Chapter 24

CONSTRUCTIONS

BASIC CONSTRUCTIONS USING RULER AND COMPASS

Construction 1

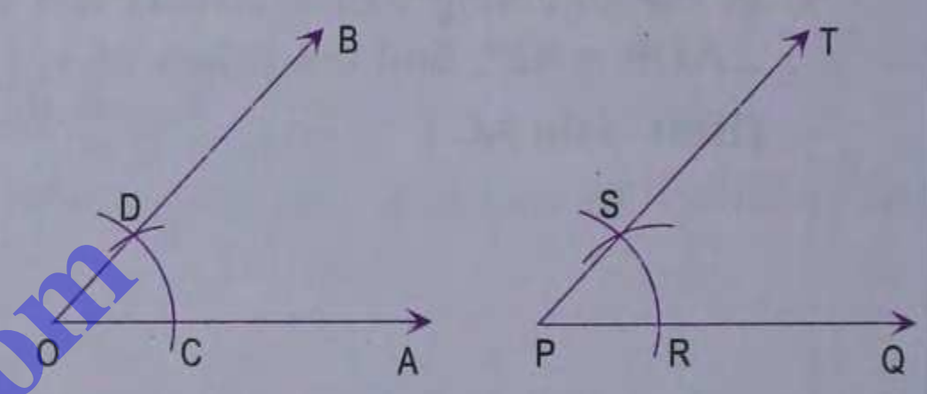
To construct an angle equal to a given angle.

Given. Any ∠AOB and a point P.

Required. To construct an angle at P equal to ∠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 ∠QPT = ∠AOB.



Construction 2

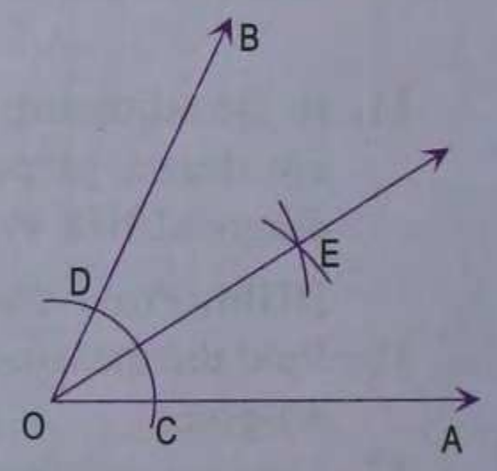
To bisect a given angle.

Given. Any ∠AOB.

Required. To bisect ∠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 ∠AOB.



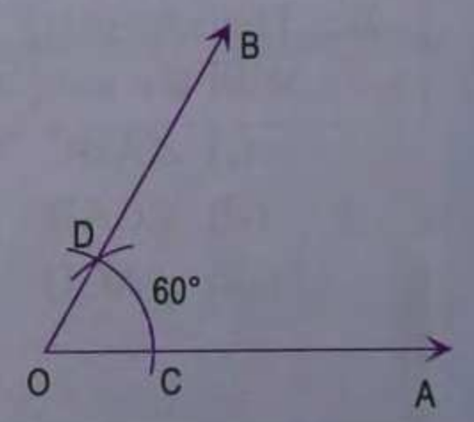
Construction 3

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

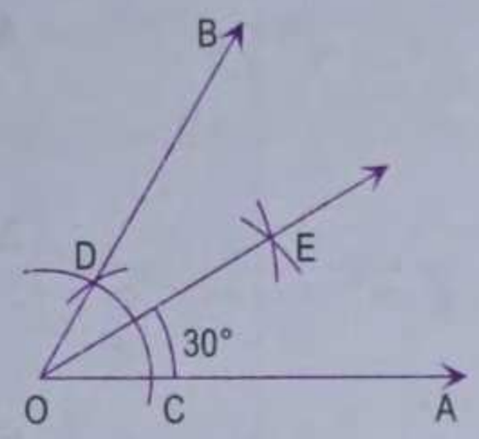
(*i*) **To construct an angle of 60°**

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 ∠AOB = 60°.



(*ii*) **To construct an angle of 30°**



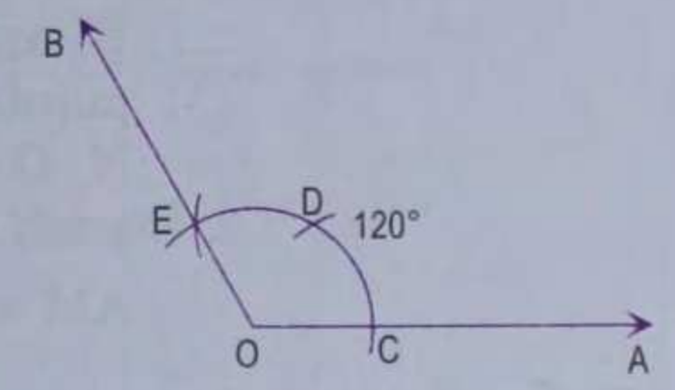
Steps of construction

1. Construct ∠AOB = 60° (as above).
2. Bisect ∠AOB (as in construction 2).
   Let ray OE be the bisector of ∠AOB, then ∠AOE = 30°.

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

Steps of construction

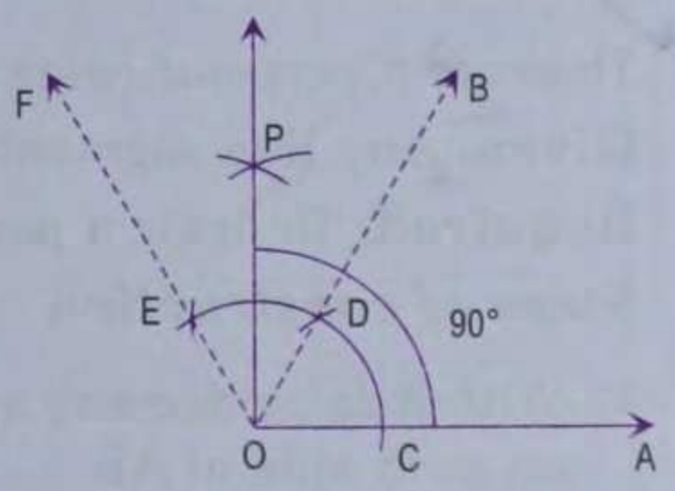
1. Draw any ray OA.
2. With O as centre and any suitable radius, draw an arc to meet OA at C.
3. With C as centre and same radius (as in step 2), draw an arc to meet the previous arc at D. With D as centre and same radius, draw another arc to cut the first arc at E.
4. Join OE and produce it to form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



(*iv*) **To construct an angle of 90°**

Steps of construction

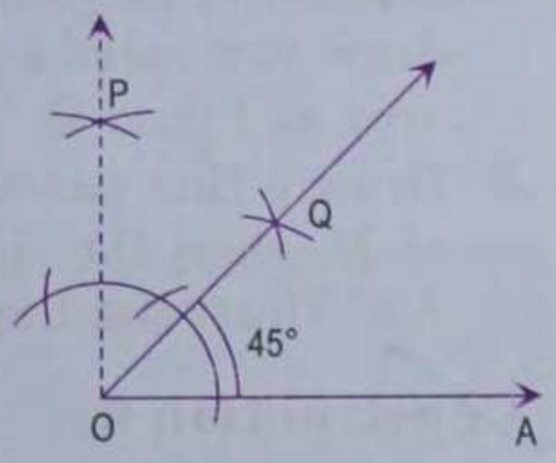
1. Construct ∠AOB = 60° (as in construction 3 (*i*)).
2. Construct ∠AOF = 120° (as above).
3. Bisect ∠BOF (as in construction 2).
   Let ray OP be the bisector of ∠BOF, then ∠AOP = 90°.



(*v*) **To construct an angle of 45°**

Steps of construction

1. Construct ∠AOP = 90° (as above).
2. Bisect ∠AOP (as in construction 2).
   Let ray OQ be the bisector of ∠AOP, then ∠AOQ = 45°.



