPF = \angle PQB$. So, alternate angles are equal and hence $FP \parallel AB$.

Exercise 24.1

- Construct an angle of 45° and bisect it. Measure each part by protractor.
- By using ruler and compass, construct an angle of :
 - 15°
 - 75°
 - 150°
 - 135° .
- Draw a line segment of 5.3 cm and draw its perpendicular bisector.
- Draw a line segment $PQ = 4.9$ cm. Draw a perpendicular to it
 - from a point A outside PQ
 - at a point A on PQ
- Draw any triangle ABC. Through A, draw a line parallel to BC.
- Draw a line $AB = 5.7$ cm. Using ruler and compass, construct $\angle CAB = 30^\circ$ and $\angle CBA = 45^\circ$. From C, draw altitude to AB.
- Construct an angle of 135° and bisect it. Measure any one part by protractor and see how accurate you are.
- Draw line segment $PQ = 5.8$ cm. Construct $\angle RPQ = 60^\circ$ and $\angle PQR = 45^\circ$. Through R, draw a line parallel to PQ.
- Draw a line segment of length 6.4 cm and divide it into three equal parts.
- Draw a line segment AB of length 7 cm and divide it into the ratio 2 : 3.

[Hint. Divide AB into $(2 + 3)$ i.e. 5 equal parts. Mark a point M on AB after 2 parts from A, then $AM : MB = 2 : 3$.]

CONSTRUCTION OF TRIANGLES

Students are advised to draw a rough *free hand sketch* before constructing the actual figure.

Construction 9

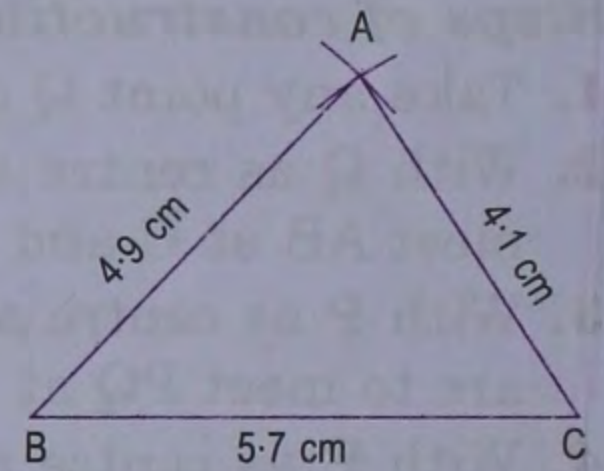
To construct a triangle when the lengths of three sides are given.

Example 1.

Construct a triangle ABC with $BC = 5.7$ cm, $CA = 4.1$ cm and $AB = 4.9$ cm.

Steps of construction

1. Draw line segment $BC = 5.7$ cm.
2. With B as centre and radius 4.9 cm ($= AB$), draw an arc.
3. With C as centre and radius 4.1 cm ($= CA$), draw an arc to cut the previous arc at A.
4. Join AB and AC. Then ABC is the required triangle.



Construction 10

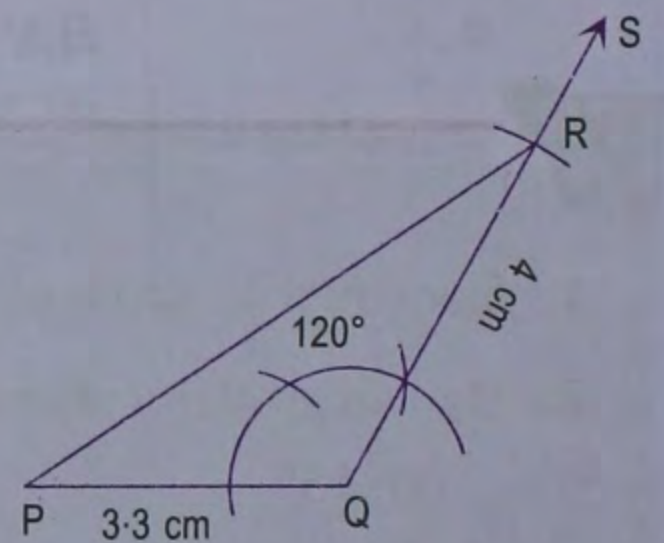
To construct a triangle when the lengths of two sides and the size of the included angle is given.

Example 2.

Construct a triangle PQR such that $PQ = 3.3$ cm, $QR = 4$ cm and $\angle Q = 120^\circ$.

Steps of construction

1. Draw a line segment $PQ = 3.3$ cm.
2. At Q, construct $\angle PQS = 120^\circ$.
3. With Q as centre and radius 4 cm ($= QR$), draw an arc to cut the line QS at R.
4. Join PR, then PQR is the required triangle.



Construction 11

To construct a triangle when the length of one side and the size of two angles are given.

Example 3.

Construct a triangle ABC such that $BC = 5.5$ cm, $\angle B = 60^\circ$ and $\angle A = 75^\circ$.

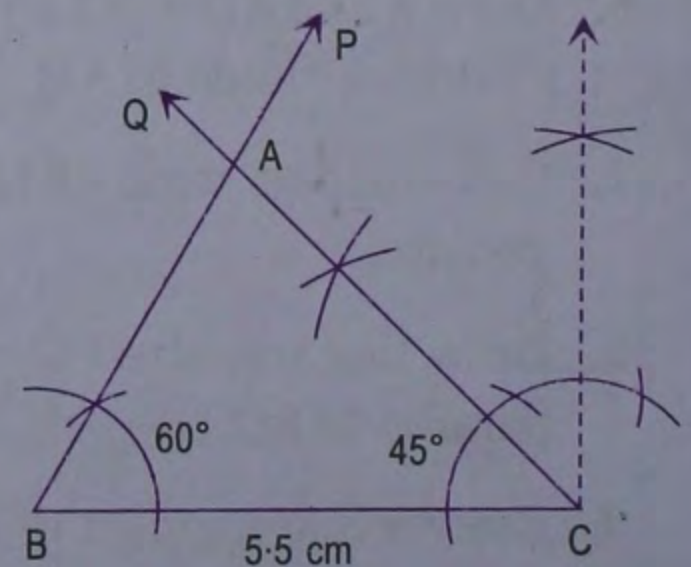
Steps of construction

To construct $\triangle ABC$, we need $\angle C$.

Since sum of angles of a triangle is 180° ,

$$\begin{aligned}\angle C &= 180^\circ - \angle B - \angle A \\ &= 180^\circ - 60^\circ - 75^\circ = 45^\circ.\end{aligned}$$

1. Draw $BC = 5.5$ cm.
2. At B, construct $\angle PBC = 60^\circ$.
3. At C, construct $\angle BCQ = 45^\circ$.
4. Let BP and CQ intersect at A, then ABC is the required triangle.



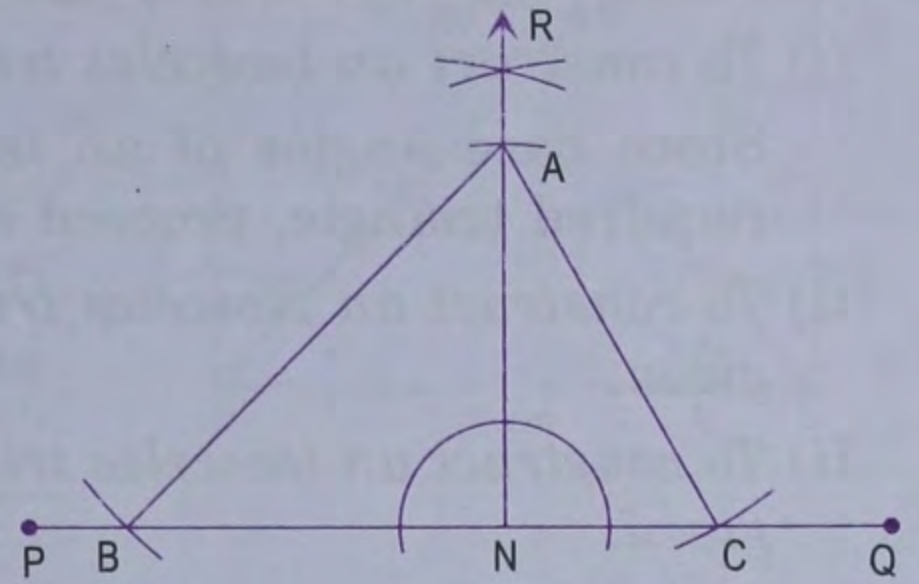
Construction 12

To construct a triangle when the lengths of two sides and the altitude to the third side is given.

Example 4. Construct a triangle ABC such that $AB = 5.2$ cm, $AC = 4.5$ cm and the altitude AN to BC is 3.9 cm.

