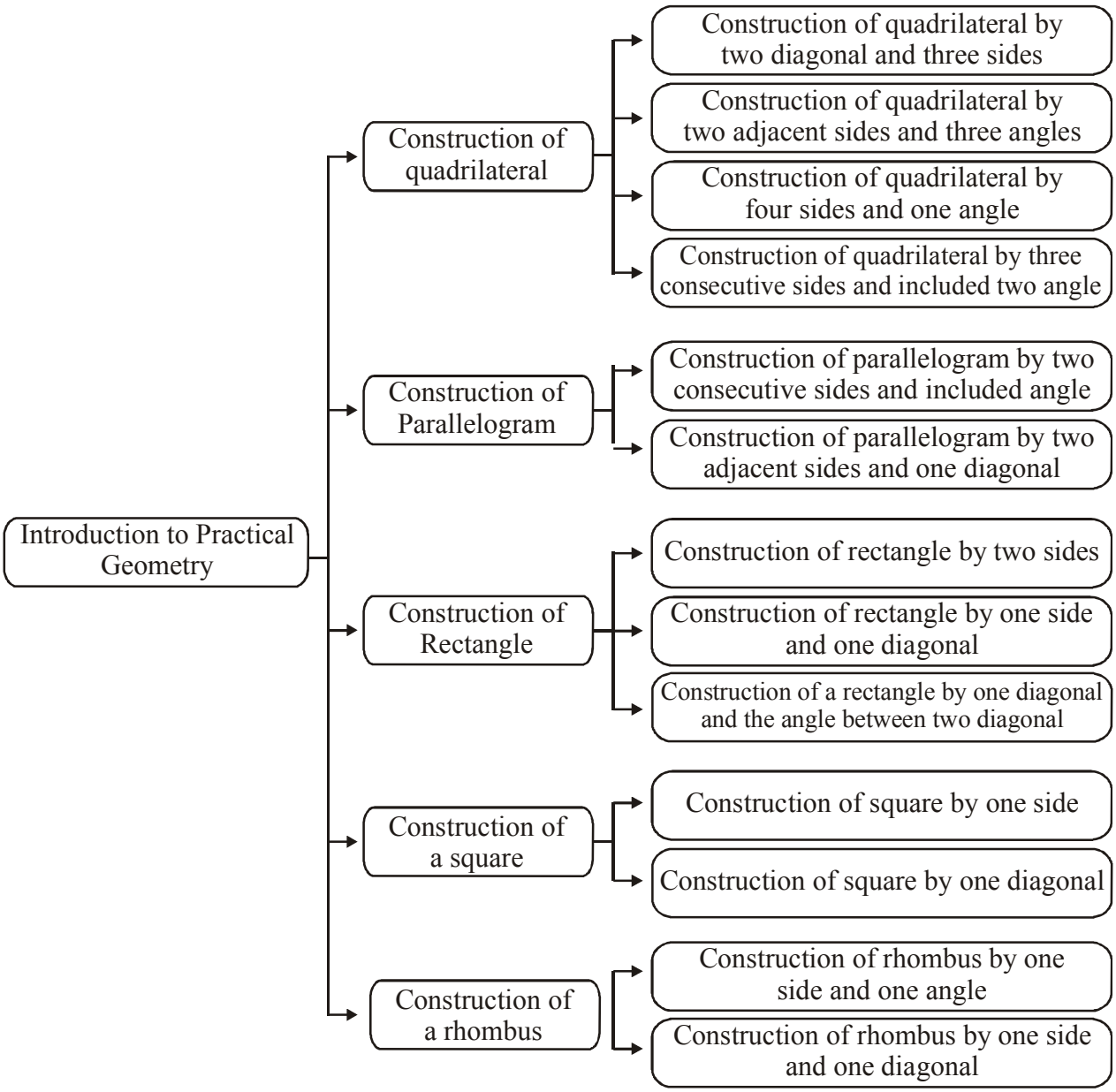
14 PRACTICAL GEOMETRY

CONCEPT TREE



14.1 INTRODUCTION

In lower classes, we have studied properties of triangles and also how these properties can be used in construction of triangles. In this chapter we will learn how to use properties of quadrilaterals in the construction of quadrilaterals. It is known that three independent measurements are required to construct a triangle. That is, to determine three points, three measurements are required. Now, to construct a quadrilateral we need to determine four vertices. Three measurements are required to determine three vertices, so another two measurements are required to determine fourth vetex. Therefore five independent measurements are required to construct a quadrilateral. In the following section we will learn how to construct a quadrilateral when five independent measurements are provided.

A simple closed plane figure bounded by four line segments is called a quadrilateral

- When four sides and one diagonal are given a quadrilateral can be constructed.
- When two diagonals and three sides are given a quadrilateral can be constructed.
- When two adjacent sides and three angles are given a quadrilateral can be constructed.
- When three sides and two included angles are given a quadrilateral can be constructed

14.2 CONSTRUCTION OF QUADRILATERALS

14.2.1 When two diagonals and three sides are given

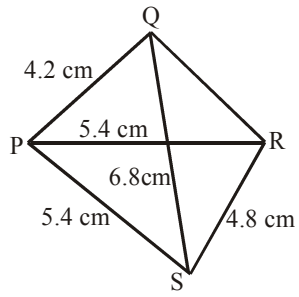


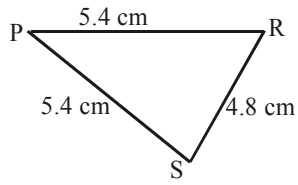
Illustration 1

Construct a quadrilateral PQRS, with PQ = 4.2 cm, PS = 5.4 cm, RS = 4.8 cm, PR = 5.4 cm and QS = 6.8 cm.

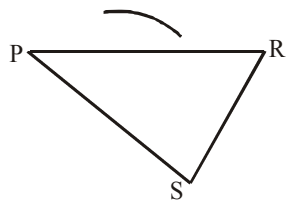
Solution

Rough sketch of the quadrilateral will help us to select the sequence of steps

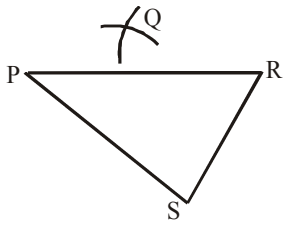
Step-1: Draw a triangle PSR as the three sides are known.



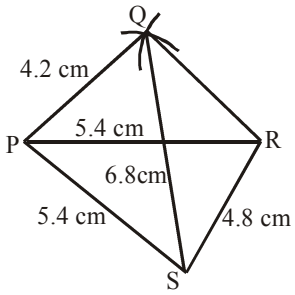
Step-2: With P as centre, with a radius equal to 4.2 cm draw an arc.



Step-3: With 'S' as centre with a radius of 6.8 cm draw an arc which intersects previous arc at Q.

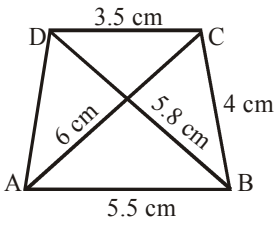


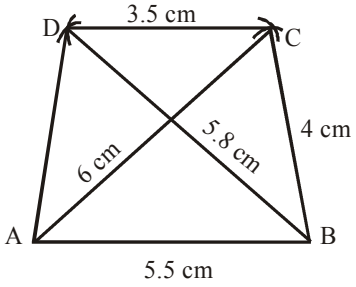
Step-4: Join QP and QR



Example 2:

Construct a quadrilateral ABCD, given that AB = 5.5 cm, BC = 4 cm, CD = 3.5 cm, AC = 6 cm and BD = 5.8 cm.





