

13 | Practical Geometry

INTRODUCTION

In class VII, you have learnt how to construct triangles. You required three measurements to construct a unique triangle.

In this chapter, we shall learn to construct quadrilaterals.

CONSTRUCTION OF QUADRILATERALS

To construct a unique quadrilateral, we require five measurements. We shall learn to construct a unique quadrilateral when the following measurements are given.

1. When four sides and one diagonal are given.
2. When two diagonals and three sides are given.
3. When two adjacent sides and three angles are given.
4. When three sides and two included angles are given.
5. When other special properties are known.

We shall learn how to construct these quadrilaterals one by one with the help of examples.

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

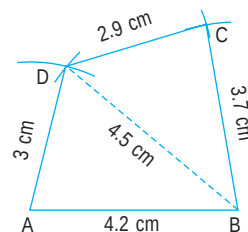
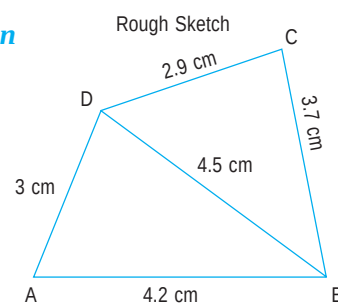
To construct a quadrilateral when four sides and one diagonal are given

■ **Example 1.** 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.

Solution. Draw a rough sketch of quadrilateral ABCD and mark the given lengths.

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.



To construct a quadrilateral when two diagonals and three sides are given

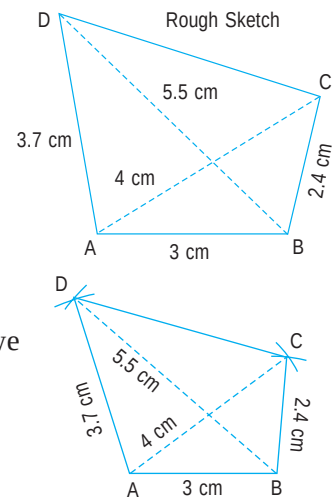
When two diagonals and three sides are given, we first draw two triangles with available data and try to construct a quadrilateral.

■ **Example 2.** Construct 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.

Solution. Draw a rough sketch of quadrilateral ABCD and mark the given lengths.

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.



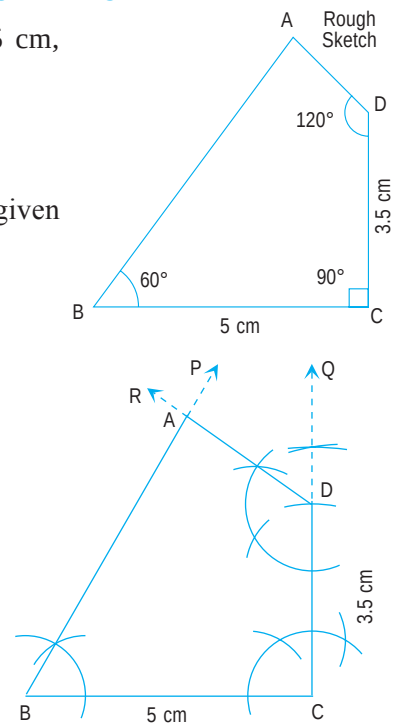
To construct a quadrilateral when two adjacent sides and three angles are given

■ **Example 3.** Construct a quadrilateral ABCD given that $BC = 5$ cm, $CD = 3.5$ cm, $\angle B = 60^\circ$, $\angle C = 90^\circ$ and $\angle D = 120^\circ$.

Solution. Draw a rough sketch of quadrilateral ABCD and mark the given angles and lengths.

Steps of construction

1. Draw a 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.



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

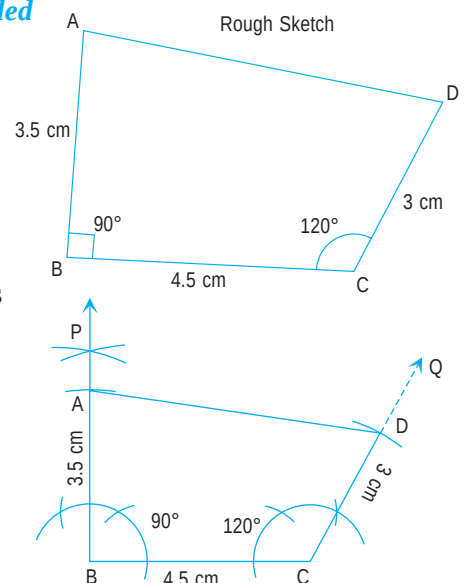
■ **Example 4.** Construct a quadrilateral ABCD given that $BC = 4.5$ cm, $AB = 3.5$ cm, $CD = 3$ cm, $\angle B = 90^\circ$ and $\angle C = 120^\circ$.