Steps of construction

1. Draw any line segment PQ . Take any point N on PQ and at N , construct perpendicular RN to PQ .
2. From NR , cut off $NA = 3.9$ cm.
3. With A as centre and radius 5.2 cm, draw an arc to meet PN at B .
4. With A as centre and radius 4.5 cm, draw an arc to meet NQ at C . Then ABC is the required triangle.



Note. In fact, we can construct more than one triangle satisfying the above given conditions.

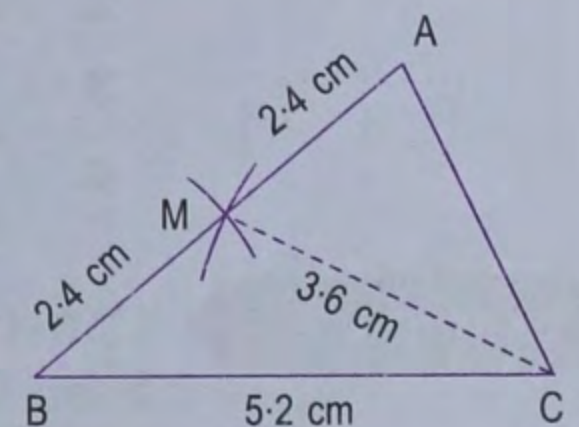
Construction 13

To construct a triangle when the lengths of two sides and the length of a median is given.

Example 5. Construct a triangle ABC such that $BC = 5.2$ cm, $AB = 4.8$ cm and median $CM = 3.6$ cm. Measure $\angle A$.

Steps of construction

1. Draw line segment $BC = 5.2$ cm.
2. With C as centre and radius 3.6 cm, draw an arc.
3. With B as centre and radius $= \frac{1}{2} AB = \left(\frac{1}{2} \times 4.8\right)$ cm $= 2.4$ cm, draw an arc to meet the previous arc at M .
4. Join BM and produce it to a point A such that $MA = MB = 2.4$ cm.
5. Join AC , then ABC is the required triangle.



On measuring $\angle A$ by protractor, we find $\angle A = 74^\circ$ (approximately).

Construction 14

To construct equilateral triangles

(i) To construct an equilateral triangle when one of its sides is given.

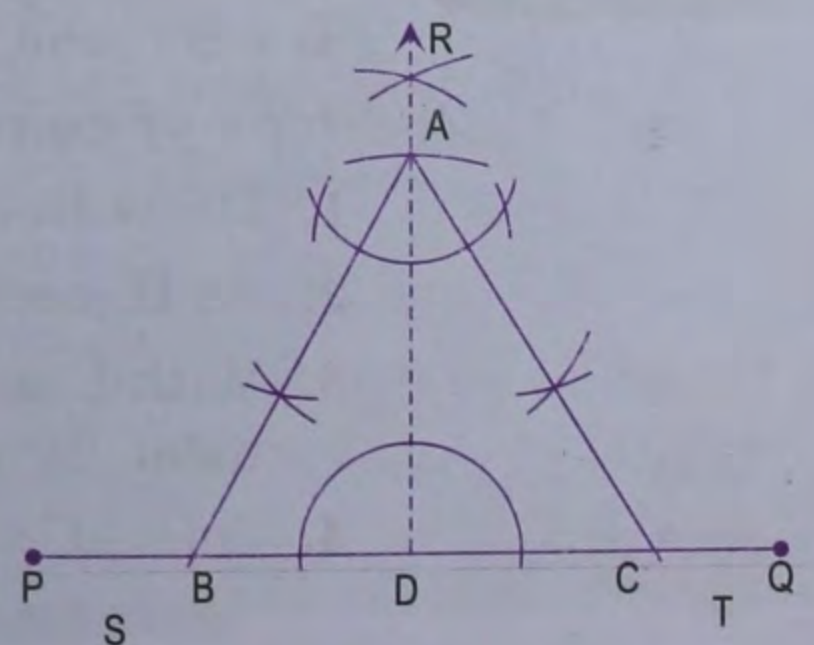
Since all the three sides of an equilateral triangle are equal, therefore, to construct the required triangle proceed as in construction 9.

(ii) To construct an equilateral triangle when its altitude is given.

Example 6. Construct an equilateral triangle whose altitude is 4 cm.

Steps of construction

1. Draw any line segment PQ .
2. Take a point D on PQ and at D , construct perpendicular DR to PQ . From DR , cut off $DA = 4$ cm.
3. At A , construct $\angle DAS = \angle DAT = \frac{1}{2} \times 60^\circ = 30^\circ$ on either side of AD . Let AS and AT meet PQ at points B and C respectively. Then, ABC is the required equilateral triangle.



Construction 15**To construct isosceles triangles**

(i) To construct an isosceles triangle when its base and one base angle are given.

Since base angles of an isosceles triangle are equal, therefore, to construct the required triangle, proceed as in construction 11.

(ii) To construct an isosceles triangle when one of equal sides and the vertical angle is given.

(iii) To construct an isosceles triangle when its base and the altitude (from the base) are given.

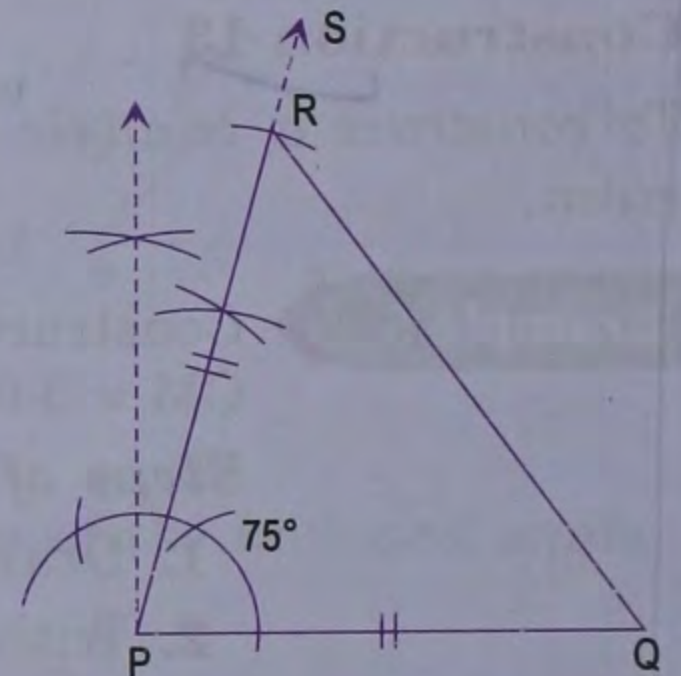
Example 7.

Construct an isosceles triangle PQR having one of its equal sides $PQ = 5.2$ cm and the vertical $\angle P = 75^\circ$.

Steps of construction

Since $\angle P$ is the vertical angle of the isosceles triangle PQR, its sides PQ and PR are equal *i.e.* $PQ = QR = 5.2$ cm. To draw ΔPQR , proceed as in construction 10.

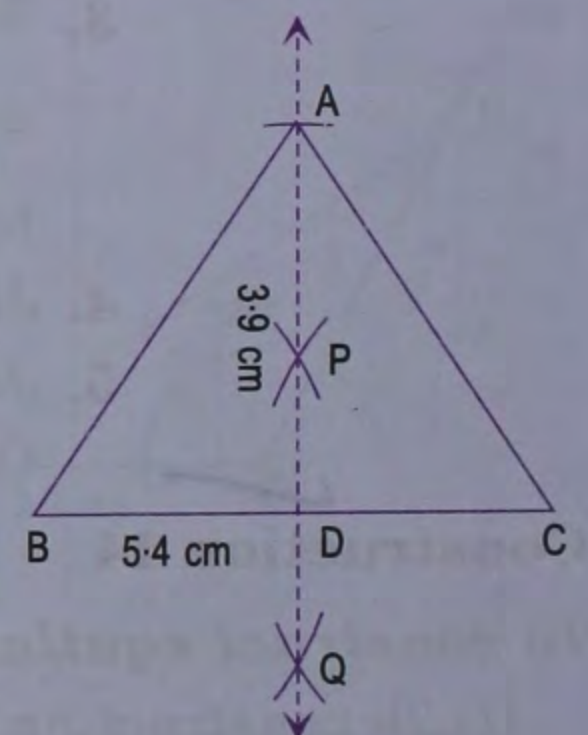
1. Draw $PQ = 5.2$ cm.
2. At P, construct $\angle QPS = 75^\circ$.
3. Cut off $PR = 5.2$ cm from PS.
4. Join QR, then PQR is the required triangle.

**Example 8.**

Construct an isosceles triangle ABC such that its base $BC = 5.4$ cm and altitude AD (to BC) = 3.9 cm.

Steps of construction

1. Draw line segment $BC = 5.4$ cm.
2. Draw PQ, the perpendicular bisector of BC. Let PQ meet BC at D.
3. From DP, cut off $DA = 3.9$ cm.
4. Join AB and AC, then ABC is the required triangle.