Solution:

Step-1: Draw AB = 5.5 cm.

Step-2: With A as centre and radius equal to 6 cm, draw an arc.

Step-3: With B as, centre and radius equal to 4 cm, draw another arc cutting first arc at C.

Step-4: Join AC and BC.

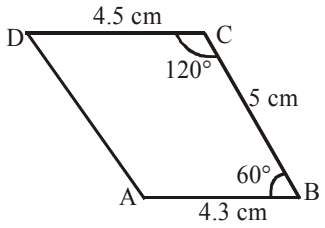
Step-5: With C as centre and radius equal to 3.5 cm, draw an arc.

Step-6: With B as centre and radius equal to 5.8 cm, draw another arc cutting the first arc at D.

Step-7: Joint AD, CD and BD. Then ABCD is the required quadrilateral.

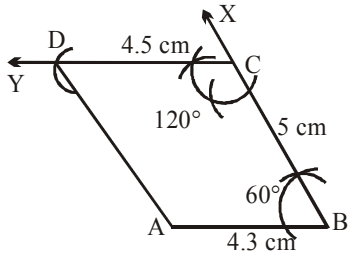
Example 3:

Construct a quadrilateral ABCD, given that AB = 4.3 cm, BC = 5 cm, CD = 4.5 cm, ∠B = 60° and ∠C = 120°. First draw a rough figure.



Solution:

Step-1: Draw AB = 4.3 cm.
Step-2: At B draw ∠XBA = 60°.
Step-3: With B as centre and radius equal to 5 cm, draw an arc cutting BX at C.
Step-4: At C draw ∠YCB = 120°
Step-5: With C as centre and radius equal to 4.5 cm, draw an arc cutting CY at D.
Step-6: Join AD. Then ABCD is the required quadrilateral.



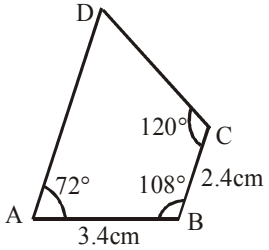
14.2.2 When two adjacent sides and three angles are given

Example 4:

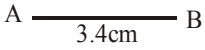
Construct a quadrilateral ABCD where AB = 3.4 cm, BC = 2.4 cm, ∠A = 72°, ∠B = 108° and ∠C = 120°.

Solution:

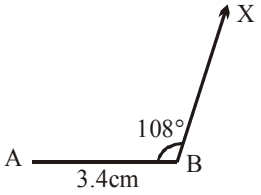
Rough sketch of the quadrilateral will help us to select the sequence of steps



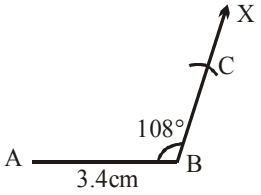
Step-1: Draw a line segment AB = 3.4 cm.



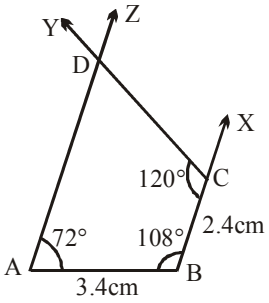
Step-2: Draw $\overrightarrow{BX}$ such that $\angle ABX = 108°$.



Step-3: Mark the point C on $\overrightarrow{BX}$ such that BC = 2.4 cm



Step-4: Draw $\overrightarrow{AZ}$ and $\overrightarrow{CY}$ such that $\angle BAZ = 72°$ and $\angle BCY = 120°$ respectively. Mark their intersection point as D.

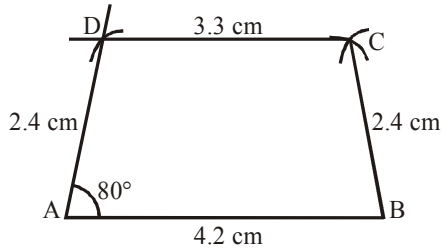


14.2.3 When four sides and one angle are given

Example 5:

Construct a quadrilateral ABCD in which AB = 4.2 cm, $\angle A = 80°$, BC = 2.4 cm, CD = 3.3 cm and AD = 2.4 cm.

Solution:



Step-1: Draw a line segment AB = 4.2 cm

Step-2: Draw $\angle BAX = 80°$.

Step-3: Mark D on AX, such that AD = 2.4 cm

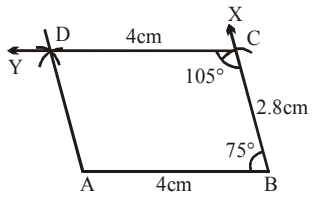
Step-4: Taking D as the centre and 3.3 cm as the radius, draw an arc and taking 'B' as the centre and 2.4 cm as radius. draw another arc to intersect the previous arc at C.

Step-4: Join CD and BC. ABCD is the required quadrilateral.

14.2.4 When three consecutive sides and two included angles are given.

Example 6: Construct a quadrilateral ABCD with AB = 4 cm, BC = 2.8 cm, CD = 4 cm, $\angle B = 75°$ and $\angle C = 105°$.

Solution:



Step-1: Draw a line segment AB = 4 cm

Step-2: Draw $\overrightarrow{BX}$ such that $\angle ABX = 75°$.

Step-3: Mark on $\overrightarrow{BX}$ such that BC = 2.8 cm

Step-4: Draw $\overrightarrow{CY}$ with makes an angle 105° with $\overline{BX}$.

Step-5: Mark D on $\overline{CY}$, such that CD = 4 cm.

Step-6: Join AD. ABCD is the required quadrilateral.

14.2.5 When four sides and one diagonal are given

Example 7:

Construct a quadrilateral ABCD in which AB = 4.6 cm, BC = 2.6 cm, CD = 3.5 cm, AD = 2.6 cm and the diagonal AC = 4.9 cm.

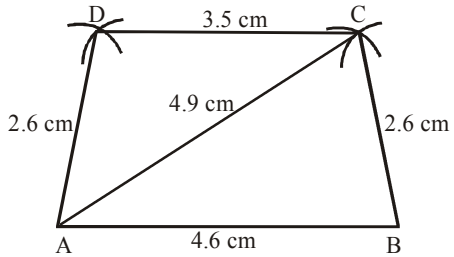
Solution:

Step-1: Draw a line segment AB = 4.6 cm.

Step-2: With A and B as centres, draw two arcs of radii 4.9 cm and 2.6 cm respectively to intersect each other at C.

Step-3: With C and A as centres, draw two arcs of radii 3.5 cm and 2.6 cm respectively to intersect at D.

Step-4: Join BC, CD and AD to form quadrilateral ABCD. ABCD is the required quadrilateral.



In a parallelogram opposite sides are equal and diagonals need not be equal while diagonal bisect each other.

14.3 CONSTRUCTION OF A PARALLELOGRAM

14.3.1 When two consecutive sides and the included angle are given

Example 8:

Construct a parallelogram ABCD, when AB = 4 cm, BC = 2.5 cm and ∠B = 100°,

Solution:

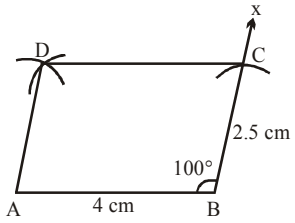
Step-1: Draw a line segment AB = 4 cm.

Step-2: Construct line BX such that ∠ABX = 100°.

Step-3: Taking B as the centre and the radius = 2.5 cm, draw an arc to cut $\overrightarrow{BX}$ at C.

Step-4: With C and A as centres draw two arcs and with 4 cm and 2.5 cm as radii respectively to intersect at D.