Construction 4

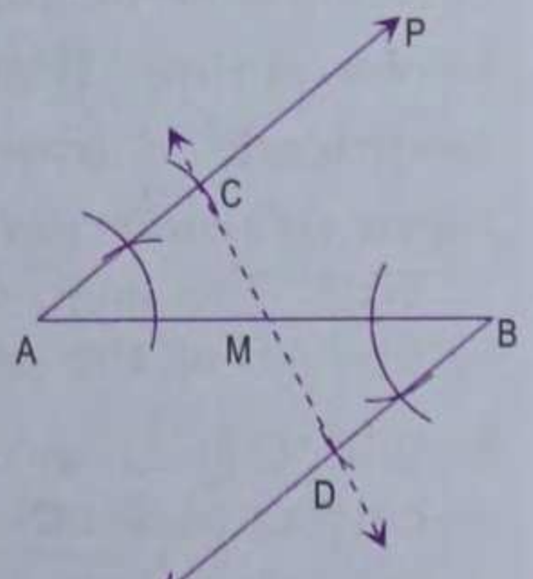
(*i*) *To bisect a given line segment.*

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 ∠ABQ = ∠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.*

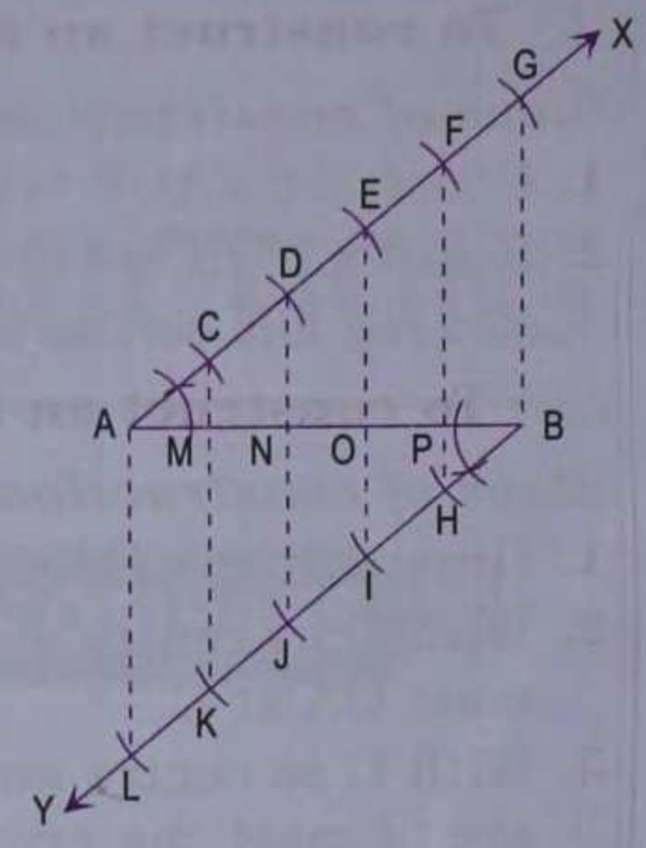
Example. Divide a line segment AB of length 7·5 cm into 5 equal parts.

Steps of construction

1. Draw line segment AB = 7·5 cm.
2. At A, construct any suitable angle XAB.
3. At B, construct ∠YBA = ∠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

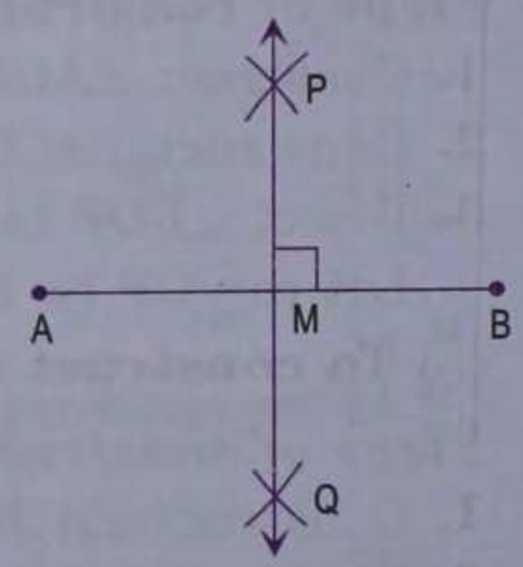
To draw a perpendicular bisector of a line segment.

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

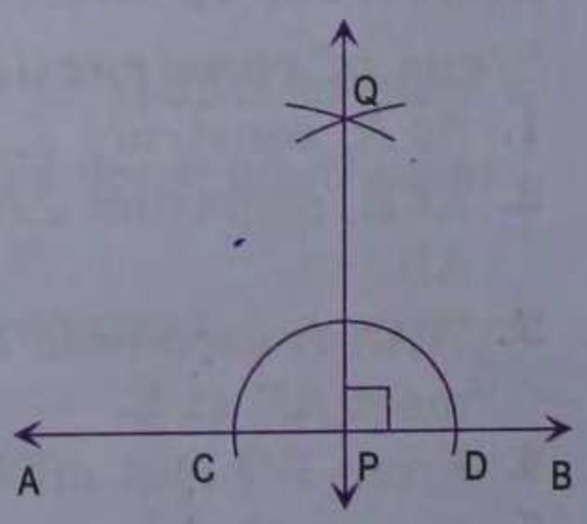
To draw a perpendicular to a line at a point on the line.

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.

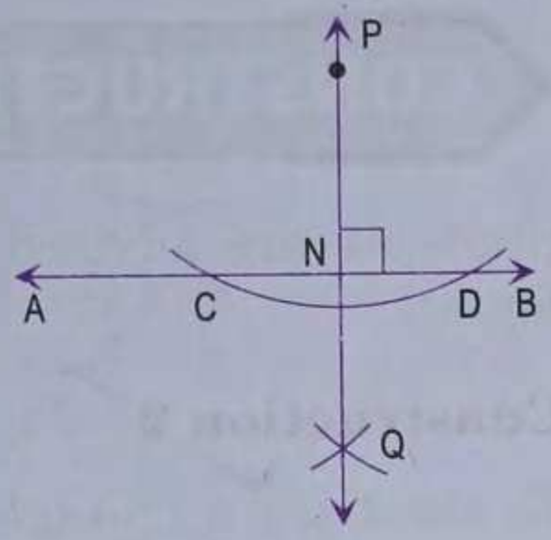
Given. A line AB and a point P outside AB.

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.

2. 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.
3. 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

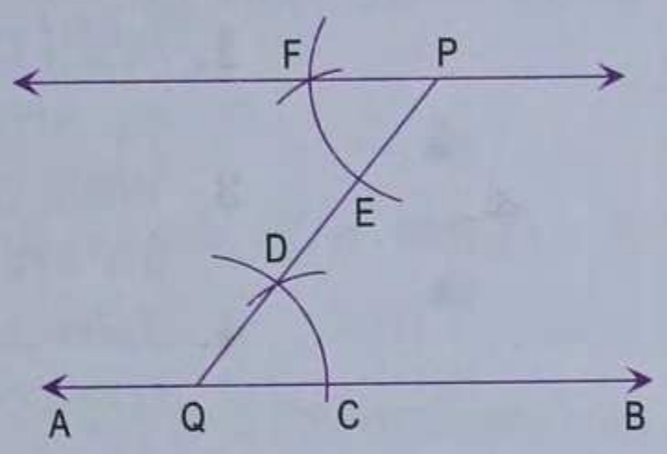
To draw a line parallel to a given line through a given point.

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

1. Take any point Q on AB. Join P and Q.
2. With Q as centre and any suitable radius, draw an arc to meet AB at C and QP at D.
3. With P as centre and same radius (as in step 2), draw an arc to meet PQ at E.
4. With E as centre and radius equal to CD, draw an arc to cut the previous arc at F.



5. 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 ∥ AB.