**Construction 16****To construct right angled triangles**

(i) To construct a right angled triangle when its one side and the hypotenuse are given.

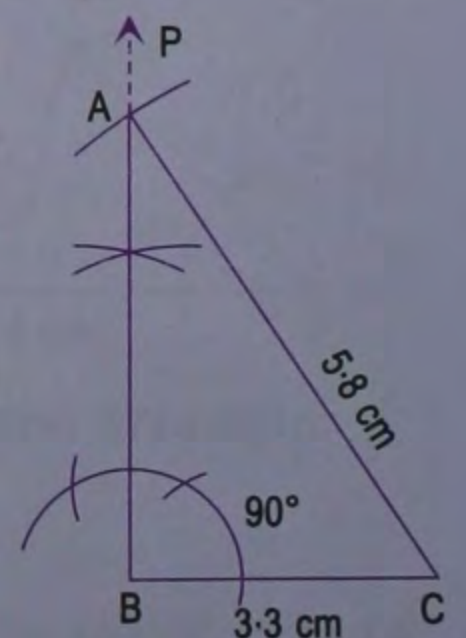
(ii) To construct isosceles right angled triangle when its hypotenuse is given.

Example 9.

Construct a triangle ABC such that $BC = 3.3$ cm, $\angle B = 90^\circ$ and hypotenuse $AC = 5.8$ cm.

Steps of construction

1. Draw line segment $BC = 3.3$ cm.
2. At B, construct $\angle CBP = 90^\circ$.
3. With C as centre and radius 5.8 cm, draw an arc to meet BP at A.
4. Join AC, then ABC is the required triangle.

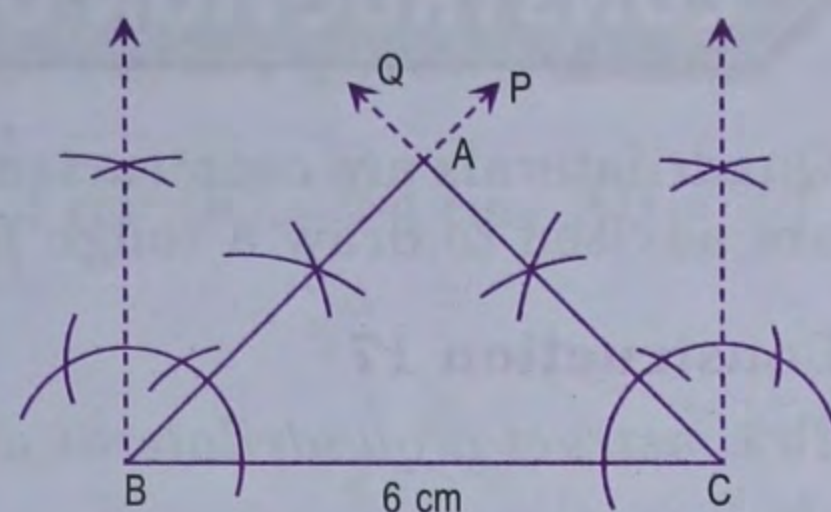


Example 10.

Construct an isosceles right angled triangle ABC such that its hypotenuse $BC = 6$ cm.

Steps of construction

1. Draw line segment $BC = 6$ cm.
2. At B, construct $\angle CBP = 45^\circ$.
3. At C, construct $\angle BCQ = 45^\circ$. Let BP and CQ meet at A, then ABC is the required triangle.

**Exercise 24.2**

1. Construct a triangle ABC given that :
 - (i) $AB = 5.2$ cm, $BC = 4.7$ cm and $CA = 4.1$ cm
 - (ii) $BC = 6.1$ cm, $AB = 5.4$ cm and $CA = 3.8$ cm.
2. Construct a triangle PQR such that $PQ = QR = RP = 5.1$ cm. Name the triangle.
3. Construct a triangle PQR such that $PQ = 3.2$ cm and $QR = RP = 5.3$ cm. Name the triangle.
4. Construct a triangle PQR such that $PR = 4$ cm, $QR = 3$ cm and $PQ = 5$ cm. Measure $\angle R$ and name the triangle.
5. Construct a triangle PQR such that $PQ = QR = 4.1$ cm and $\angle Q = 60^\circ$. Measure $\angle P$ and $\angle R$. Name the triangle.
6. Construct a triangle ABC such that $AB = BC = 4.6$ cm and $\angle B = 75^\circ$. Measure $\angle A$ and $\angle C$.
7. Construct a triangle PQR such that $PQ = 4$ cm, $QR = 3$ cm and $\angle Q = 90^\circ$. Measure PR.
8. Construct a triangle ABC given that $AB = 5.4$ cm, $\angle A = 60^\circ$ and $\angle B = 75^\circ$. Measure $\angle C$. From C, draw a perpendicular to AB.
9. Construct a triangle PQR given that $QR = 4.9$ cm, $\angle Q = 45^\circ$ and $\angle P = 75^\circ$.
10. Construct a triangle ABC given that $AB = 5.3$ cm, $AC = 4.8$ cm and the altitude AM to BC is 4.2 cm.
11. Construct a triangle ABC given that $BC = 5.4$ cm, $AB = 6$ cm and median $CM = 4.6$ cm.
12. Construct a triangle PQR given that $PQ = 5.6$ cm, $PR = 4.8$ cm and median $RM = 3.9$ cm.
13. Construct a triangle ABC given that $BC = 5$ cm, $\angle B = 60^\circ$ and median $CM = 5.8$ cm.
14. Construct an equilateral triangle PQR such that the length of its side is 4.8 cm. Measure all the angles of ΔPQR .
15. Construct an equilateral triangle whose altitude is 4.4 cm.
16. Construct an isosceles triangle ABC with base $BC = 4.5$ cm and $\angle C = 45^\circ$. Measure $\angle A$.
17. Construct an isosceles triangle given that its base $AB = 5$ cm and the altitude CM to the base $AB = 4.2$ cm.
18. Construct a triangle ABC such that $AB = 4.2$ cm, $\angle A = 90^\circ$ and the hypotenuse $BC = 5.8$ cm.
19. Construct an isosceles right angled triangle ABC such that its hypotenuse $AB = 5.7$ cm.
20. Construct a right angled triangle whose hypotenuse is 5.6 cm and one side is 4.2 cm.
21. Construct a triangle ABC given that base $BC = 6$ cm, $\angle B = 60^\circ$ and altitude (height) = 4.6 cm.
 [Hint. Draw $BC = 6$ cm. At B, construct $\angle CBP = 60^\circ$. At C, draw $CQ \perp BC$. From CQ, cut off $CR = 4.6$ cm. Through R, draw a line parallel to BC to meet BP at A.]

CONSTRUCTION OF QUADRILATERALS

Quadrilaterals are constructed by splitting the figure into two suitable triangles. Students are advised to draw a rough *free hand sketch* before constructing the actual figure.

Construction 17

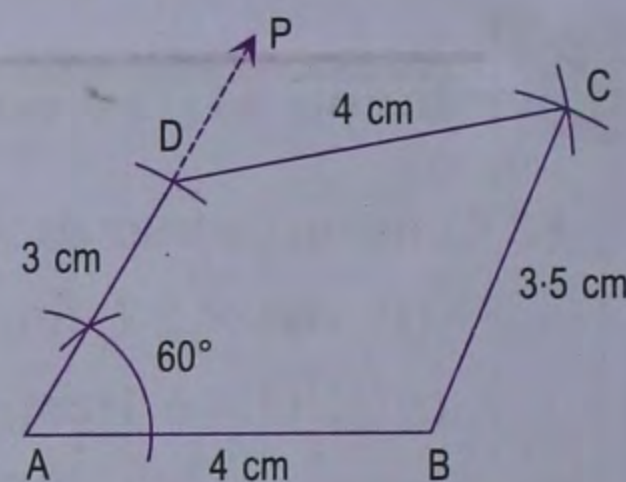
To construct a quadrilateral when its four sides and one angle is given

Example 1.

Construct a quadrilateral ABCD such that $AB = 4$ cm, $BC = 3.5$ cm, $CD = 4$ cm, $AD = 3$ cm and $\angle A = 60^\circ$.

Steps of construction

1. Draw line segment $AB = 4$ cm.
2. At A, construct $\angle BAP = 60^\circ$.
3. From AP, cut off $AD = 3$ cm.
4. With B as centre and radius = 3.5 cm, draw an arc.
5. With D as centre and radius = 4 cm, draw an arc to meet the previous arc at C.
6. Join BC and CD, then ABCD is the required quadrilateral.