Step-5: Join AD and CD. ABCD is the required parallelogram,



14.3.2 When two adjacent sides and one diagonal are given.

Example 9:

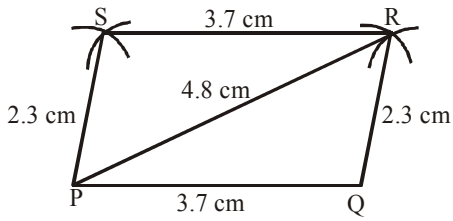
Construct a parallelogram PQRS, when PQ = 3.7 cm, QR =2.3 cm and PR = 4.8 cm.

Solution:

Step-1: Draw a line segment PQ = 3.7 cm.

Step-2: Draw an arc with P as the centre and a radius of 4.8 cm.

Step-3: With Q as the centre and QR = 2.3 cm, draw another arc to intersect the previous arc of Step 2 at R and join QR.



Step-4: With R as the centre, draw an arc of radius 3.7 cm.

Step-5: With P as the centre, draw another arc of radius 2.3 cm to intersect the arc in step-4 at S. Join RS and PS. PQRS is the required parallelogram.

In a parallelogram, if one angle is a right angle, then it is called a rectangle. In a rectangle the diagonals are equal and they bisect each other.

14.4 CONSTRUCTION OF A RECTANGLE

14.4.1 When two adjacent sides are given

Example 10:

Construct a rectangle PQRS with PQ = 5.2 cm and QR = 2.6 cm.

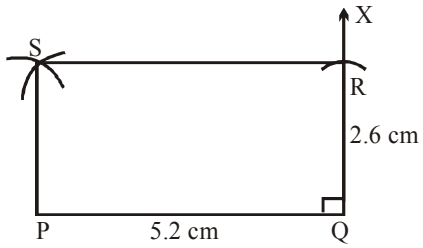
Solution:

Step-1: Draw PQ = 5.2 cm

Step-2: At Q, construct a right angle, such that ∠PQX =90°.

Step-3: Taking Q as the centre and 2.6 cm as radius, draw an arc to cut $\overrightarrow{QX}$, at R.

Step-4: With R and P as centres draw two arcs with radii 5.2 cm and 2.6 cm respectively to cut each other at S. Join PS and RS. PQRS is the required rectangle.



14.4.2 When a side and a diagonal are given.

Example 11:

Construct a rectangle PQRS with PQ = 5.3 cm and diagonal PR = 5.8 cm.

Solution:

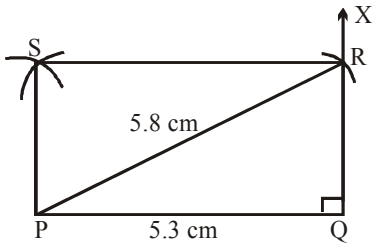
Step-1: Draw a line segment PQ = 5.3 cm.

Step-2: At Q, construct ∠PQX = 90°.

Step-3: Taking P as the centre and 5.8 cm as radius, draw an arc to cut $\overrightarrow{QX}$ at R.

Step-4: With R and Q as centres, 5.3 cm and 5.8 cm respectively as radii, draw two arcs to intersect each other at S.

Step-5: Join RS and PS to form the required rectangle PQRS.



14.4.3 When one diagonal and the angle between two diagonals are given

Example 12:

Construct a rectangle PQRS such that PR = 5.2 cm and the angle between the diagonals is 50°.

Solution:

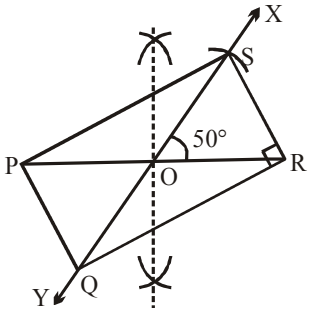
Step-1: Draw a line segment PR = 5.2 cm.

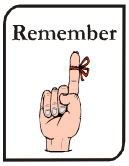
Step-2: Mark the midpoint of PR as O.

Step-3: Draw $\overleftrightarrow{XY}$ which makes an angle of 50° with $\overline{PR}$ at the point O.

Step-4: With O as the centre and with radius equal to $\frac{1}{2}$(PR) = 2.6 cm cut $\overrightarrow{OX}$ and $\overrightarrow{OY}$ at S and Q respectively,

Step-5: Join PQ, QR, RS and PS to form the required rectangle PQRS.





In a square the diagonals bisect each other at right angles and they are equal in length.

14.5 CONSTRUCTION OF A SQUARE

14.5.1 When one side is given

Example 13:

Construct a square of side 3 cm.

Solution:

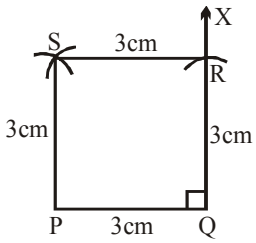
Step-1: Draw a line segment PQ = 3 cm.

Step-2: Construct ∠PQX = 90°.

Step-3: Mark the point R on $\overrightarrow{QX}$ such that QR = 3 cm.

Step-4: With R and P as centres and with radii of 3 cm each draw two arcs to intersect each other at S.

Step-5: Join PS and RS to form the required square PQRS.



14.5.2 When a diagonal is given.

Example 14:

Construct a square with its diagonal as 4 cm.

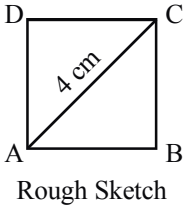
Solution:

Step-1: Draw a line segment AC = 4 cm.

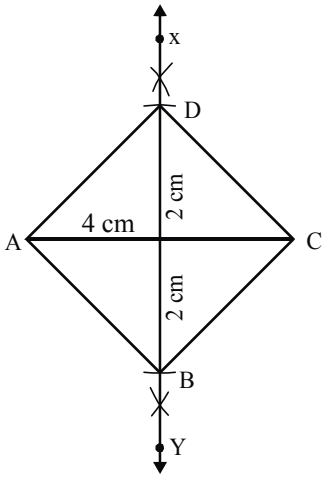
Step-2: Draw perpendicular bisector XY of $\overline{AC}$ to bisect $\overline{AC}$ at O.

Step-3: Mark the points B and D on $\overrightarrow{OY}$ and $\overrightarrow{OX}$ respectively such that OB = OD = 2 cm.

Step-4: Join AB, BC, CD and DA to form the required square ABCD.



Rough Sketch



In a rhombus, the diagonals need not be equal and diagonals bisect each at right angle. Pythagoras theorem can be applied to rhombus. It has all sides equal.

14.6 CONSTRUCTION OF A RHOMBUS

14.6.1 When one side and one angle are given

Example 15:

Construct a rhombus PQRS with PQ = 3.6 cm and ∠P = 50°.

Solution:

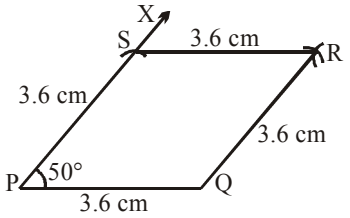
Step-1: Draw a line segment PQ = 3.6 cm.

Step-2: Construct ∠QPX = 50°.

Step-3: Taking P as the centre and a radius equal to 3.6 cm, draw an arc to cut $\overrightarrow{PX}$ at S such that PS = 3.6 cm.

Step-4: From Q and S, draw two arcs with radii 3.6 cm each to meet each other at R.

Step-5: Join QR and SR to form the required rhombus PQRS.



14.6.2 When one side and one diagonal are given

Example 16:

Construct a rhombus PQRS such that PQ = 3.2 cm and PR = 4.2 cm.