Exercise 24.1

1. Construct an angle of 45° and bisect it. Measure each part by protractor.
2. By using ruler and compass, construct an angle of :
   (*i*) 15° (*ii*) 75° (*iii*) 150° (*iv*) 135°.
3. Draw a line segment of 5·3 cm and draw its perpendicular bisector.
4. Draw a line segment PQ = 4·9 cm. Draw a perpendicular to it
   (*i*) from a point A outside PQ (*ii*) at a point A on PQ
5. Draw any triangle ABC. Through A, draw a line parallel to BC.
6. Draw a line AB = 5·7 cm. Using ruler and compass, construct $\angle CAB = 30°$ and $\angle CBA = 45°$. From C, draw altitude to AB.
7. Construct an angle of 135° and bisect it. Measure any one part by protractor and see how accurate you are.
8. Draw line segment PQ = 5·8 cm. Construct $\angle RPQ = 60°$ and $\angle PQR = 45°$. Through R, draw a line parallel to PQ.
9. Draw a line segment of length 6·4 cm and divide it into three equal parts.
10. 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.

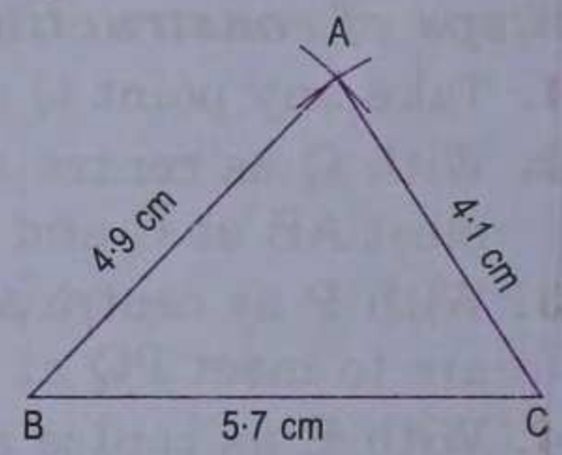
Construction 9

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.



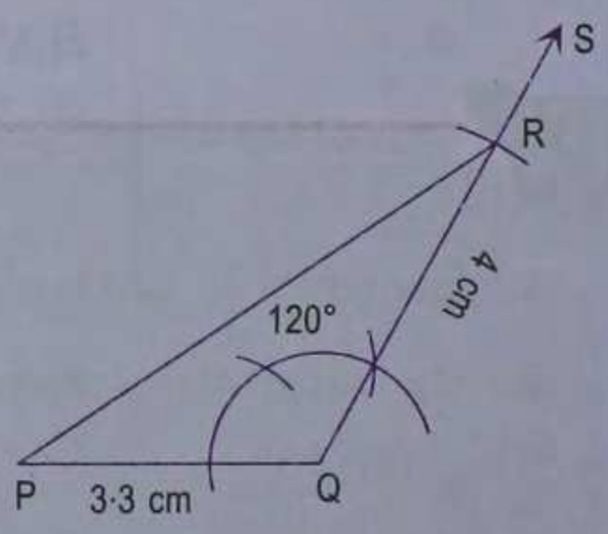
Construction 10

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 ∠Q = 120°.

Steps of construction

1. Draw a line segment PQ = 3·3 cm.
2. At Q, construct ∠PQS = 120°.
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, ∠B = 60° and ∠A = 75°.

Steps of construction

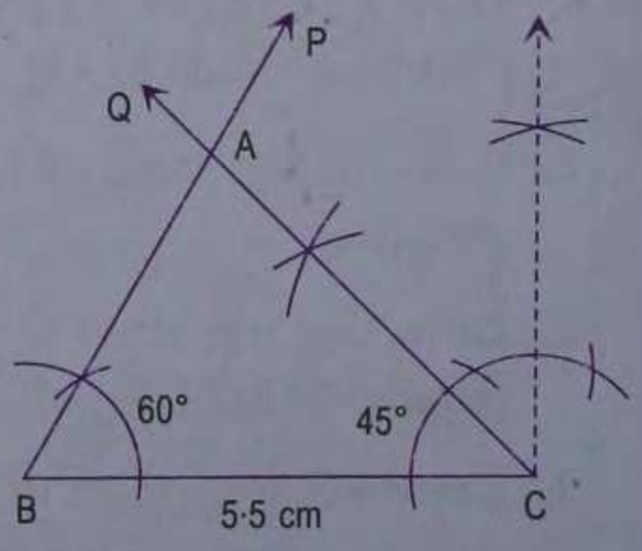
To construct ΔABC, we need ∠C.

Since sum of angles of a triangle is 180°,

∠C = 180° – ∠B – ∠A

= 180° – 60° – 75° = 45°.

1. Draw BC = 5·5 cm.
2. At B, construct ∠PBC = 60°.
3. At C, construct ∠BCQ = 45°.
4. Let BP and CQ intersect at A, then ABC is the required triangle.



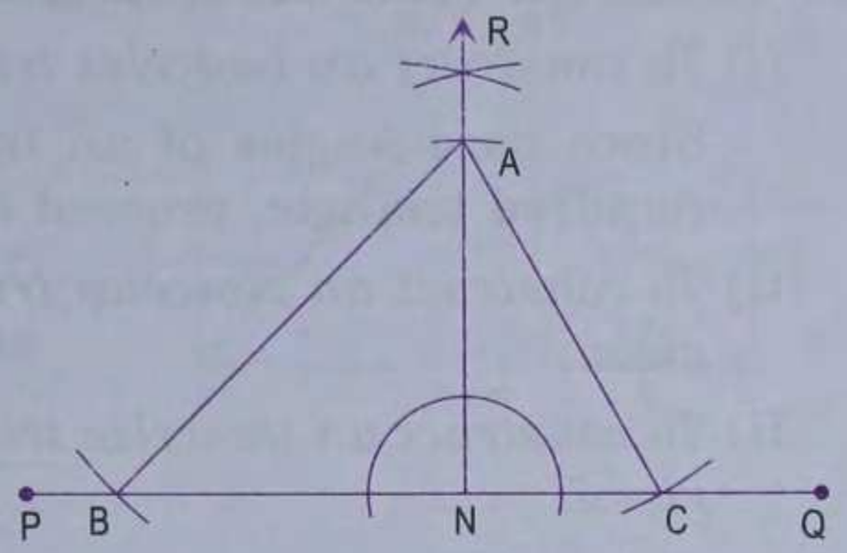
Construction 12

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.

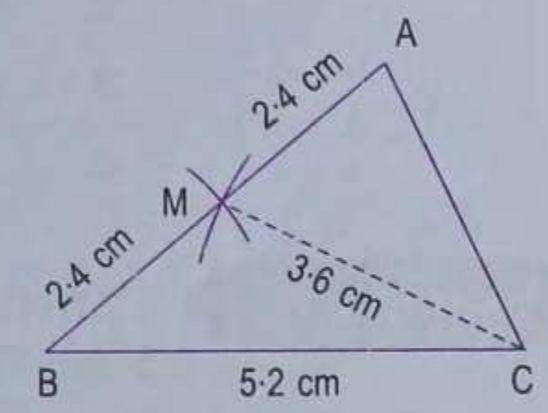
Construction 13

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 ∠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 $= \left(\frac{1}{2} \times 4{\cdot}8\right)$ cm $= 2{\cdot}4$ 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 ∠A by protractor, we find ∠A = 74° (approximately).



Construction 14

To construct equilateral triangles

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

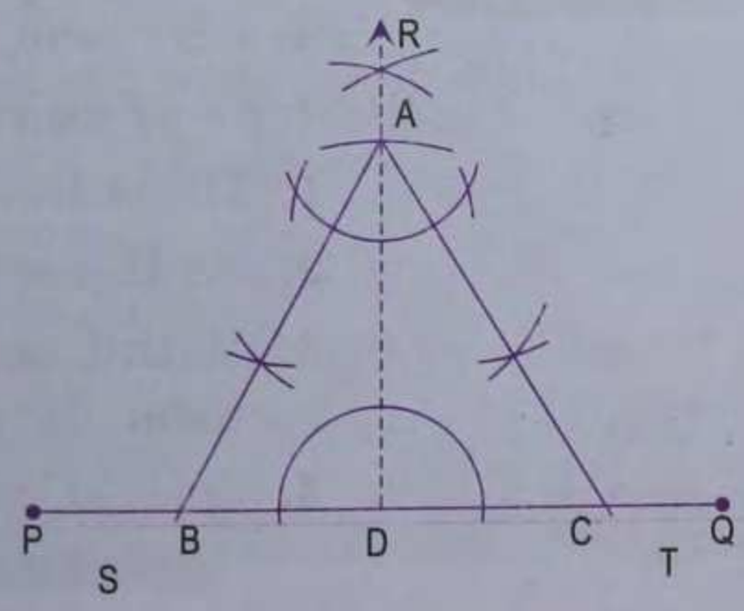
Since all the three sides of an equilateral triangle are equal, therefore, to construct the required triangle proceed as in construction 9.