Construction 18

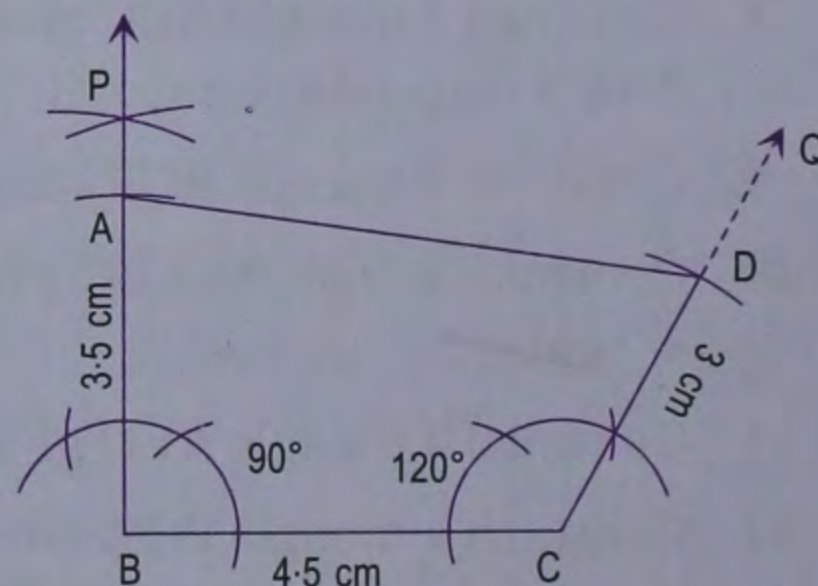
To construct a quadrilateral when its three sides and two angles are given.

Example 2.

Construct a quadrilateral ABCD given that $BC = 4.5$ cm, $AB = 3.5$ cm, $CD = 3$ cm, $\angle B = 90^\circ$ and $\angle C = 120^\circ$.

Steps of construction

1. Draw $BC = 4.5$ cm.
2. At B, construct $\angle CBP = 90^\circ$.
3. At C, construct $\angle BCQ = 120^\circ$.
4. From BP, cut off $BA = 3.5$ cm.
5. From CQ, cut off $CD = 3$ cm.
6. Join AD, then ABCD is the required quadrilateral.



Construction 19

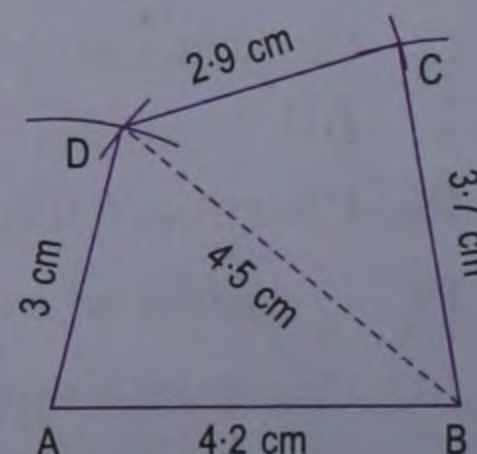
To construct a quadrilateral whose four sides and one diagonal are given.

Example 3.

Draw a quadrilateral ABCD given that $AB = 4.2$ cm, $BC = 3.7$ cm, $CD = 2.9$ cm, $AD = 3$ cm and $BD = 4.5$ cm.

Steps of construction

1. Draw $AB = 4.2$ cm.
2. With A as centre and radius = 3 cm, draw an arc. With B as centre and radius = 4.5 cm, draw an arc to meet the previous arc at D. Join AD and BD (dotted).
3. With B as centre and radius = 3.7 cm, draw an arc. With D as centre and radius = 2.9 cm, draw an arc to meet the previous arc at C.
4. Join BC and CD, then ABCD is the required quadrilateral.



Construction 20

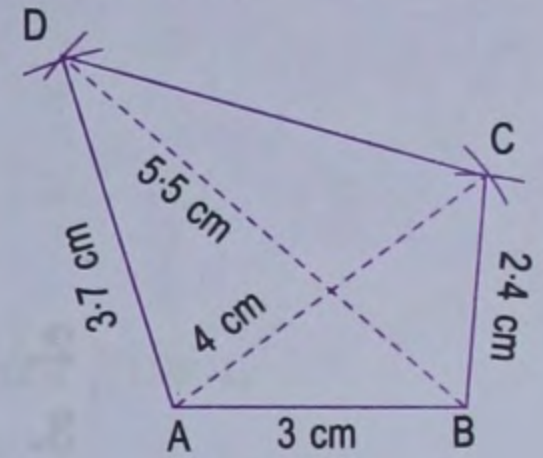
To construct a quadrilateral whose three sides and two diagonals are given.

Example 4.

Draw a quadrilateral ABCD given that $AB = 3$ cm, $BC = 2.4$ cm, $AD = 3.7$ cm, $AC = 4$ cm and $BD = 5.5$ cm. Measure CD.

Steps of construction

1. Construct $\triangle ABC$.
2. Construct $\triangle ABD$.
3. Join CD, then ABCD is the required quadrilateral.
On measuring CD, we find that $CD = 4.5$ cm.

**Construction 21**

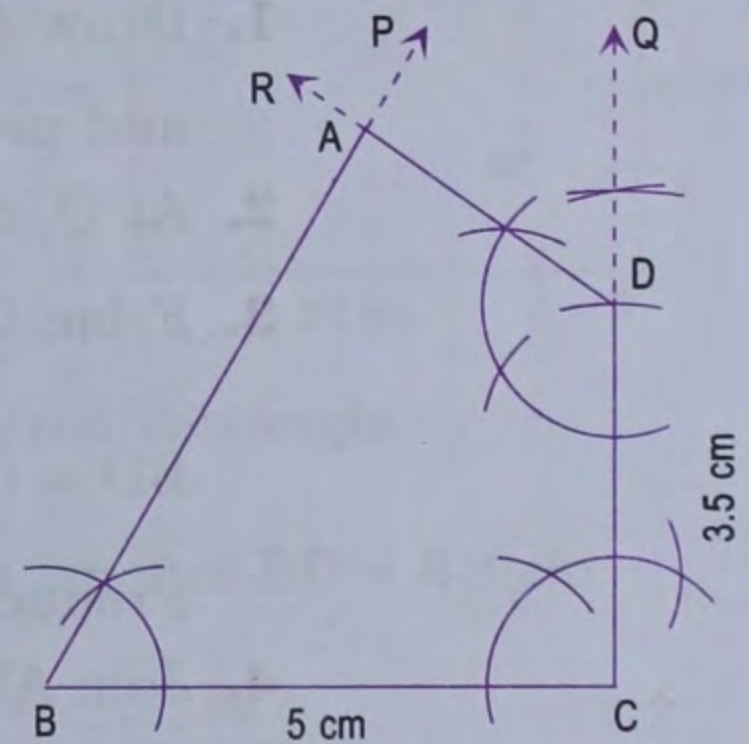
To construct a quadrilateral whose two adjacent sides and three angles are given.

Example 5.

Construct a quadrilateral ABCD given that $BC = 5$ cm, $CD = 3.5$ cm, $\angle B = 60^\circ$, $\angle C = 90^\circ$ and $\angle D = 120^\circ$.

Steps of construction

1. Draw line segment $BC = 5$ cm.
2. At B, construct $\angle CBP = 60^\circ$.
3. At C, construct $\angle BCQ = 90^\circ$.
4. From CQ, cut off $CD = 3.5$ cm.
5. At D, construct $\angle CDR = 120^\circ$.
6. Let BP and DR meet at A, then ABCD is the required quadrilateral.

**CONSTRUCTION OF PARALLELOGRAMS****Construction 22****To construct parallelograms**

- (i) To construct a parallelogram whose two adjacent sides and the included angle are given.

Since opposite sides of a parallelogram are equal, therefore, to construct the required parallelogram, proceed as in construction 17.

- (ii) To construct a parallelogram whose two adjacent sides and one diagonal are given.

Since opposite sides of a parallelogram are equal, therefore, to construct the required parallelogram, proceed as in construction 19.

- (iii) To construct a parallelogram whose one side and both diagonals are given.

- (iv) To construct a parallelogram whose two diagonals and the included angle are given.

Example 6.

Draw a parallelogram ABCD given that $AB = 4.5$ cm, $AC = 4.8$ and $BD = 6.4$ cm.

