10

PRACTICAL GEOMETRY

CONTENTS

➤ CONSTRUCTION OF A PAIR OF PARALLEL LINES USING SET SQUARES AND RULER

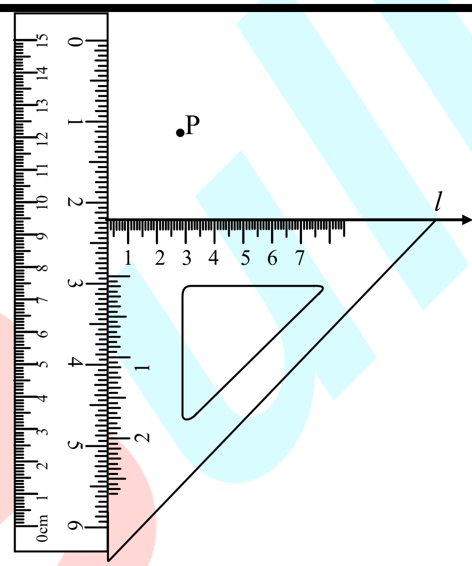
Construct a line parallel to a given line *l* passing through a given point P not on the line :

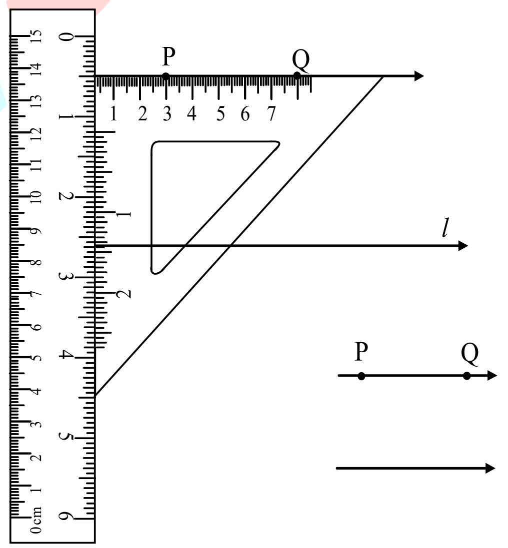
(i) Draw a line *l*.

(ii) Place a set square with the arm of its right angle.

(iii) Holding the set square fixed, place a ruler along the other arm of the right angle.

(iv) Holding the ruler fixed, slide the set square along the edge of the ruler until the perpendicular edge of the set square passes through the given point P as shown in figure





(v) Keeping the set square fixed at same position, draw a line PQ through the point P along the edge of set square.

The line PQ is the required line through the point P and parallel to the line *l*.

◈ **Construction of a parallel line to a given line m and at a given distance (d) from it :**

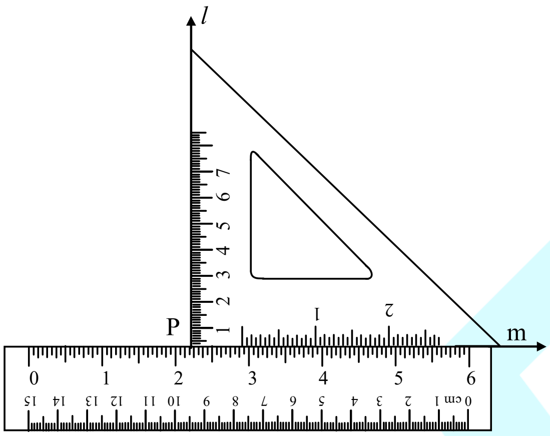
(i) Draw a line m and mark a point P on line m.

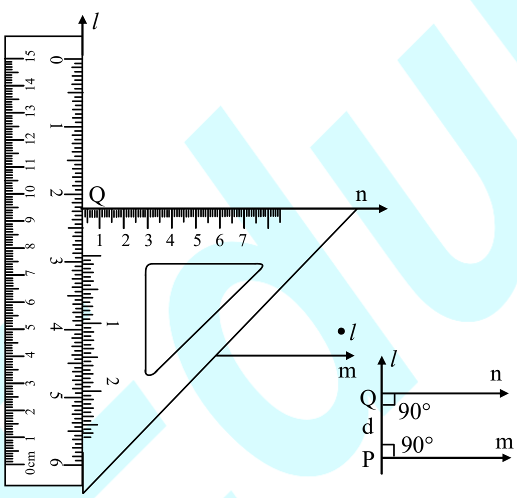
(ii) Using a set square, construct a line *l* perpendicular to m at P.