(*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 ∠DAS = ∠DAT $= \frac{1}{2} \times 60° = 30°$ 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.*

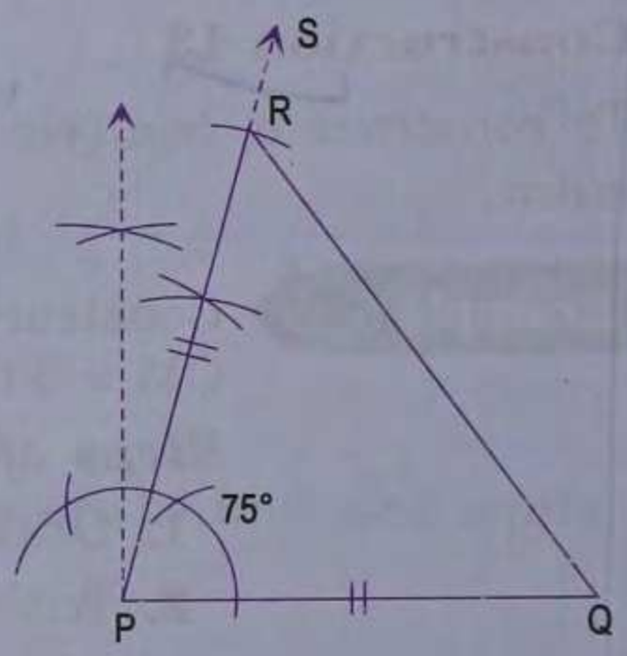
(*iii*) *To construct an isosceles triangle when its base and the altitude (from the base) are given.*

Example 7. Construct an isosceles triangle PQR having one of its equal sides PQ = 5·2 cm and the vertical ∠P = 75°.

Steps of construction

Since ∠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.

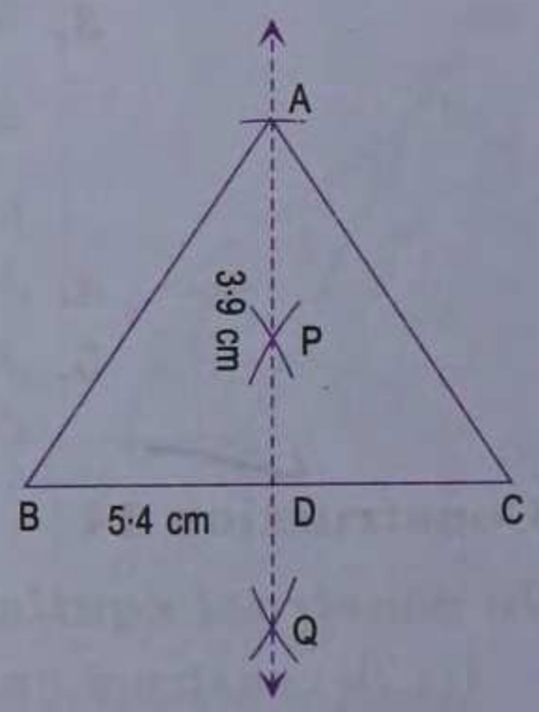
1. Draw PQ = 5·2 cm.
2. At P, construct ∠QPS = 75°.
3. Cut off PR = 5·2 cm from PS.
4. Join QR, then PQR is the required triangle.



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

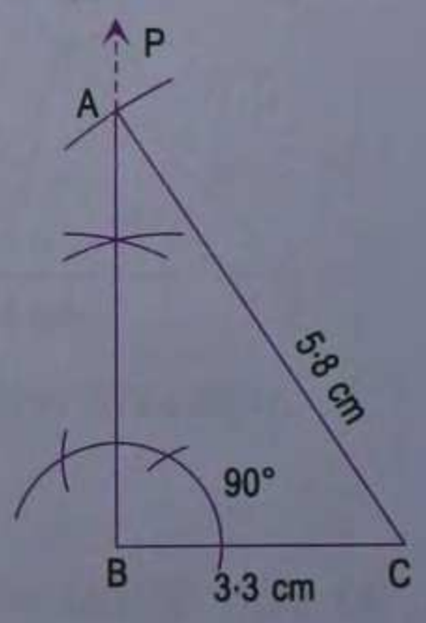
(*i*) *To construct a right angled triangle when its one side and the hypotenuse are given.*

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

Example 9. Construct a triangle ABC such that BC = 3·3 cm, ∠B = 90° and hypotenuse AC = 5·8 cm.

Steps of construction

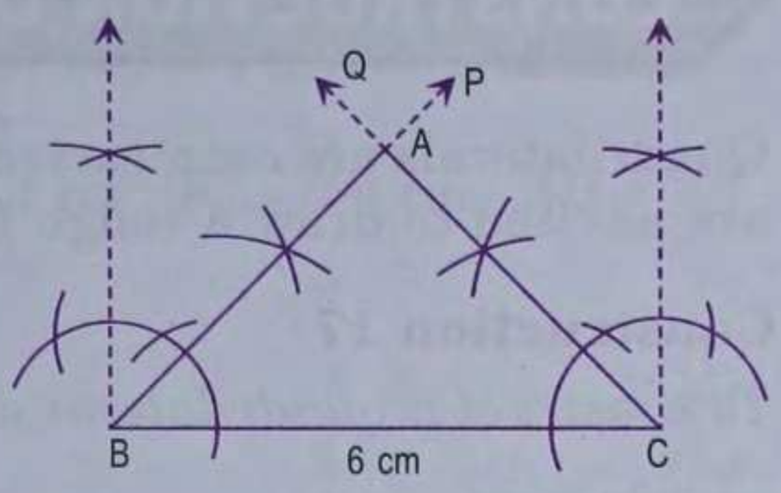
1. Draw line segment BC = 3·3 cm.
2. At B, construct ∠CBP = 90°.
3. With C as centre and radius 5·8 cm, draw an arc to meet BP at A.
4. Join AC, then ABC is the required triangle.



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 $\angle CBP = 45°$.
3. At C, construct $\angle BCQ = 45°$. 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 $\angle Q = 60°$. Measure $\angle P$ and $\angle R$. Name the triangle.
6. Construct a triangle ABC such that AB = BC = 4·6 cm and $\angle B = 75°$. Measure $\angle A$ and $\angle C$.
7. Construct a triangle PQR such that PQ = 4 cm, QR = 3 cm and $\angle Q = 90°$. Measure PR.
8. Construct a triangle ABC given that AB = 5·4 cm, $\angle A = 60°$ and $\angle B = 75°$. Measure $\angle C$. From C, draw a perpendicular to AB.
9. Construct a triangle PQR given that QR = 4·9 cm, $\angle Q = 45°$ and $\angle P = 75°$.
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, $\angle B = 60°$ 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 $\angle C = 45°$. 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, $\angle A = 90°$ 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, $\angle B = 60°$ and altitude (height) = 4·6 cm.
    [Hint. Draw BC = 6 cm. At B, construct $\angle CBP = 60°$. 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.]

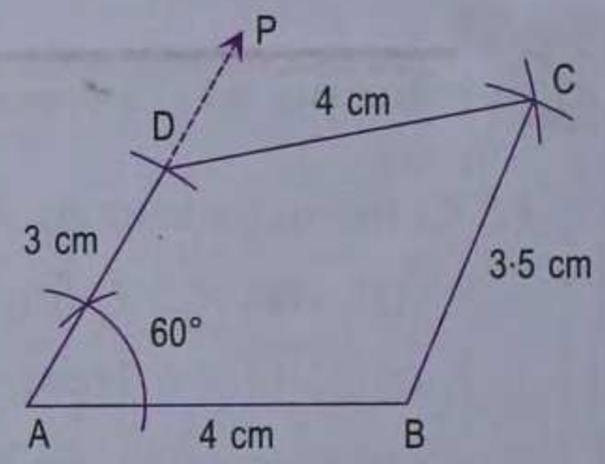
CONSTRUCTION OF QUADRILATERALS

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 ∠A = 60°.