Steps of construction

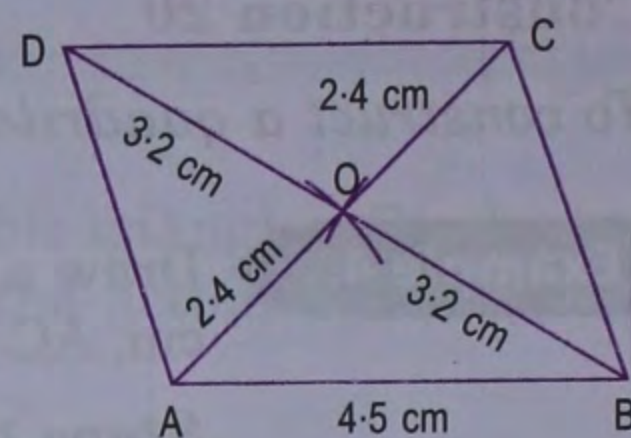
1. Construct $\triangle OAB$ with $AB = 4.5$ cm,

$$AO = \frac{1}{2} AC = \left(\frac{1}{2} \times 4.8\right) \text{ cm} = 2.4 \text{ cm and}$$

$$BO = \frac{1}{2} BD = \left(\frac{1}{2} \times 6.4\right) \text{ cm} = 3.2 \text{ cm.}$$

(\because Diagonals of a parallelogram bisect each other.)

2. Produce AO to C such that $OC = OA$.
3. Produce BO to D such that $OD = OB$.
4. Join CD, then ABCD is the required parallelogram.

**Example 7.**

Draw a parallelogram ABCD such that $AC = 6.4$ cm, $BD = 4.8$ cm and an angle between them = 60° .

Steps of construction

1. Draw $AO = \frac{1}{2} AC = \left(\frac{1}{2} \times 6.4\right) \text{ cm} = 3.2$ cm and produce AO to C such that $OC = OA$.

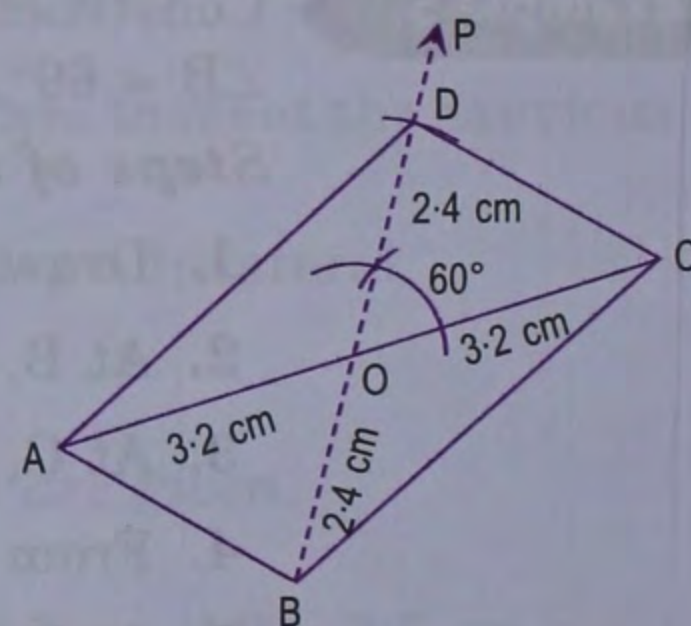
2. At O, construct $\angle COP = 60^\circ$.

3. From OP, cut $OD = \frac{1}{2}$

$$BD = \left(\frac{1}{2} \times 4.8\right) \text{ cm} = 2.4 \text{ cm.}$$

Produce DO to B such that $OB = OD$.

4. Join AB, BC, CD and DA, then ABCD is the required parallelogram.

**Exercise 24.3**

1. Construct a quadrilateral ABCD such that $AB = 4.5$ cm, $BC = 4$ cm, $CD = 3.9$ cm, $AD = 3.2$ cm and $\angle B = 60^\circ$.
2. Construct a quadrilateral ABCD such that $AB = 5$ cm, $BC = 4.2$ cm, $AD = 3.5$ cm, $\angle A = 90^\circ$, $\angle B = 60^\circ$.
3. Construct a quadrilateral ABCD in which $AB = 3.5$ cm, $BC = 5$ cm, $CD = 5.6$ cm, $DA = 4$ cm and $BD = 5.4$ cm.
4. Construct a quadrilateral PQRS in which $PQ = 3$ cm, $QR = 2.5$ cm, $PS = 3.5$ cm, $PR = 4$ cm and $QS = 5$ cm.
5. Construct a quadrilateral ABCD given that $BC = 6$ cm, $CD = 4$ cm, $\angle B = 45^\circ$, $\angle C = 90^\circ$ and $\angle D = 120^\circ$.
6. Construct a parallelogram ABCD such that $AB = 5$ cm, $BC = 3.2$ cm and $\angle B = 120^\circ$.
7. Construct a parallelogram ABCD such that $AB = 4.8$ cm, $BC = 4$ cm and diagonal $BD = 5.4$ cm.
8. Construct a parallelogram ABCD such that $BC = 4.5$ cm, $BD = 4$ cm and $AC = 5.6$ cm.
9. Construct a parallelogram ABCD such that $AC = 6$ cm, $BD = 4.6$ cm and angle between them is 45° .

CONSTRUCTION OF RECTANGLES, RHOMBI AND SQUARES

Construction 23

To construct a rectangle :

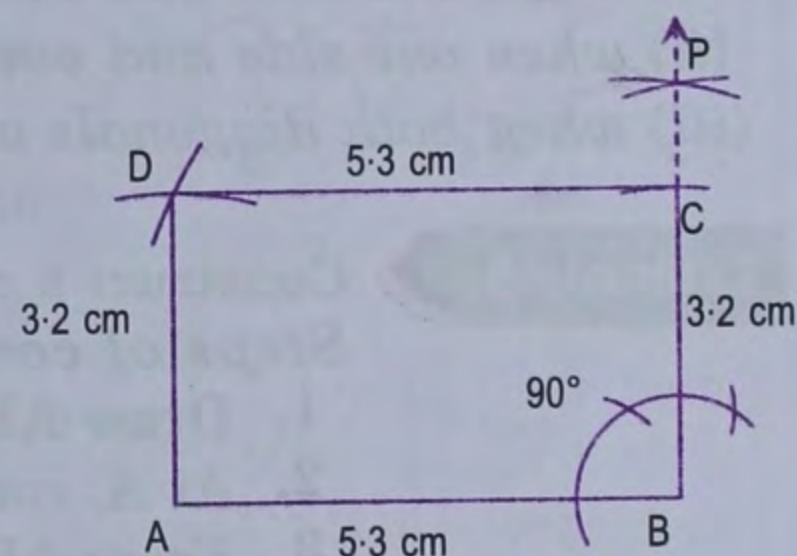
- (i) when adjacent sides are given.
- (ii) when one side and one diagonal are given.
- (iii) when one side and the angle between the side and a diagonal are given.
- (iv) when one diagonal and the angle between two diagonals is given.

Example 1.

Construct a rectangle ABCD given that $AB = 5.3$ cm and $BC = 3.2$ cm.

Steps of construction

1. Draw $AB = 5.3$ cm.
2. At B, construct $\angle ABP = 90^\circ$.
3. From BP, cut off $BC = 3.2$ cm.
4. With C as centre and radius = 5.3 cm, draw an arc.
5. With A as centre and radius = 3.2 cm, draw an arc to meet the previous arc at D.
6. Join AD and CD. Then ABCD is the required rectangle.

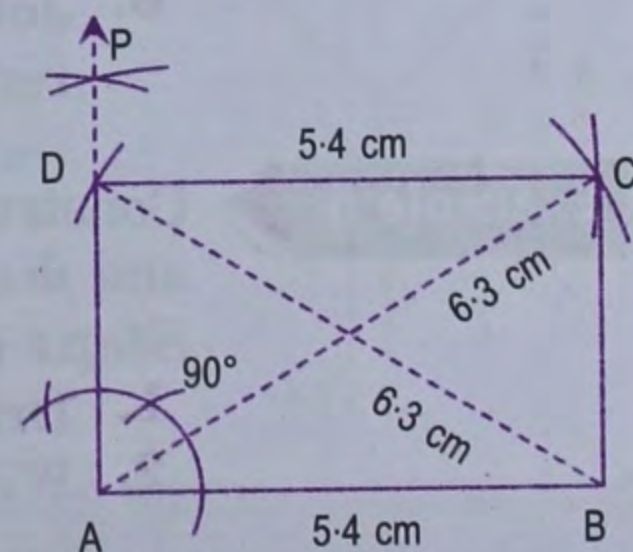


Example 2.

Construct a rectangle ABCD such that $AB = 5.4$ cm and $BD = 6.3$ cm.

Steps of construction

1. Draw $AB = 5.4$ cm.
2. At A, construct $\angle BAP = 90^\circ$.
3. With B as centre and radius = 6.3 cm, draw an arc to meet AP at D.
4. With A as centre and radius = 6.3 cm draw an arc.
5. With D as centre and radius = 5.4 cm, draw an arc to meet the previous arc at C.
6. Join BC and CD. Then ABCD is the required rectangle.