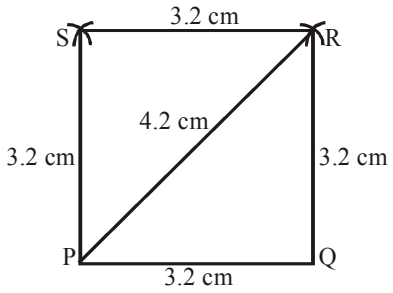
Solution:

Step-1: Draw a line segment PQ = 3.2 cm.

Step-2: Taking P as the centre and a radius equal to 4.2 cm, draw an arc and taking Q as centre, radius as 3.2 cm draw another arc to cut the previous arc at R.

Step-3: With R and P as centres and the radii equal to 3.2 cm each, draw two arcs to meet at S.

Step-4: Join PS, RS and QR to form Rhombus PQRS.



POINTS TO REMEMBER

- Three measurements are required to construct a triangle uniquely.
- Five independent measurements are required to construct a quadrilateral uniquely.
- Three independent measurements are required to construct a parallelogram uniquely.
- Two independent measurements are required to construct a rectangle or a rhombus uniquely.
- The measurements of sides or diagonal is required to construct a square uniquely.

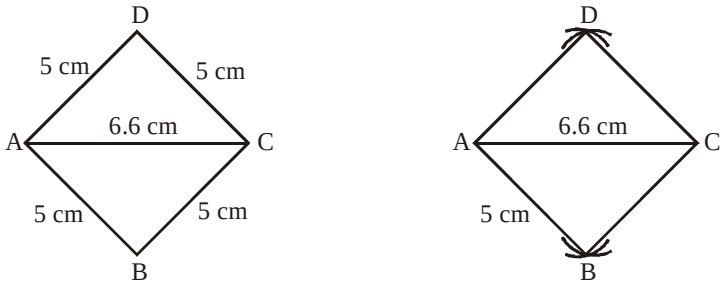
SOLVED EXAMPLES

Example 1 :

Construct a rhombus ABCD in which diagonal AC = 6.6 cm and AB = 5 cm.

Solution :

First draw a rough figure.



Step of construction:

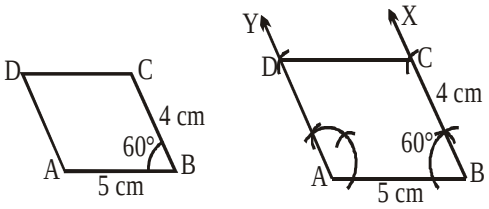
1. Draw AC = 6.6 cm
2. With A as centre and radius equal to 5 cm, draw an arc above the line segment AC and another below AC.
3. Again with C as centre and radius equal to 5 cm, draw two arcs one above the line segment AC and another below the line segment AC cutting the first two arcs at point D and B respectively.
4. Join AB, BC, CD and DA. Then, ABCD is the required rhombus.

Example 2 :

Construct a parallelogram ABCD, given that AB = 5 cm, BC = 4 cm and ∠B = 60°.

Solution :

First draw a rough figure.



Step of construction:

1. Draw AB = 5 cm
2. With A as centre and radius equal to 5 cm, draw an arc above the line segment AC and another below AC.
3. Again with C as centre and radius equal to 5 cm, draw two arcs one above the line segment AC and another below the line segment AC cutting the first two arcs at point D and B respectively.
4. Join AB, BC, CD and DA. Then, ABCD is the required rhombus.

CONCEPT APPLICATION LEVEL - I [NCERT Questions]

EXERCISE - 1

Q.1 Construct the following quadrilaterals:

(i) Quadrilateral ABCD

AB = 4.5 cm, BC = 5.5 cm, CD = 4 cm, AD = 6 cm, AC = 7 cm

(ii) Quadrilateral JUMP

JU = 3.5 cm, UM = 4 cm, MP = 5 cm, PJ = 4.5 cm, PU = 6.5 cm

(iii) Parallelogram MORE

OR = 6 cm, RE = 4.5 cm, EO = 7.5 cm

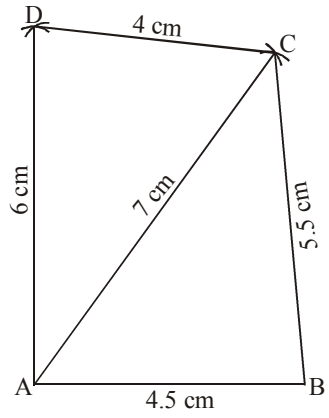
(iv) Rhombus BEST

BE = 4.5 cm, ET = 6 cm

Sol. (i) Steps of construction

1. Draw AB = 4.5 cm
2. With A as centre and radius AC = 7 cm, draw an arc.
3. With B as centre and radius BC = 5.5 cm, draw another arc to the intersect the arc of step (2) at C.
4. With A as centre and radius AD = 6 cm, draw an arc on the side of AC, opposite to that of B.
5. With C as centre and radius CD = 4 cm, draw another arc to intersect the arc of step (4) at D.
6. Join BC, CD, DA and AC.

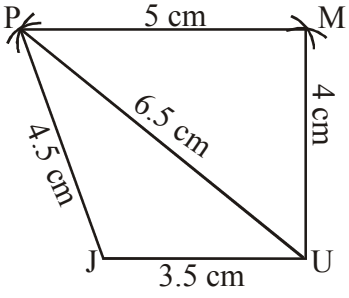
Then, ABCD is the required quadrilateral.



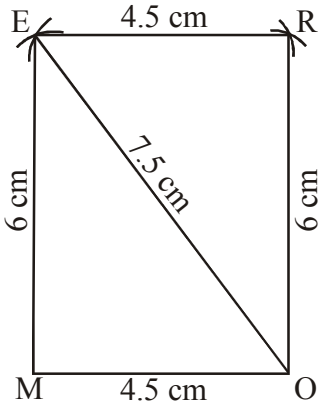
(ii) Steps of construction

1. Draw JU = 3.5 cm
2. With J as centre and radius JP = 4.5 cm, draw an arc.
3. With U as centre and radius UP = 6.5 cm, draw another arc to intersect the arc of step 2 at P.
4. With U as centre and radius UM = 4 cm, draw an arc on the side of PU opposite to that of J.
5. With P as centre and radius PM = 5 cm, draw another arc to intersect the arc of step 4 at M.
6. Join UM, MP, PJ and UP.

Then, JUMP is the required quadrilateral.



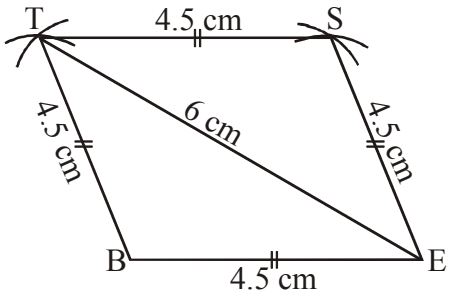
(iii) Steps of Construction



1. Draw MO = 4.5 cm
2. With M as centre and radius ME = 6 cm, draw an arc.
3. With O as centre radius OE = 7.5 cm, draw an arc to intersect the arc of step 2 at E.
4. With O as centre and radius OR = 6 cm, draw an arc on the side of OE opposite to that of M.
5. With E as centre and radius ER = 4.5 cm, draw another arc to intersect the arc of step 4 at the E.
6. Join OR, RE, EM and EO.

Then, MORE is the required parallelogram.

(iv) Steps of Construction



1. Draw BE = 4.5 cm
2. With B as centre and BT = 4.5 cm, draw an arc.
3. With E as centre and radius ET = 6 cm, draw another arc to intersect arc of step 2 at T.
4. With E as centre and radius ES = 4.5 cm, draw an arc on the side of ET opposite to that of B.
5. With T as centre and radius TS = 4.5 cm, draw another arc to intersect the arc of step 4 at S.
6. Join ES, ST, TB and TE.