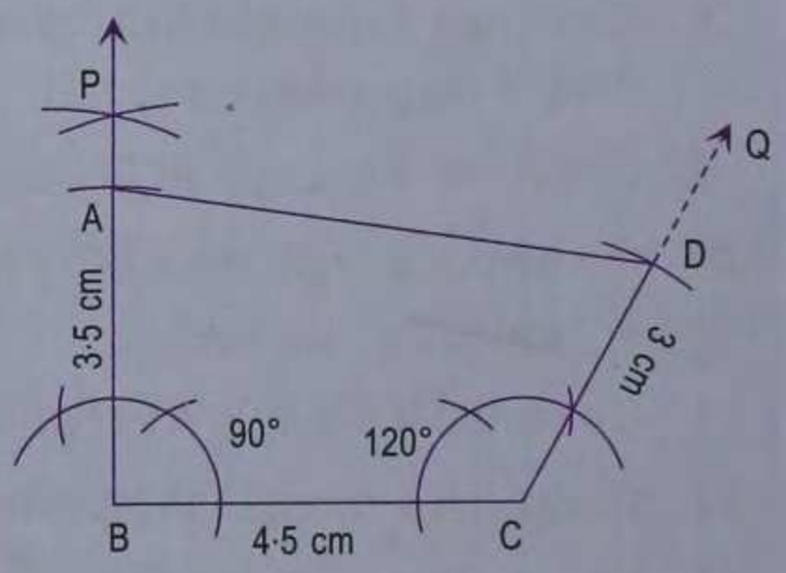
Steps of construction

1. Draw line segment AB = 4 cm.
2. At A, construct ∠BAP = 60°.
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, ∠B = 90° and ∠C = 120°.



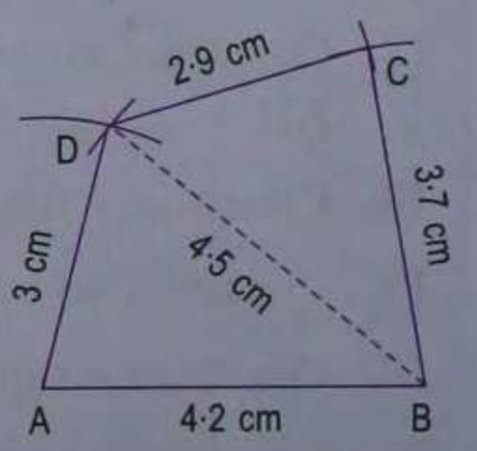
Steps of construction

1. Draw BC = 4·5 cm.
2. At B, construct ∠CBP = 90°.
3. At C, construct ∠BCQ = 120°.
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.



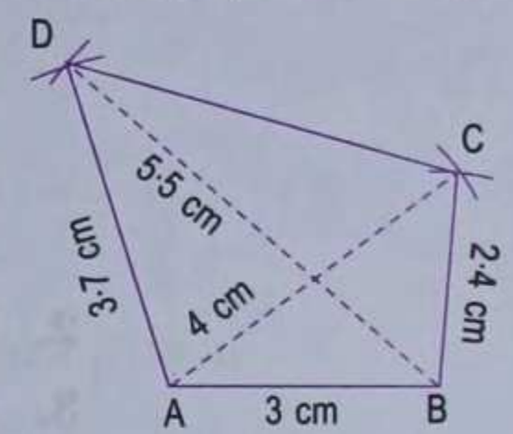
Steps of construction

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

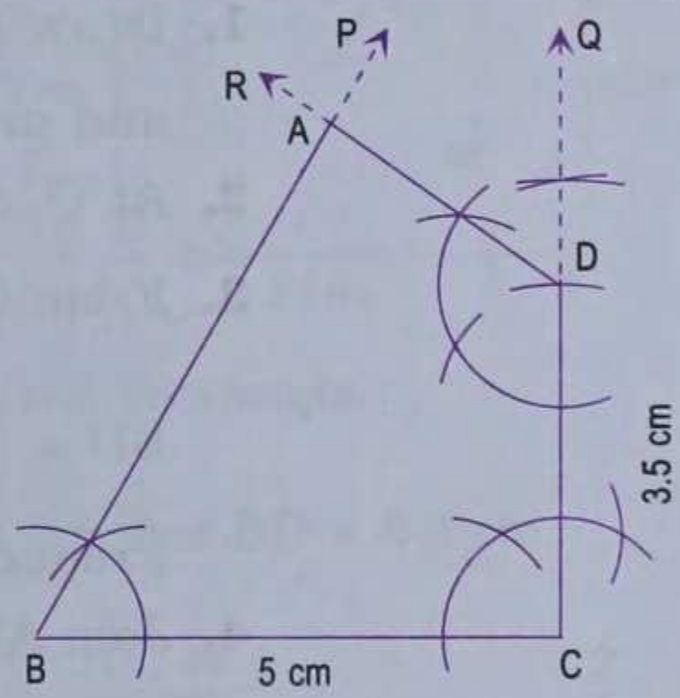
1. Construct ΔABC.
2. Construct ΔABD.
3. Join CD, then ABCD is the required quadrilateral.

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, ∠B = 60°, ∠C = 90° and ∠D = 120°.



Steps of construction

1. Draw line segment BC = 5 cm.
2. At B, construct ∠CBP = 60°.
3. At C, construct ∠BCQ = 90°.
4. From CQ, cut off CD = 3·5 cm.
5. At D, construct ∠CDR = 120°.
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.*

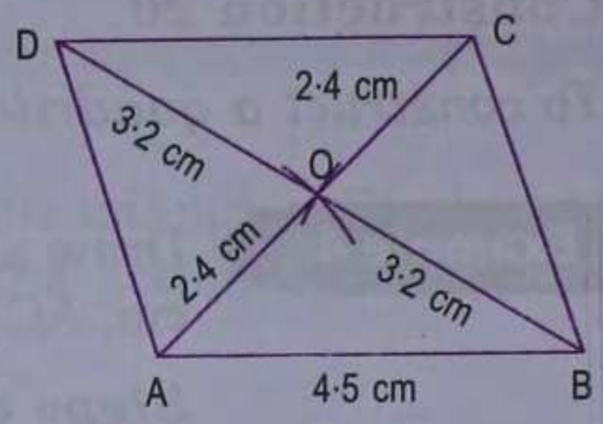
Since opposite sides of a parallelogram are equal, therefore, to construct the required parallelogram, proceed as in construction 19.