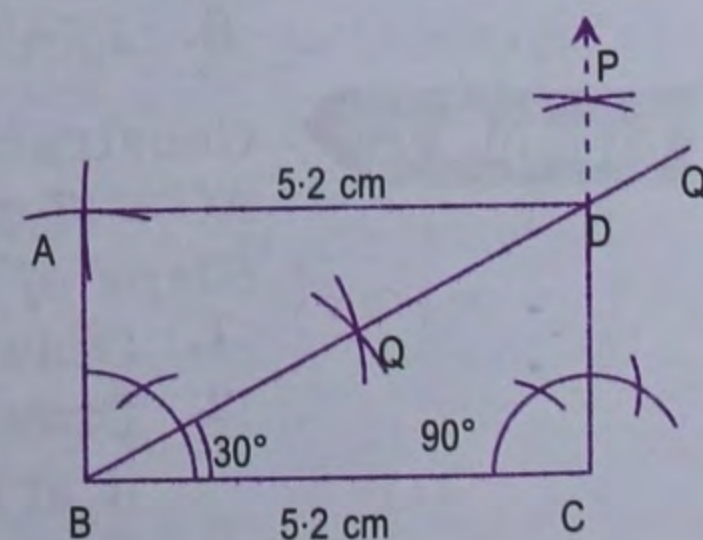


Example 3.

Construct a rectangle ABCD given that $BC = 5.2$ cm and $\angle DBC = 30^\circ$.

Steps of construction

1. Draw $BC = 5.2$ cm.
2. At C, construct $\angle BCP = 90^\circ$.
3. At B, construct $\angle CBQ = 30^\circ$. Let BQ meet CP at D.
4. With D as centre and radius = 5.2 cm draw an arc.
5. With B as centre and radius = CD, draw an arc to meet the previous arc at A.
6. Join AB and AD, then ABCD is the required rectangle.

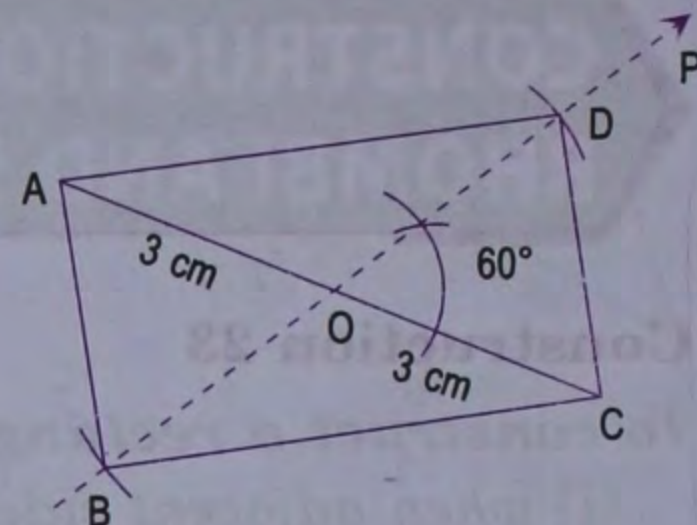


Example 4.

Draw a rectangle ABCD such that diagonal $AC = 6$ cm and an angle between two diagonals = 60° .

Steps of construction

1. Draw $AO = \frac{1}{2} AC = \left(\frac{1}{2} \times 6\right) \text{ cm} = 3 \text{ cm}$ and produce AO to C such that $OC = OA = 3 \text{ cm}$.
2. At O, construct $\angle COP = 60^\circ$.
3. From OP, cut off $OD = \frac{1}{2} AC = \left(\frac{1}{2} \times 6\right) \text{ cm} = 3 \text{ cm}$.
Produce DO to B such that $OB = OD = 3 \text{ cm}$.
4. Join AB, BC, CD and DA. Then ABCD is the required rectangle.

**Construction 24****To construct rhombus :**

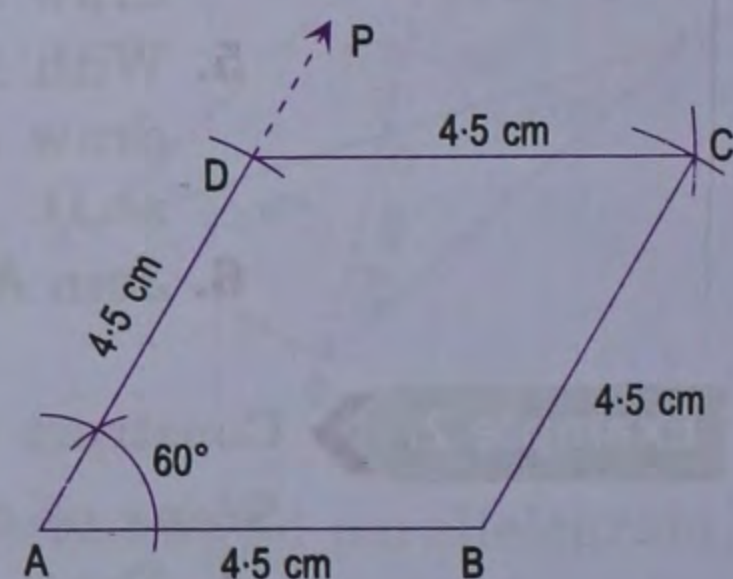
- (i) when one side and one angle are given.
- (ii) when one side and one diagonal are given.
- (iii) when both diagonals are given.

Example 5.

Construct a rhombus ABCD given that $AB = 4.5 \text{ cm}$ and $\angle A = 60^\circ$.

Steps of construction

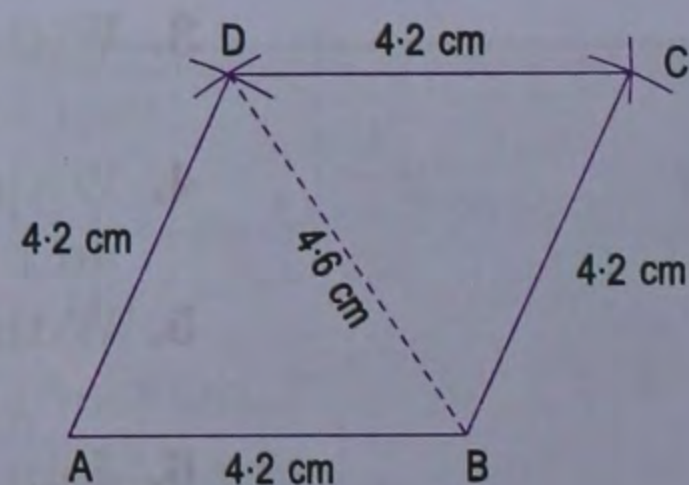
1. Draw $AB = 4.5 \text{ cm}$.
2. At A, construct $\angle BAP = 60^\circ$.
3. From AP, cut off $AD = 4.5 \text{ cm}$.
4. With B as centre and radius = 4.5 cm , draw an arc.
5. With D as centre and radius 4.5 cm , draw an arc to meet the previous arc at C.
6. Join BC and CD. Then ABCD is the required rhombus.

**Example 6.**

Construct a rhombus ABCD such that $AB = 4.2 \text{ cm}$ and diagonal $BD = 4.6 \text{ cm}$.

Steps of construction

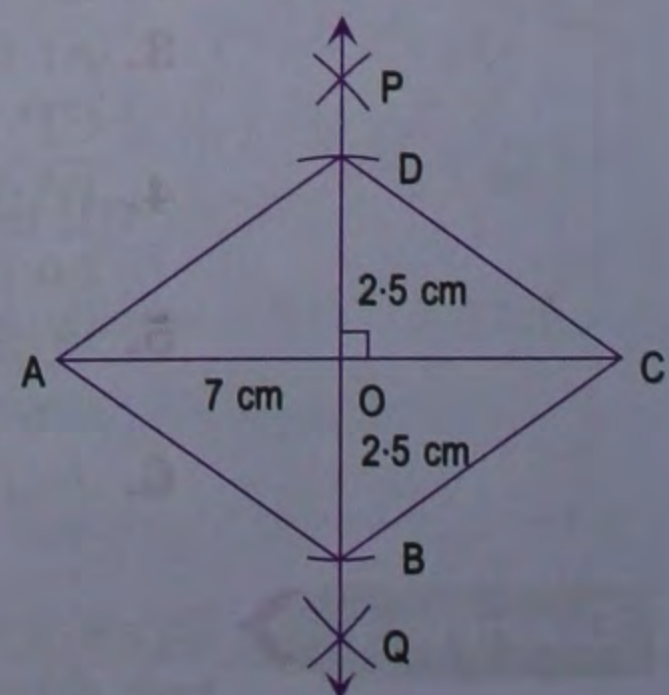
1. Draw $AB = 4.2 \text{ cm}$.
2. With A as centre and radius = 4.2 cm , draw an arc.
3. With B as centre and radius = 4.6 cm , draw an arc to meet the previous arc at D.
4. With B as centre and radius = 4.2 cm , draw an arc.
5. With D as centre and radius = 4.2 cm , draw an arc to meet the previous arc at C.
6. Join AD, BC and CD. Then ABCD is the required rhombus.