Then, BEST is the required rhombus.

EXERCISE - 2

Q.1 Construct the following quadrilaterals:

(i) Quadrilateral LIFT

LI = 4 cm, IF = 3 cm, TL = 2.5 cm, LF = 4.5 cm, IT = 4 cm.

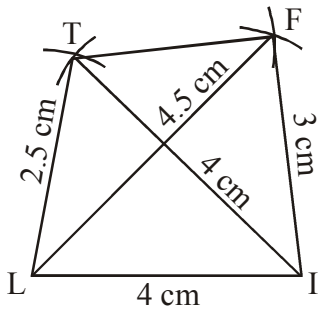
(ii) Quadrilateral GOLD

OL = 7.5 cm, GL = 6 cm, GD = 6 cm, LD = 5 cm, OD = 10 cm

(iii) Rhombus BEND

BN = 5.6 cm, DE = 6.5 cm

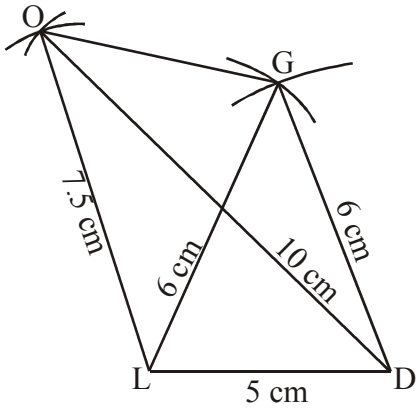
Sol. (i) Steps of construction



1. Draw LI = 4 cm.
2. With L as centre and radius LT = 2.5 cm, draw an arc.
3. With I as centre and radius IT = 4 cm, draw another arc to intersect the arc of step 2 at T.
4. With I as centre and radius IF = 3 cm, draw an arc.
5. With L as centre and radius LF = 4.5 cm, draw another arc to intersect the arc of step 4 at F.
6. Join IF, FT, TL, LF and IT.

Then, LIFT the required quadrilateral.

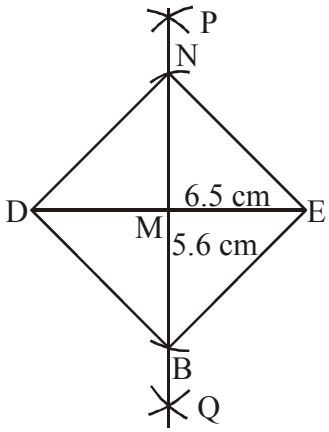
(ii) Steps of construction



1. Draw LD = 5 cm.
2. With L as centre and radius LG = 6 cm, draw an arc.
3. With D as centre and radius DG = 6 cm, draw another arc to intersect the arc of step 2 at G.
4. With L as centre and radius LO =7.5 cm, draw an arc.
5. With D as centre and radius DO =10 cm, draw another arc to intersect the arc of step 4 at O.
6. Join DG, GO, OL, LG and DO.

Then GOLD is the required quadrilateral.

(iii) Steps of Construction



1. Draw DE = 6.5 cm.
2. Draw perpendicular bisector PQ of DE. Let M be the mid-point of DE.
3. Cut MN = $\frac{1}{2}$ × 5.6 cm = 2.8 cm from MP.
4. Cut MB = $\frac{1}{2}$ × 5.6 cm = 2.8 cm from MQ.
5. Join DN, NE, EB and BD.

Then, BEND is the required rhombus.

EXERCISE - 3

Q.1 Construct the following quadrilaterals:

(i) Quadrilateral MORE

MO = 6 cm, OR = 4.5 cm, ∠M = 60°, ∠O = 105°, ∠R = 105°

(ii) Quadrilateral PLAN

PL = 4 cm, LA = 6.5 cm, ∠P = 90°, ∠A = 110°, ∠N = 85°

(iii) Parallelogram HEAR

HE = 5 cm, EA = 6 cm, ∠R = 85°

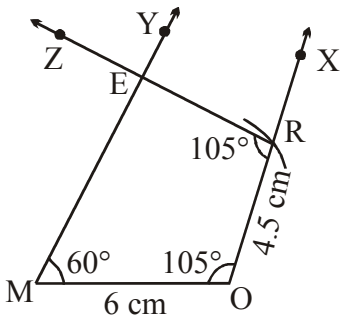
(iv) Rectangle OKAY

OK= 7cm, KA = 5 cm

Sol. (i) Steps of construction

1. Draw MO = 6 cm.
2. At O, draw ray OX such that ∠MOX = 105°
3. Cut OR = 4.5 cm from ray OX.
4. At M, draw ray MY such that ∠OMY = 60°
5. At R, draw ray RZ such that ∠ORZ = 105°
   Let the rays. MY and RZ meet at E.

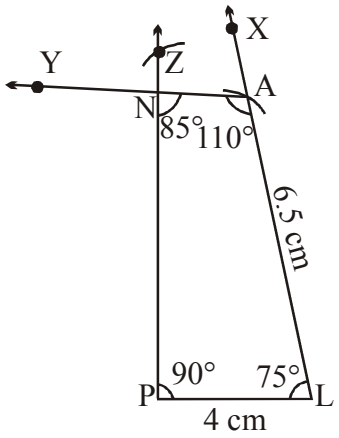
Then, MORE is the required quadrilateral.



(ii) Steps of construction

1. Draw PL = 4 cm.
2. At L, draw ray LX such that ∠PLX = 75°.
   By Angle-sum property of quadrilateral,
   ∠P + ∠A + ∠N + ∠L = 360°
   ⇒ 90° + 110° + 85° + ∠L = 360°
   ⇒ 285° + ∠L = 360°
   ⇒ ∠L = 360° – 285° = 75°
3. Cut LA = 6.5 cm from ray LX.
4. At A, draw ray AY such that ∠LAY = 110°.
5. At P, draw ray PZ such that ∠LPZ = 90°.
   Let the rays AY and PZ meet at N.

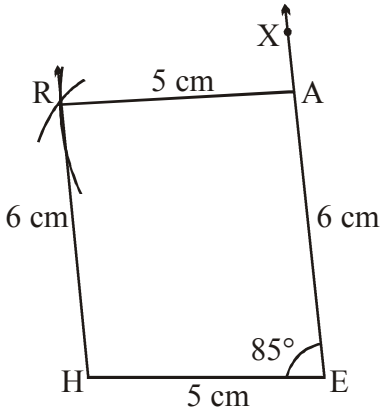
Then, PLAN is the required quadrilateral.



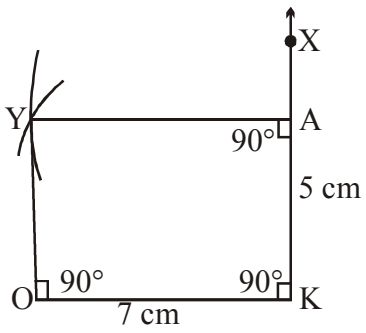
(iii) Steps of construction

1. Draw HE = 5 cm.
2. At E, draw ray EX such that ∠HEX = 85°.
   Opposite angles of a parallelogram are equal.
3. Cut EA = 6 cm from the ray EX.
4. With A as centre and radius AR = 5 cm, draw an arc.
5. With H as centre and radius HR = 6 cm, draw another arc to intersect the arc of step 4 at R.
6. Join AR and HR.

Then, HEAR is the required parallelogram.