(*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 ΔOAB with AB = 4·5 cm,

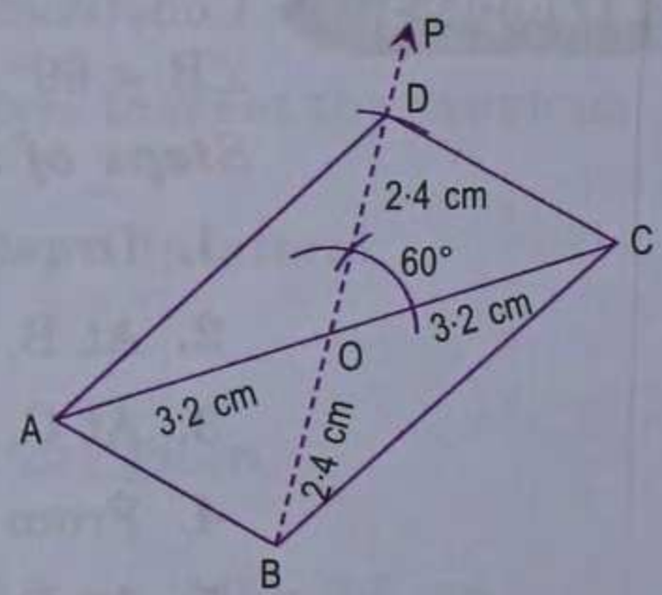
   $AO = \frac{1}{2} AC = \left(\frac{1}{2} \times 4{\cdot}8\right)$ cm = 2·4 cm and

   $BO = \frac{1}{2} BD = \left(\frac{1}{2} \times 6{\cdot}4\right)$ cm = 3·2 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 $AO = \frac{1}{2} AC = \left(\frac{1}{2} \times 6{\cdot}4\right)$ cm = 3·2 cm and produce AO to C such that OC = OA.
2. At O, construct $\angle COP = 60°$.
3. From OP, cut $OD = \frac{1}{2}$

   $BD = \left(\frac{1}{2} \times 4{\cdot}8\right)$ cm = 2·4 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 $\angle B = 60°$.
2. Construct a quadrilateral ABCD such that AB = 5 cm, BC = 4·2 cm, AD = 3·5 cm, $\angle A = 90°$, $\angle B = 60°$.
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, $\angle B = 45°$, $\angle C = 90°$ and $\angle D = 120°$.
6. Construct a parallelogram ABCD such that AB = 5 cm, BC = 3·2 cm and $\angle B = 120°$.
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.

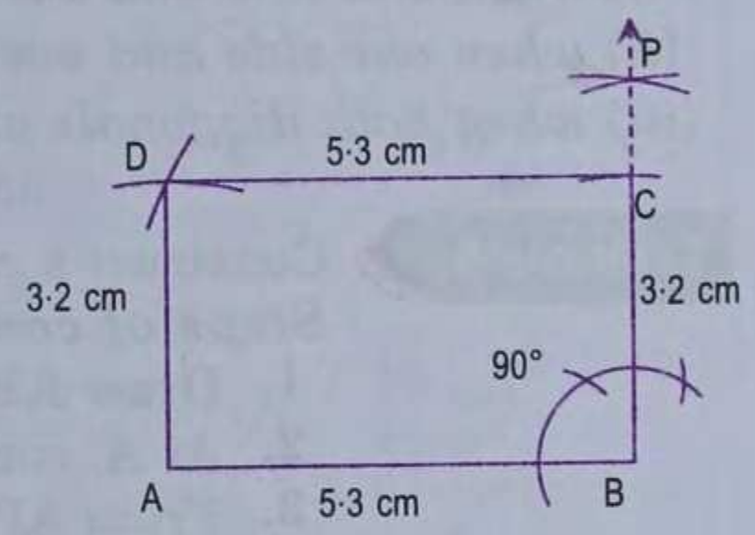
(iii) when one side and the angle between the side and a diagonal are given.

(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

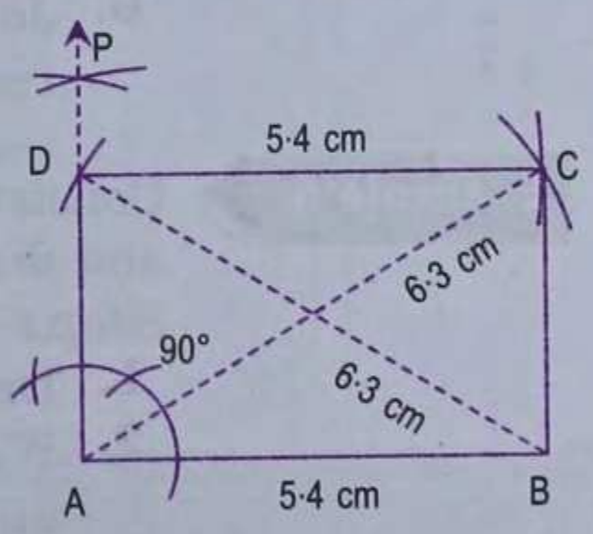
1. Draw AB = 5·3 cm.
2. At B, construct ∠ABP = 90°.
3. From BP, cut off BC = 3·2 cm.
4. With C as centre and radius = 5·3 cm, draw an arc.
5. With A as centre and radius = 3·2 cm, draw an arc to meet the previous arc at D.
6. Join AD and CD. Then ABCD is the required rectangle.



Example 2. Construct a rectangle ABCD such that AB = 5·4 cm and BD = 6·3 cm.

Steps of construction

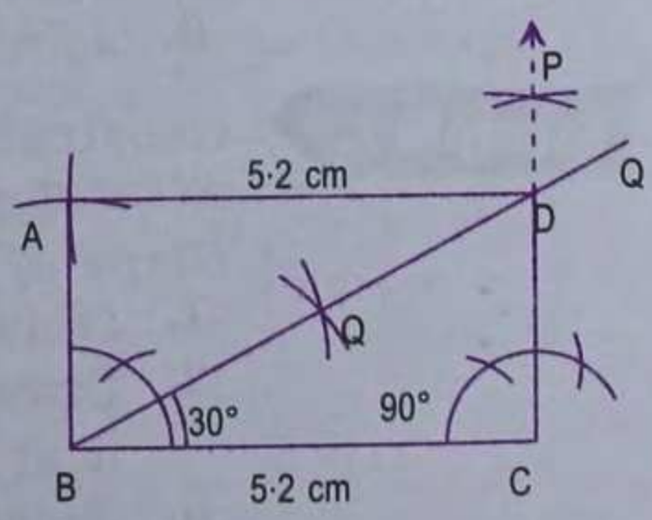
1. Draw AB = 5·4 cm.
2. At A, construct ∠BAP = 90°.
3. With B as centre and radius = 6·3 cm, draw an arc to meet AP at D.
4. With A as centre and radius = 6·3 cm draw an arc.
5. With D as centre and radius = 5·4 cm, draw an arc to meet the previous arc at C.
6. Join BC and CD. Then ABCD is the required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



Example 3. Construct a rectangle ABCD given that BC = 5·2 cm and ∠DBC = 30°.

Steps of construction

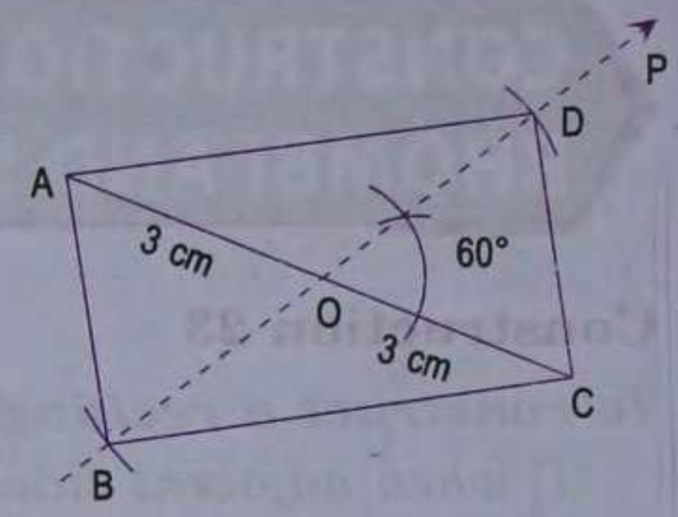
1. Draw BC = 5·2 cm.
2. At C, construct ∠BCP = 90°.
3. At B, construct ∠CBQ = 30°. Let BQ meet CP at D.
4. With D as centre and radius = 5·2 cm draw an arc.
5. With B as centre and radius = CD, draw an arc to meet the previous arc at A.
6. Join AB and AD, then ABCD is the required rectangle.