**Example 7.**

Construct a rhombus ABCD whose diagonal $AC = 7 \text{ cm}$ and diagonal $BD = 5 \text{ cm}$.

Steps of construction

1. Draw $AC = 7 \text{ cm}$.
2. Draw perpendicular bisector PQ of AC to meet it at O.
3. From POQ, cut off OB and OD such that $OB = OD = \frac{1}{2} BD = \left(\frac{1}{2} \times 5\right) \text{ cm} = 2.5 \text{ cm}$.
4. Join AB, BC, CD and DA. Then ABCD is the required rhombus.

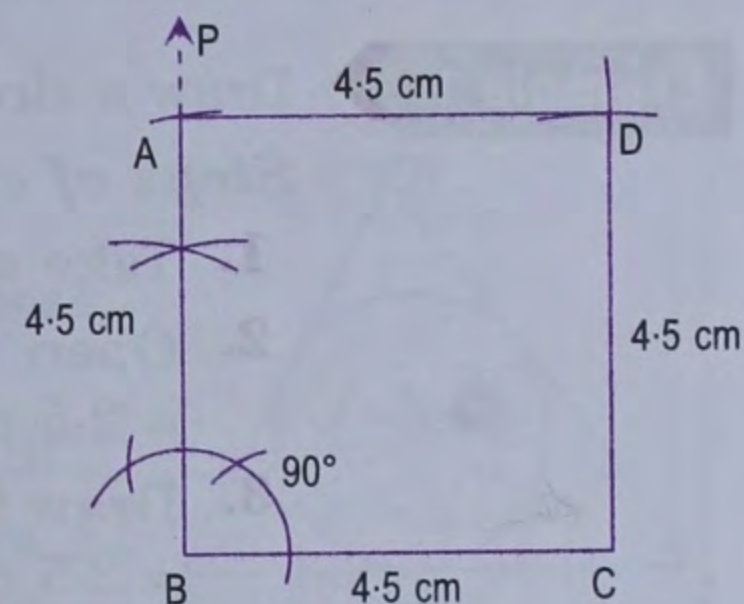


Construction 25**To construct a square :**

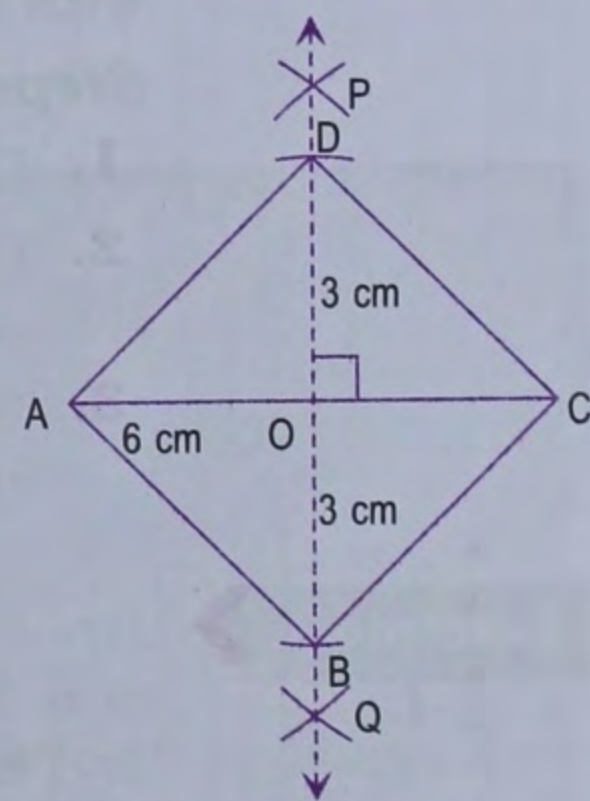
- (i) when one side is given.
- (ii) when one diagonal is given.

Example 8. Construct a square ABCD whose side BC = 4.5 cm.**Steps of construction**

1. Draw BC = 4.5 cm.
2. At B, construct $\angle CBP = 90^\circ$.
3. From BP, cut off BA = 4.5 cm.
4. With C as centre and radius = 4.5 cm, draw an arc.
5. With A as centre and radius = 4.5 cm, draw an arc to meet the previous arc at D.
6. Join AD and CD. Then ABCD is the required square.

**Example 9.** Construct a square ABCD whose diagonal AC = 6 cm.**Steps of construction**

1. Draw AC = 6 cm.
2. Draw perpendicular bisector PQ of AC to meet it at O.
3. From POQ, cut off OB = OD such that $OB = OD = \frac{1}{2} AC = \left(\frac{1}{2} \times 6\right) \text{ cm} = 3 \text{ cm}$.
4. Join AB, BC, CD and DA. Then ABCD is the required square.

**Exercise 24.4**

1. Construct a rectangle whose adjacent sides are 5.6 cm and 4 cm.
2. Construct a rectangle such that one side is 5 cm and one diagonal is 6.8 cm.
3. Construct a rectangle ABCD such that AB = 4 cm and $\angle BAC = 60^\circ$.
4. Construct a rectangle such that one diagonal is 6.6 cm and an angle between two diagonals is 120° .
5. Construct a rectangle whose one diagonal is 7 cm and an angle between two diagonals is 45° .
6. Construct a rhombus whose one side is 5 cm and one angle is 45° .
7. Construct a rhombus whose one side is 4.5 cm and one diagonal is 5 cm.
8. Construct a rhombus whose diagonals are 6.8 cm and 5.2 cm.
9. Construct a square whose one side is 4.3 cm.
10. Construct a square whose one diagonal is 6.2 cm.

CONSTRUCTION OF CIRCLES

Construction 26

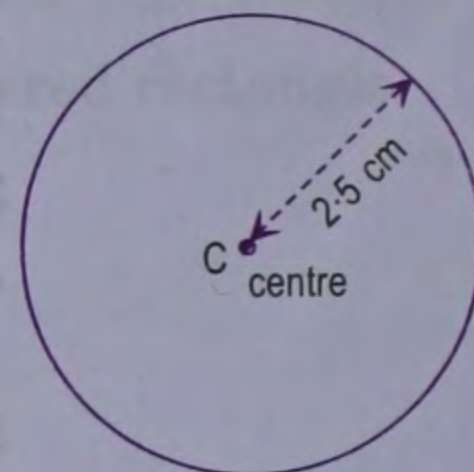
- (i) To construct a circle when its radius is given.
 (ii) To construct a circle on a given line segment as a diameter.
 (iii) To construct a circle of given radius and passing through two given points.

Example 1.

Draw a circle of radius 2.5 cm.

Steps of construction

1. Take any point C as centre.
2. Open the compass and take its opening = 2.5 cm.
3. Draw the circle with C as centre and radius = 2.5 cm.

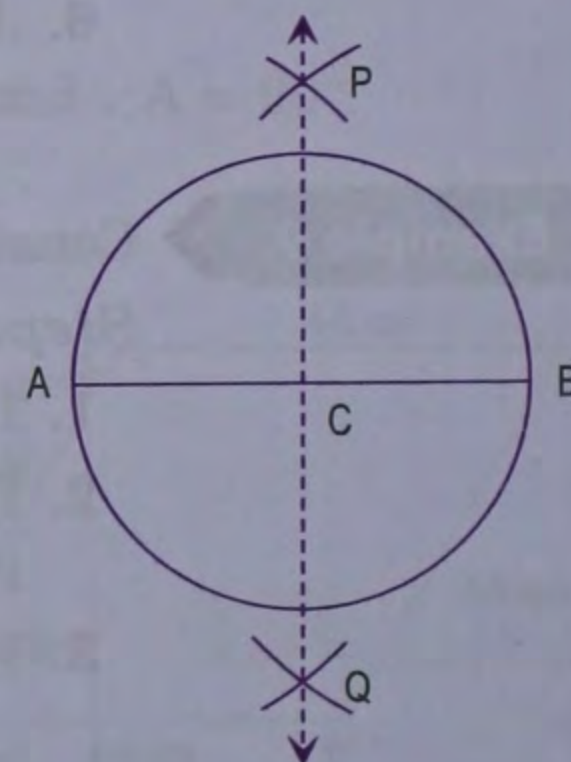


Example 2.

Draw a line segment AB = 4.8 cm. Construct a circle with AB as diameter.

Steps of construction

1. Draw line segment AB = 4.8 cm.
2. Draw perpendicular bisector PQ of line segment AB. Let PQ meet AB at C.
3. With C as centre and radius = CA, draw the circle.