Solution. Draw a rough sketch of quadrilateral ABCD and mark the given angles and lengths.

Note. While drawing a rough sketch mark “included” angles carefully.

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.

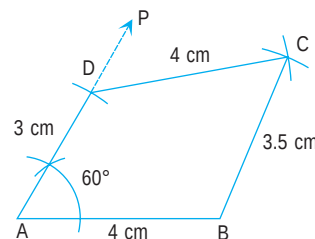
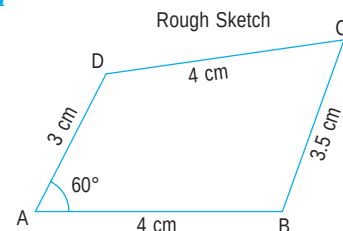
To construct a quadrilateral when its four sides and one angle is given

■ **Example 5.** Construct a quadrilateral ABCD where $AB = 4$ cm, $BC = 3.5$ cm, $CD = 4$ cm, $AD = 3$ cm and $\angle A = 60^\circ$.

Solution. Draw a rough sketch of quadrilateral ABCD and mark the given angle and lengths.

Steps of construction

1. Draw a 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.



Exercise 13.1

1. Construct a quadrilateral PQRS where $PQ = 4$ cm, $QR = 6$ cm, $RS = 5$ cm, $PS = 5.5$ cm and $PR = 7$ cm.
2. Construct a quadrilateral ABCD where $AB = 4.5$ cm, $BC = 5.5$ cm, $CD = 4$ cm, $AD = 6$ cm and $AC = 7$ cm.
3. Construct a quadrilateral JUMP where $JU = 3.5$ cm, $UM = 4$ cm, $MP = 5$ cm, $PJ = 4.5$ cm and $PU = 6.5$ cm.
4. Construct a quadrilateral ABCD, given that $BC = 4.5$ cm, $AD = 5.5$ cm, $CD = 5$ cm, $AC = 5.5$ cm and $BD = 7$ cm.
5. Construct a quadrilateral LIFT, where $LI = 4$ cm, $IF = 3$ cm, $TL = 2.5$ cm, $LF = 4.5$ cm and $IT = 4$ cm.
6. Construct a quadrilateral GOLD where $OL = 7.5$ cm, $GL = 6$ cm, $GD = 6$ cm, $LD = 5$ cm and $OD = 10$ cm.
7. Construct a quadrilateral PQRS where $PQ = 3.5$ cm, $QR = 6.5$ cm, $\angle P = 75^\circ$, $\angle Q = 105^\circ$ and $\angle R = 120^\circ$.
8. Construct a quadrilateral ABCD where $AB = 6$ cm, $BC = 4.5$ cm, $\angle A = 60^\circ$, $\angle B = 105^\circ$ and $\angle C = 105^\circ$.
9. Construct a quadrilateral ABCD where $AB = 4$ cm, $BC = 6.5$ cm, $\angle A = 90^\circ$, $\angle C = 110^\circ$ and $\angle D = 85^\circ$.
10. Construct a quadrilateral ABCD where $AB = 4$ cm, $BC = 5$ cm, $CD = 6.5$ cm, $\angle B = 105^\circ$ and $\angle C = 80^\circ$.
11. Construct a quadrilateral DEAR where $DE = 4$ cm, $EA = 5$ cm, $AR = 4.5$ cm, $\angle E = 60^\circ$ and $\angle A = 90^\circ$.
12. Construct a quadrilateral PQRS where $PQ = 3.5$ cm, $QR = 3$ cm, $RS = 4$ cm, $\angle Q = 75^\circ$ and $\angle R = 120^\circ$.
13. Construct a quadrilateral BEST where $BE = 3.8$ cm, $ES = 3.4$ cm, $ST = 4.5$ cm, $TB = 5$ cm and $\angle E = 80^\circ$.
14. Construct a quadrilateral ABCD where $AB = 4.5$ cm, $BC = 4$ cm, $CD = 3.9$ cm, $AD = 3.2$ cm and $\angle B = 60^\circ$.