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



Construction 24

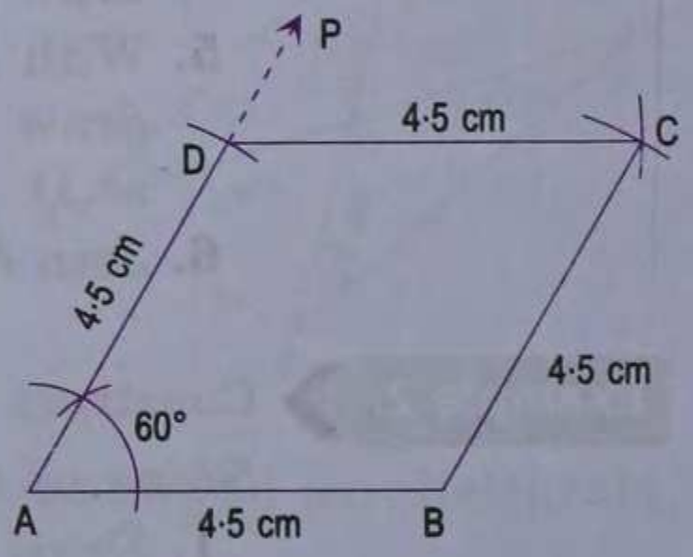
To construct rhombus :

(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 cm and ∠A = 60°.

Steps of construction

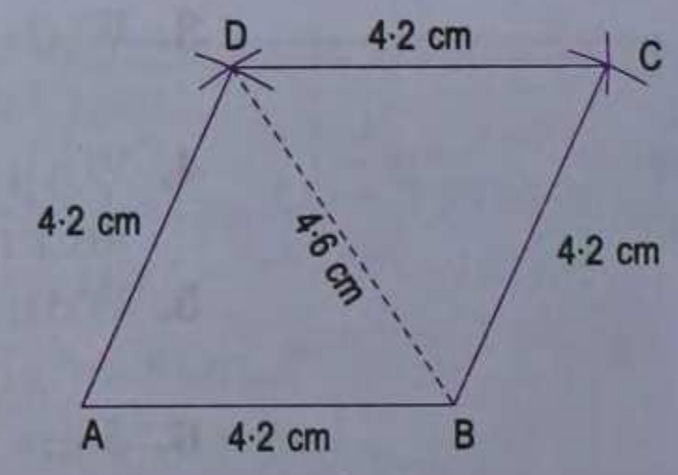
1. Draw AB = 4·5 cm.
2. At A, construct ∠BAP = 60°.
3. From AP, cut off AD = 4·5 cm.
4. With B as centre and radius = 4·5 cm, draw an arc.
5. With D as centre and radius 4·5 cm, draw an arc to meet the previous arc at C.
6. Join BC and CD. Then ABCD is the required rhombus.



Example 6. Construct a rhombus ABCD such that AB = 4·2 cm and diagonal BD = 4·6 cm.

Steps of construction

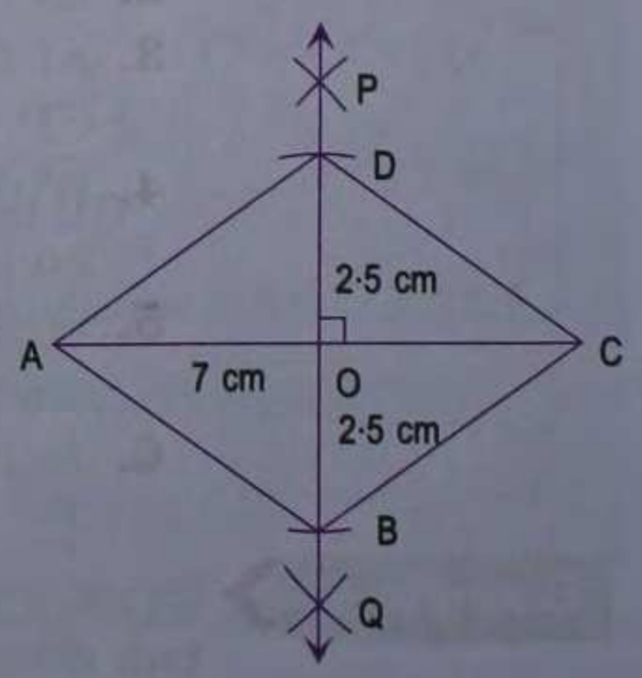
1. Draw AB = 4·2 cm.
2. With A as centre and radius = 4·2 cm, draw an arc.
3. With B as centre and radius = 4·6 cm, draw an arc to meet the previous arc at D.
4. With B as centre and radius = 4·2 cm, draw an arc.
5. With D as centre and radius = 4·2 cm, draw an arc to meet the previous arc at C.
6. Join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



Example 7. Construct a rhombus ABCD whose diagonal AC = 7 cm and diagonal BD = 5 cm.

Steps of construction

1. Draw AC = 7 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 = $\left(\frac{1}{2}\times 5\right)$ cm = 2·5 cm.
4. Join AB, BC, CD and DA. Then ABCD is the required rhombus.



Construction 25

To construct a square :

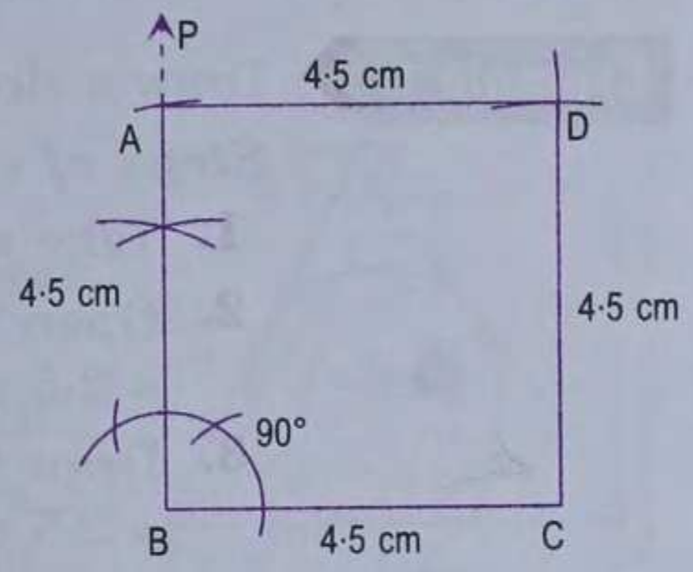
(i) when one side is given.

(ii) when one diagonal is given.

Example 8. Construct a square ABCD whose side BC = 4·5 cm.

Steps of construction

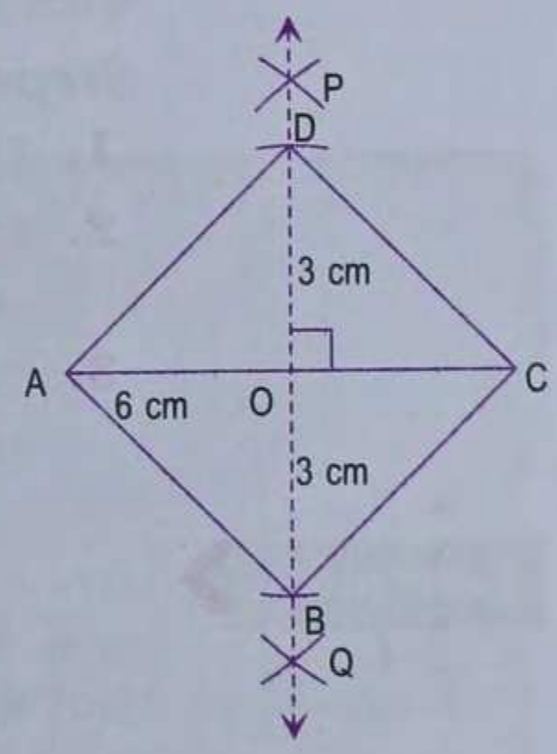
1. Draw BC = 4·5 cm.
2. At B, construct $\angle CBP = 90°$.
3. From BP, cut off BA = 4·5 cm.
4. With C as centre and radius = 4·5 cm, draw an arc.
5. With A as centre and radius = 4·5 cm, draw an arc to meet the previous arc at D.
6. Join AD and CD. Then ABCD is the required square.