(iv) Steps of construction



1. Draw OK = 7 cm.
2. At K, draw ray KX such that ∠OKX = 90°.
3. Cut KA = 5 cm from ray KX.
4. Taking A as centre and radius AY = 7 cm, draw an arc.
5. Taking O as centre and radius OY = 5 cm, draw another arc to intersect the arc of step 4 at Y.
6. Join AY and OY.

Then OKAY is the required rectangle.

EXERCISE - 4

Q.1 Construct the following quadrilaterals:

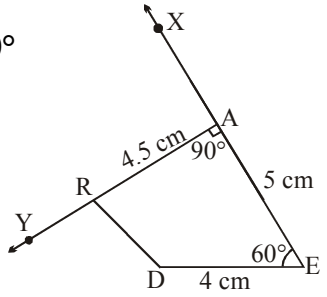
(i) Quadrilateral DEAR

DE = 4 cm, EA = 5 cm, AR = 4.5 cm, ∠E = 60°, ∠A = 90°

(ii) Quadrilateral TRUE

TR = 3.5 cm, RU = 3 cm, UE = 4 cm, ∠R = 75°, ∠U = 120°

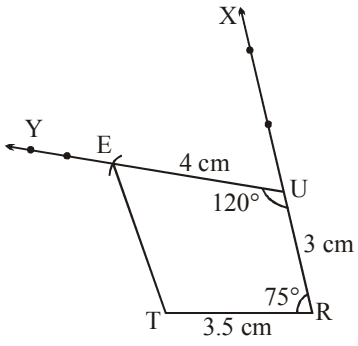
[Sol. (i) Steps of construction



1. Draw DE = 4 cm.
2. At E draw ray EX such that ∠DEX = 60°.
3. From ray EX, cut EA = 5 cm.
4. At A, draw ray AY such that ∠EAY = 90°
5. Cut AR = 4.5 cm from ray AY.
6. Join RD.

Then, DEAR is the required quadrilateral.

(ii) Steps of construction



1. Draw TR = 3.5 cm.
2. At R, draw ray RX such that ∠TRX = 75°.
3. Cut RU = 3 cm from ray RX.
4. At U, draw ray UY such that ∠RUY = 120°.
5. Cut UE = 4 cm from ray UY.
6. Join ET.

Then, TRUE is the required quadrilateral.

EXERCISE - 5

Q.1 Draw the following:

1. The square READ with RE = 5.1 cm.

2. A rhombus where diagonals are 5.2 cm and 6.4 cm long.

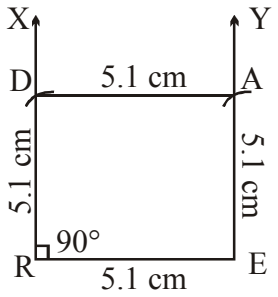
3. A rectangle with adjacent sides of lengths 5 cm and 4 cm.

4. A parallelogram OKAY where OK = 5.5 cm and KA = 4.2 cm.

Sol. (1) Steps of construction

1. Draw RE = 5.1 cm.
2. At R, draw a ray RX such that $\angle ERX = 90°$.
3. From ray RX, cut RD = 5.1 cm.
4. At E, draw a ray EY such that $\angle REY = 90°$.
5. From ray EY, cut EA = 5.1 cm.
5. Join AD.

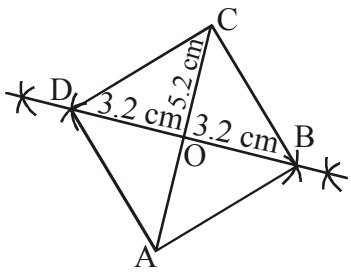
Then, READ is the required square.



(2) Steps of Construction

1. Draw AC = 5.2 cm.
2. Construct its perpendicular bisector.Let them meet at O.
3. Cut off $\frac{6.4}{2}$ = 3.2 cm lengths on of the drawn bisector, we get B and D.
4. Join AB, BC, CD and DA .

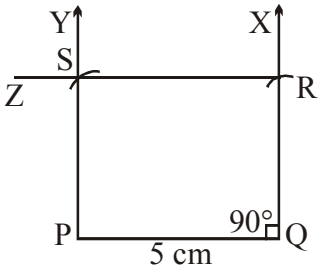
Then, ABCD is the required rhombus.



(3) Steps of Construction

1. Draw PQ =5 cm.
2. At Q, draw a ray QX such that $\angle PQX = 90°$.
3. From ray QX, cut QR = 4 cm.
4. Through P, draw a ray PY parallel to QR.
5. Through R, draw a ray RZ parallel to QP to meet the ray of step 4 at S.

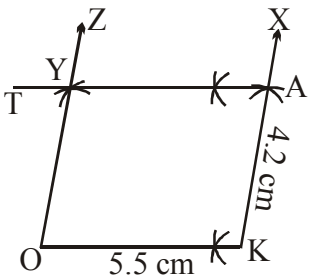
Then, PQRS the required rectangle.



(4) Steps of Construction

1. Draw OK = 5.5 cm.
2. At K, draw a ray KX.
3. From ray KX, cut KA = 4.2 cm.
4. Through A, draw a ray AT parallel to KO.
5. Through O, draw a ray OZ parallel to KA to cut the ray of step 4 at Y.

Then, OKAY is the required parallelogram.



TRY THESE

Q.1 Arshad has five measurements of a quadrilateral ABCD. These are AB = 5 cm, ∠A = 50°, AC = 4 cm, BD = 5 cm and AD = 6 cm. Can he construct a unique quadrilateral? Give reasons for your answer.

Sol. We cannot construct a unique quadrilateral because

(i) We can construct ΔABD but not ΔBCD

(ii) Neither we can construct ΔACD not ΔABC.

Q.2 (i) We saw that 5 measurements of a quadrilateral can determine a quadrilateral uniquely. Do you think any five measurements of the quadrilateral can do this?

(ii) Can you draw a parallelogram BATS where BA = 5 cm, AT = 6 cm and AS = 6.5 cm? Why?

(iii) Can you draw a rhombus ZEAL where ZE = 3.5 cm, diagonal EL = 5 cm? Why?

(iv) A student attempted to draw a quadrilateral PLAY where PL = 3 cm, LA = 4 cm, AY = 4.5 cm, PY = 2 cm and LY = 6 cm, but could not draw it. What is the reason?

Sol. (i) No! Any five measurements cannot determine a quadrilateral uniquely. To determine a quadrilateral uniquely, we require any one of the following sets of measurements.

(a) four sides and one diagonal.

(b) two sides and three diagonals.

(c) two adjacent sides and three angles.

(d) three sides and two included angles.

(ii) Yes, we can draw a parallelogram BATS, where BA = 5 cm, AT = 6 cm and AS = 6.5 cm because the opposite sides of a parallelogram are equal in length.

(iii) Yes! we can draw a rhombus ZEAL because all the four sides of a rhombus are equal in length.

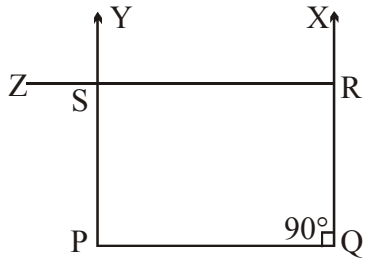
(iv) The students could not draw it because PL + PY < LY. Actually the sum of the lengths of any two sides of a triangle must always be greater than the length of the third side.

Q.3 How will you construct a rectangle PQRS if you know only the lengths PQ and QR?