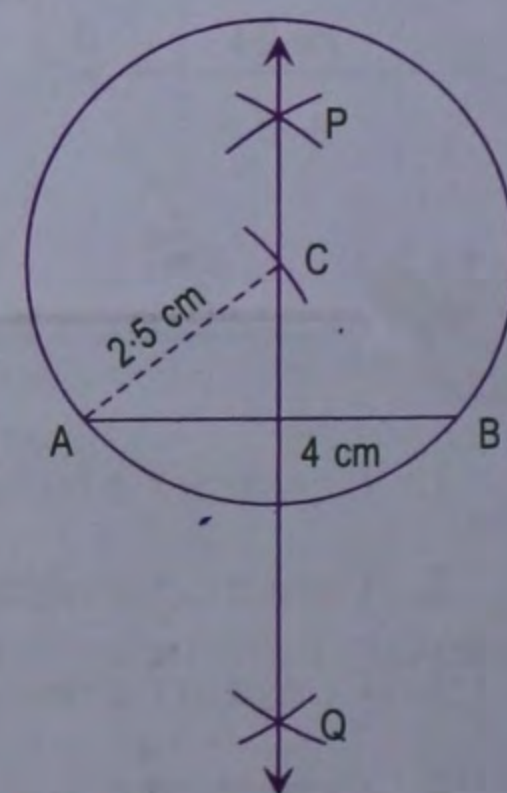


Example 3.

Draw a line segment AB = 4 cm. Construct a circle of radius 2.5 cm and passing through the points A and B.

Steps of construction

1. Draw line segment AB = 4 cm.
2. Draw perpendicular bisector PQ of AB.
3. With A (or B) as centre and radius = 2.5 cm, draw an arc to meet PQ at C.
4. With C as centre and radius = 2.5 cm, draw a circle. It is the required circle.



Construction 27

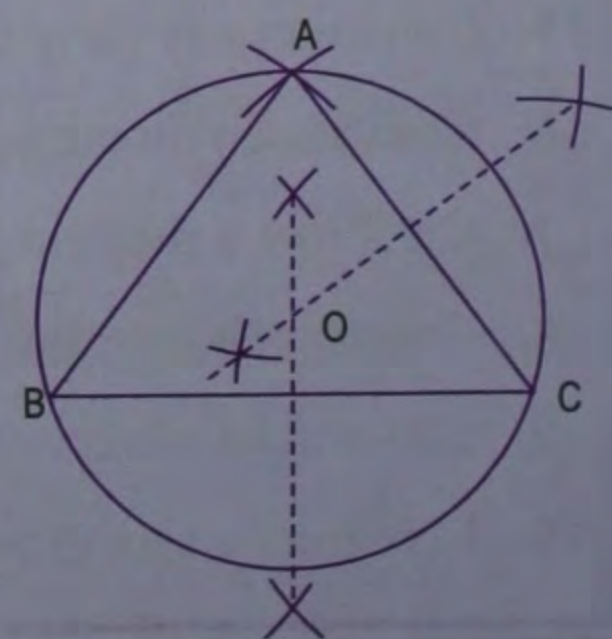
To construct a circumcircle of a given triangle.

Example 4.

Construct a triangle with sides 5 cm, 4.5 cm and 4 cm. Also construct the circumcircle of this triangle.

Steps of construction

1. Draw a triangle ABC with BC = 5 cm, AC = 4.5 cm and AB = 4 cm.
2. Draw perpendicular bisectors of any two sides, say BC and AC. Let these perpendicular bisectors meet at O.



- With O as centre and radius equal to OA, draw a circle. The circle so drawn passes through the points A, B and C, and is the required circumcircle of ΔABC .

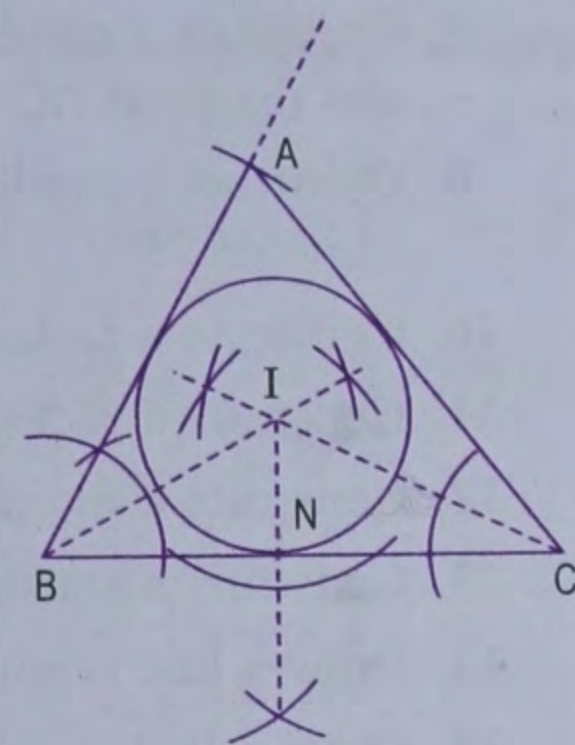
Construction 28

To construct an incircle of a given triangle.

Example 5. Construct a triangle ABC given that $BC = 5.2$ cm, $AB = 4.4$ cm and $\angle B = 60^\circ$. Also construct the incircle of ΔABC .

Steps of construction

- Construct ΔABC with the given data.
- Draw the bisectors of $\angle B$ and $\angle C$. Let these bisectors meet at the point I.
- From I, draw IN perpendicular to the side BC.
- With I as centre and radius equal to IN, draw a circle. The circle so drawn touches all the sides of ΔABC , and is the required incircle of ΔABC .



Exercise 24.5

- Construct a circle of radius 2.7 cm.
- Construct a circle of diameter 4.8 cm.
[Hint. Radius = $\frac{1}{2}$ diameter = $\left(\frac{1}{2} \times 4.8\right)$ cm = 2.4 cm.]
- Draw a line segment $PQ = 5.1$ cm. Construct a circle with PQ as diameter.
- Draw a line segment $AB = 3.8$ cm. Construct a circle of radius 2.4 cm and passing through the points A and B.
- Construct a triangle ABC with $BC = 5.6$ cm, $CA = 4.8$ cm and $AB = 6.1$ cm. Also construct the circumcircle of this triangle.
- Draw an equilateral triangle of side 5 cm and construct its circumcircle.
- Draw a right angled triangle with one side = 3.4 cm and hypotenuse = 6.2 cm. Construct its circumcircle.
- Draw an isosceles triangle whose one of equal sides is 5 cm and vertical angle is 75° . Construct its circumcircle.
- Draw a triangle with sides 6 cm, 5 cm and 4 cm. Construct its incircle.
- Draw an equilateral triangle with side 4.5 cm. Draw a circle which touches all its sides.
- Construct a triangle ABC such that $AB = 5.8$ cm, $\angle A = 60^\circ$ and $\angle B = 45^\circ$. Also construct the incircle of ΔABC .

Check Your Progress

- Construct an equilateral triangle having altitude = 4.3 cm.
- Construct a triangle ABC with $BC = 4.8$ cm, $CA = 5.2$ cm and median $AM = 5.4$ cm.

3. Construct an isosceles triangle PQR with base $PQ = 5.7$ cm and altitude RM to the base $PQ = 4.3$ cm.
4. Construct an isosceles triangle ABC given that base $BC = 6$ cm and vertical $\angle A = 120^\circ$.
[Hint. Each base angle = 30° .]
5. Construct a right angled triangle ABC right angled at B and $CA = 2BC = 5.8$ cm.
6. Construct an isosceles right angled triangle with hypotenuse 5.7 cm.
7. Draw a quadrilateral ABCD with $AB = 6$ cm, $BC = 4$ cm, $CD = 4$ cm and $\angle B = \angle C = 90^\circ$.
8. Construct a quadrilateral ABCD in which $AB = 5$ cm, $BC = 2.5$ cm, $CD = 6$ cm, $\angle BAD = 90^\circ$ and diagonal $AC = 5.5$ cm.
9. Construct a parallelogram ABCD with diagonal $AC = 4$ cm, diagonal $BD = 6$ cm and containing an angle of 75° .
10. Construct a rectangle PQRS such that $PQ = 3.5$ cm and $\angle RPS = 75^\circ$.
11. Construct a rectangle whose one diagonal is 6.8 cm and an angle between two diagonals is 105° .
12. Construct a rhombus whose diagonals are 7 cm and 5.3 cm.
13. Construct a square whose one diagonal is 5.8 cm.
14. Draw a line segment $AB = 4.9$ cm. Construct a circle with AB as diameter.
15. Draw a line segment $PQ = 4.1$ cm. Construct a circle of radius 2.6 cm and passing through the points P and Q.
16. Construct a triangle ABC having $AB = 2.3$ cm, $BC = 5.4$ cm and $\angle B = 120^\circ$. Also construct the circumcircle of this triangle.
17. Construct a triangle ABC given that $BC = 4.7$ cm, $\angle C = 60^\circ$ and median $BM = 4$ cm. Also construct the incircle of this triangle.