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 $= \left(\frac{1}{2} \times 6\right)$ cm = 3 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 $\angle BAC = 60°$.
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

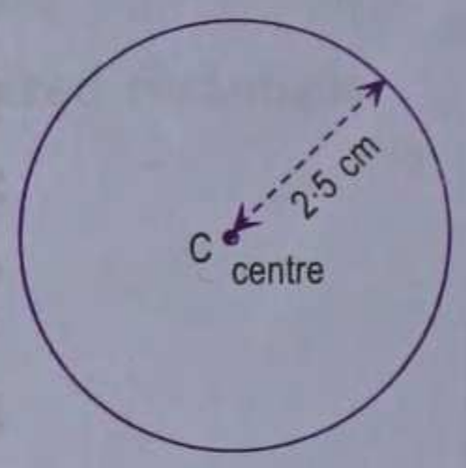
Construction 26

(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

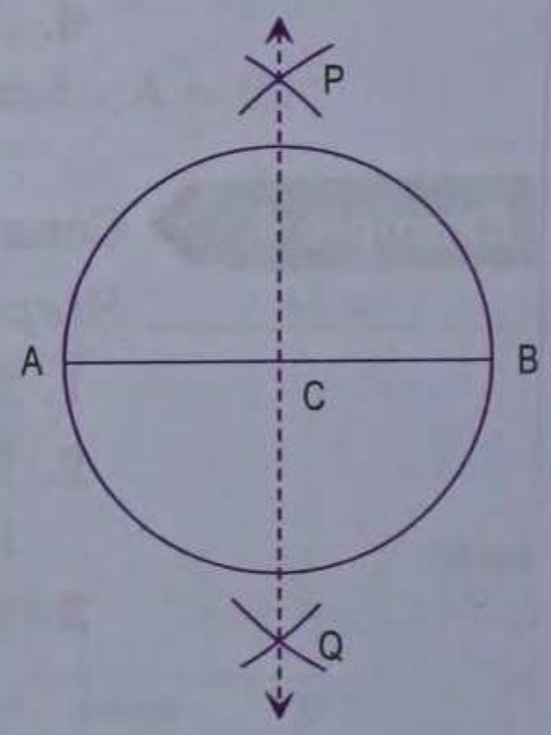
1. Take any point C as centre.
2. Open the compass and take its opening = 2·5 cm.
3. Draw the circle with C as centre and radius = 2·5 cm.



Example 2. Draw a line segment AB = 4·8 cm. Construct a circle with AB as diameter.

Steps of construction

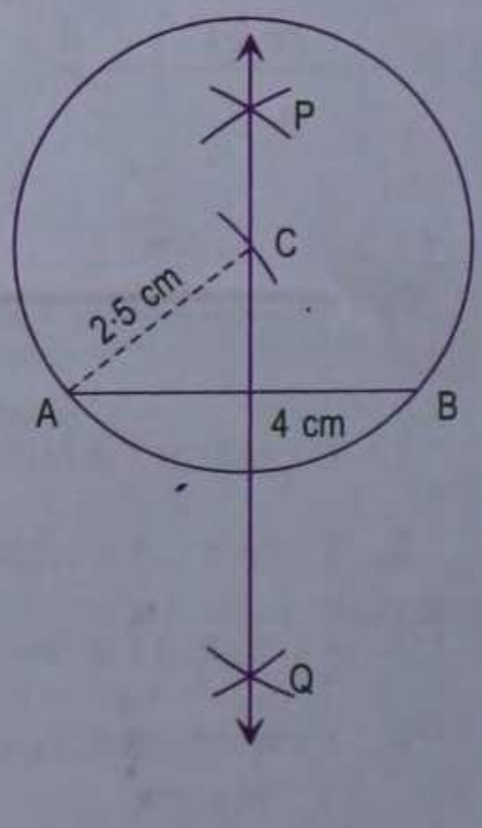
1. Draw line segment AB = 4·8 cm.
2. Draw perpendicular bisector PQ of line segment AB. Let PQ meet AB at C.
3. With C as centre and radius = CA, draw the circle.



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.



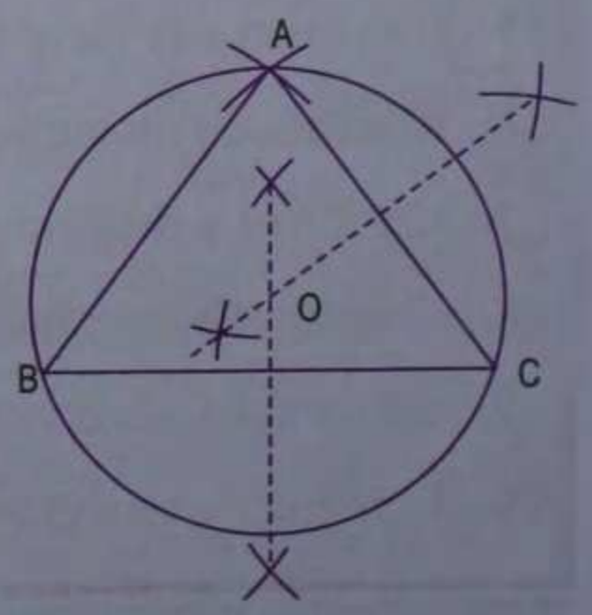
Construction 27

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.



3. 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.

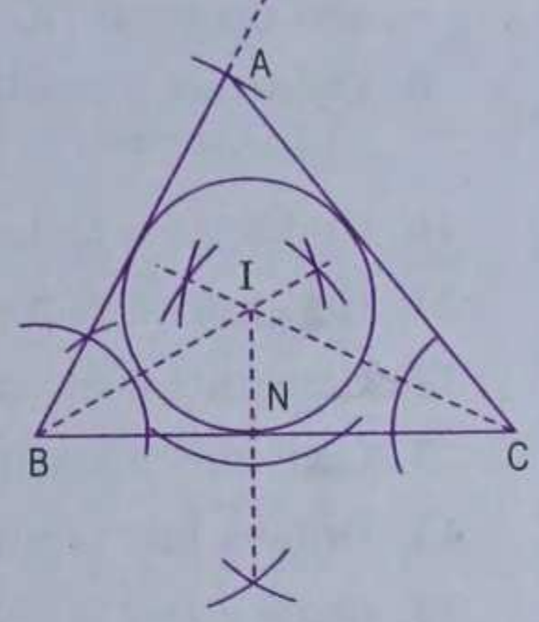
Construction 28

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 $\angle B = 60°$. Also construct the incircle of ΔABC.

Steps of construction

1. Construct ΔABC with the given data.
2. Draw the bisectors of $\angle B$ and $\angle C$. Let these bisectors meet at the point I.
3. From I, draw IN perpendicular to the side BC.
4. 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 Δ ABC.



Exercise 24.5

1. Construct a circle of radius 2·7 cm.
2. Construct a circle of diameter 4·8 cm.

   [Hint. Radius = $\frac{1}{2}$ diameter = $\left(\frac{1}{2} \times 4{\cdot}8\right)$ cm = 2·4 cm.**]**
3. Draw a line segment PQ = 5·1 cm. Construct a circle with PQ as diameter.
4. Draw a line segment AB = 3·8 cm. Construct a circle of radius 2·4 cm and passing through the points A and B.
5. 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.
6. Draw an equilateral triangle of side 5 cm and construct its circumcircle.
7. Draw a right angled triangle with one side = 3·4 cm and hypotenuse = 6·2 cm. Construct its circumcircle.
8. Draw an isosceles triangle whose one of equal sides is 5 cm and vertical angle is 75°. Construct its circumcircle.
9. Draw a triangle with sides 6 cm, 5 cm and 4 cm. Construct its incircle.
10. Draw an equilateral triangle with side 4·5 cm. Draw a circle which touches all its sides.
11. Construct a triangle ABC such that AB = 5·8 cm, $\angle A = 60°$ and $\angle B = 45°$. Also construct the incircle of ΔABC.

Check Your Progress

1. Construct an equilateral triangle having altitude = 4·3 cm.
2. 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 $\angle A = 120°$.
   [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 $\angle B = \angle C = 90°$.
8. Construct a quadrilateral ABCD in which AB = 5 cm, BC = 2·5 cm, CD = 6 cm, $\angle BAD = 90°$ 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 $\angle RPS = 75°$.
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 $\angle B = 120°$. Also construct the circumcircle of this triangle.
17. Construct a triangle ABC given that BC = 4·7 cm, $\angle C = 60°$ and median BM = 4 cm. Also construct the incircle of this triangle.