Sol. Steps of construction

1. Draw PQ of given length.
2. At Q, draw a ray QX such that ∠PQX = 90°.
3. From ray QX, cut QR of given length.
4. Through P, draw a ray PY parallel to QR.
5. Through R, draw a ray RZ parallel to QP to meet the ray of step 4 at S.

Then, PQRS the required rectangle.



Q.4 Construct the kite EASY, if AY = 8 cm, EY = 4 cm and SY = 6 cm. Which properties of the kite did you use in the process.

Sol. Kite EASY cannot be constructed with the given measurements as a kite has two pairs of equal consecutive sides. Here,

AE = EY = 4 cm

AY = 8 cm

∴ AE + EY = 8 cm = AY

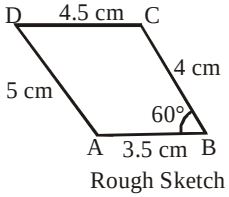
which is not possible as the sum of the lengths of any two sides of a triangle must be greater than the third side.

CONCEPT APPLICATION LEVEL - II

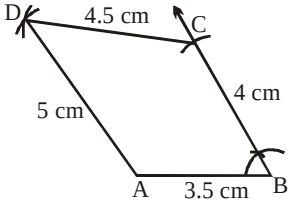
Q.1 Construct a quadrilateral ABCD having given AB = 3.5 cm, BC = 4 cm, CD = 4.5 cm, DA = 5 cm and ∠B = 60°.

Sol. Steps of Construction:

1. Draw AB = 3.5 cm.
2. At B draw ∠ABY = 60°.
3. Cut off from BY, a segment BC = 4 cm
4. With A as centre and radius 5 cm draw an arc.
5. With C as centre and radius 4.5 cm draw an arc cutting the first arc at D.
6. Join A to D and also C to D. Then ABCD is the required quadrilateral.



Rough Sketch

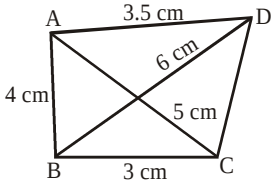


Q.2 Construct a quadrilateral ABCD, given AB = 4 cm, BC = 3 cm, AD = 3.5 cm, diagonal AC = 5 cm and diagonal BD = 6 cm.

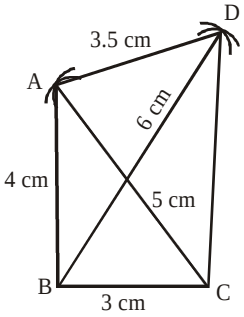
Sol. Steps of Construction:

1. Draw BC = 3 cm.
2. With B as centre and radius 4 cm draw an arc.
3. With C as centre and radius 5 cm draw an arc cutting the first arc at A.
4. Join B to A and also C to A.
5. With A as centre and radius 3.5 cm draw an arc.
6. with B as centre and radius 6 cm draw an arc cutting the first arc at D.
7. Join C to D, B to D and also A to D.

Then ABCD is the required quadrilateral.



Rough Sketch

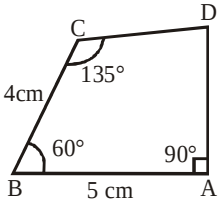


Q.3 Construct a quadrilateral ABCD, given AB = 5 cm, BC = 4 cm, ∠B = 60°, ∠A = 90° and ∠C = 135°.

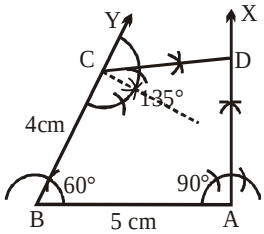
Sol. Steps of Construction:

1. Draw AB = 5 cm.
2. At B draw ∠ABY = 60°
3. From BY cut off BC = 4 cm
4. At A draw ∠BAX = 90°.
5. At C draw ∠BCD = 135°, so that its arm CD cuts AX at D.

Then ABCD is the required quadrilateral.

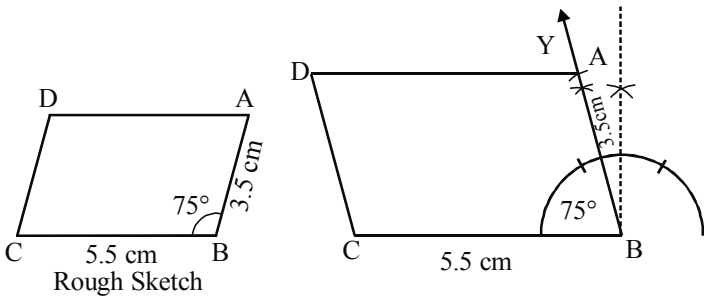


Rough Sketch



Q.4 Construct a parallelogram ABCD, given that AB = 3.5 cm, BC = 5.5 cm and ∠B = 75°.

Sol. Steps of Construction:



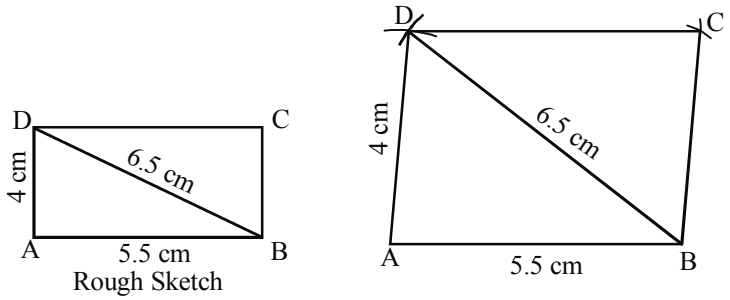
1. Draw BC = 5.5 cm.
2. At B draw ∠CBY = 75°.
3. From BY, cut off BA = 3.5 cm.
4. With A as centre and radius 5.5. cm draw an arc.
5. With C as centre and radius 3.5 cm draw another arc cutting the first arc at D.
6. Join A to D and C to D. Then ABCD is the required parallelogram.

Q.5 Construct a parallelogram ABCD, given that AB = 5.5 cm, AD = 4 cm and diagonal BD = 6.5 cm.

Sol. Steps of Construction:

1. Draw AB = 5.5 cm.
2. With A as centre and radius 4 cm draw an arc.
3. With B as centre and radius 6.5 cm draw another arc cutting the first arc at D.
4. Joint A to D
5. Now with D as centre and radius 5.5 cm (= AB) draw an arc.
6. With B as centre and radius 4 cm (= AD) draw another arc cutting the arc of step 5 at C.
7. Join D to C and also B to C.

Then ABCD is the required parallelogram.

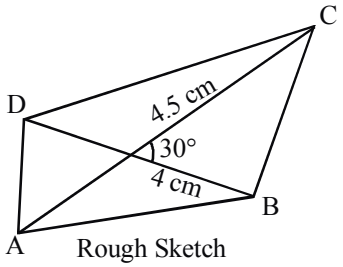


Q.6 Construct a parallelogram ABCD, given that AC = 4.5 cm, BD = 4 cm and the angle between the diagonals is 30°.

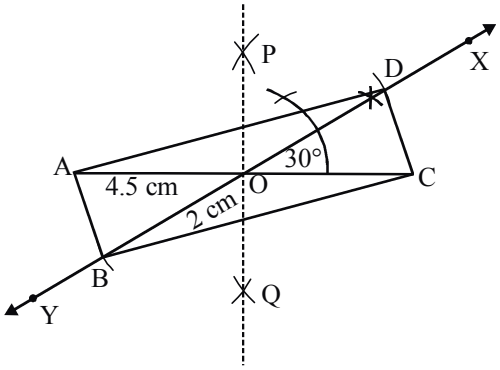
Sol. Steps of Construction:

1. Draw AC = 4.5 cm.
2. Draw PQ, the perpendicular bisector of AC meeting AC at O.
3. Through O draw a line XY making $\angle XOC = 30°$.
4. Cut off OD = OB = 2 cm $\left(=\frac{1}{2}BD\right)$ from XY.
5. Joint A to B, B to C, C to D and A to D.

Then ABCD is the required parallelogram.



Rough Sketch

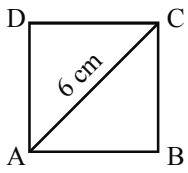


Q.7 Construct a square ABCD, given that diagnonal AC = 6 cm.

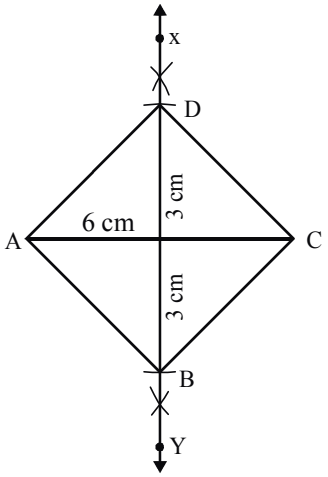
Sol. Steps of Construction:

1. Draw a segment AC = 6 cm.
2. Draw XY, the right bisector of AC meeting AC at O.
3. Cut off OD = OB = 3 cm $\left(=\frac{1}{2}AC\right)$ from OX and OY respectively.
4. Join A to B, B to C, C to D and A to D.

Then ABCD is the required square.



Rough Sketch

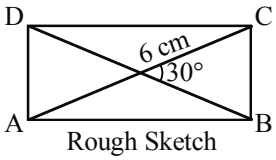


Q.8 Construct a rectangle ABCD whose diagonal AC = 6 cm and the angle between the diagonals is 30°.

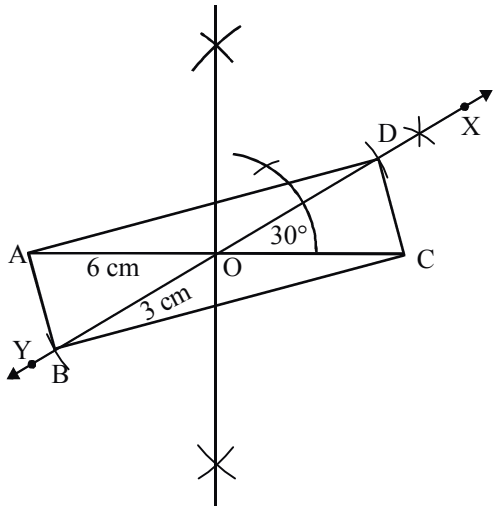
Sol. Steps of Construction:

1. Draw AC = 6 cm.
2. Bisect AC at O.
3. At O, draw XY making $\angle COX = 30°$.
4. Cut off OB = OD = 3 cm $\left(=\frac{1}{2}AC\right)$.
5. Join A to B, B to C, C to D and A to D.

Then ABCD is the required rectangle.



Rough Sketch

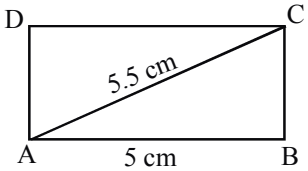


Q.9 Construct a rectangle ABCD given that side AB = 5 cm and the diagonal AC = 5.5 cm.

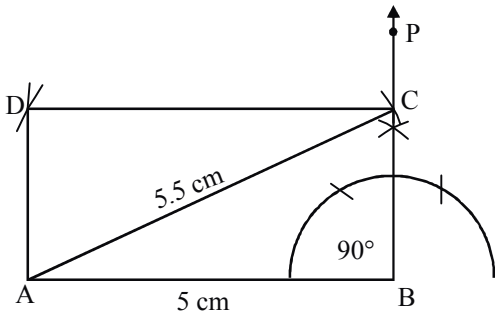
Sol. Steps of construction:

1. Draw AB = 5 cm.
2. At B, draw BP ⊥ AB.
3. With A as centre and radius 5.5 cm draw an arc cutting BP at C.
4. With C as centre and radius 5 cm draw an arc.
5. With A as centre and radius equal to BC draw another arc cutting the first arc at D.
6. Join A to D and also C to D.

Then ABCD is the required rectangle.



Rough Sketch

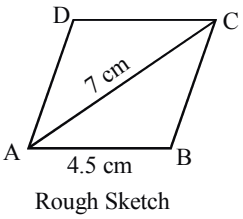


Q.10 Construct a rhombus ABCD given that side AB = 4.5 cm and a diagonal is 7 cm.

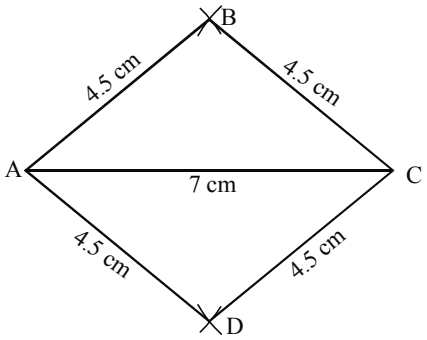
Sol. Step of Construction:

1. Draw AC = 7 cm.
2. With A and C as centres and radius 4.5 cm draw arcs on both sides of AC, cutting each other at B and D.
3. Join A to B, C to B and C to D, A to D.

Then ABCD is the required rhombus.



Rough Sketch

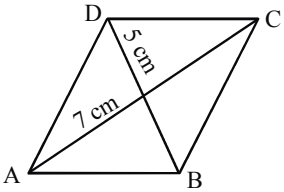


Q.11 Construct a rhombus ABCD whose diagonals AC and BD are 7 cm and 5 cm respectively.

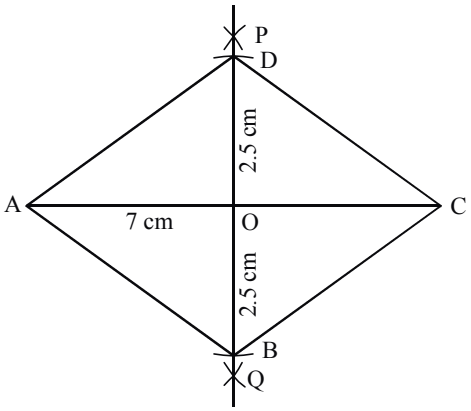
Sol. Step of Construction:

1. Draw AC = 7 cm
2. Draw PQ, the perpendicular bisector of AC, meeting AC at O.
3. From OP and OQ cut off OD = OB = 2.5 cm $\left(=\frac{1}{2}BD\right)$ respectively.
4. Join A to B, B to C, C to D and D to A.

Then ABCD is the required rhombus.



Rough Sketch



Q.12 To construct a unique rectangle, the minimum number of measurements required is **[IMO-2016]**
(A) 4 (B) 3 (C) 2 (D) 1

Q.13 Given below are the steps of construction to construct a quadrilateral ABCD where AB = 5.6 cm, BC = 4.1 cm, CD = 4.4 cm, AD = 3.3 cm and ∠A = 75°. Which of the following is INCORRECT step?
Step-I : Draw AB = 5.6 cm and construct ∠BAX = 75°.
Step-II: With A as centre and radius = 3.3 cm, cut off AD = 3.3 cm along AX.
Step-III : Join BD. With D as centre and radius = 4.1 cm, draw an arc.
Step-IV : With B as centre and radius = 4.1 cm, draw an arc to cut the arc drawn in above step at C. Join BC, CD to obtain the required quadrilateral ABCD. **[IMO-2016]**
(A) Step-I (B) Step-II (C) Step-III (D) Step-IV

ANSWER KEY → Q.12 C Q.13 C