(iii) With a ruler or compasses mark a point Q on *l* such that the segment PQ = d cm.

(iv) Using set square construct a line n perpendicular to *l* at Q.

Then, n is the required line parallel to m at a distance of d cm from it.



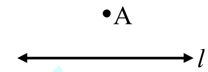
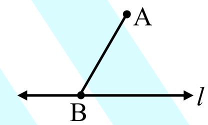
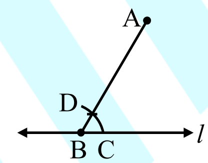
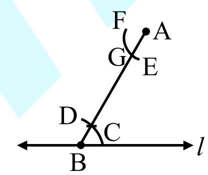
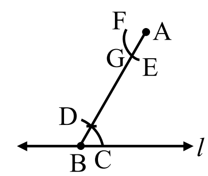
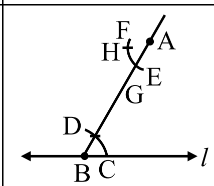
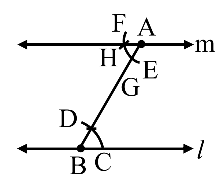


➤ CONSTRUCTION OF PARALLEL LINES BY RULER AND COMPASSES

Now we will show how to construct a line parallel to a given line passing through a given point not lying on it.

Given : A line *l* and a point A not lying on it.

To Const. : A line parallel to *l* through A.

S.No.	Steps of Construction	Construction
1.	Draw a line segment *l* and mark a point A not lying on it.	
2.	Take any point B on *l* and join B to A.	
3.	With B as centre and convenient radius draw an arc cutting *l* at C and AB to D	
4.	Now with A as centre and the same radius as in step 3 draw an arc EF cutting AB at G	
5.	Place the metal point of the compasses at C and adjust the opening so that the pencil point is at D.	
6.	With the same opening as in step 5 and with G as centre draw another arc cutting the arc EF at H.	
7.	Now join AH and draw a line m.	

Then, m is the required line parallel to *l* and passing through the given point A.

Note :

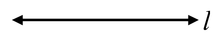
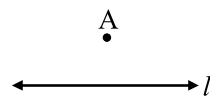
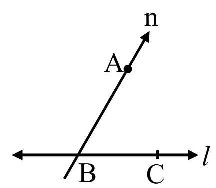
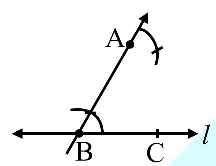
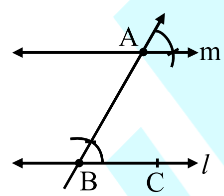
In the above figure, *l* and m are two parallel lines and AB is a transversal.

∠ABC and ∠FAB are alternate interior angles

But ∠ABC = ∠FAB [By construction]

Hence, *l* ∥ m [∵ alternate interior angles are equal]

◈ **Alternative Method**

S.No.	Steps of Construction	Construction
1.	Draw a line *l*.	
2.	Mark a point A which is not lying on *l*.	
3.	Draw a line n, through A which meets the line *l* at point B	
4.	At point A, draw an angle such that it is equal to ∠ABC.	
5.	Draw line m which is parallel to line *l*.	

➤ TRIANGLE CONSTRUCTION (POSSIBILITIES)

There are following possibilities of constructing a triangle :

(1) When its **three sides are given. (Also known as SSS triangle construction).**

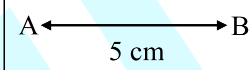
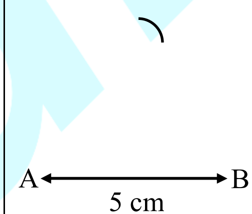
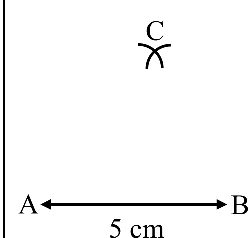
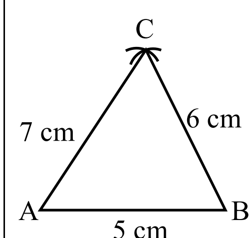
(2) When its **two sides and the included angle is given. (Also known as SAS triangle construction).**

(3) When its **two angles and the included side is given. (Also known as ASA triangle construction).**

- The sum of two sides of a triangle is always greater than the third side.
- The sum of three angles of a triangle should be equal to 180°.

➤ SIDE-SIDE-SIDE (SSS) TRIANGLE CONSTRUCTION

When length of the three sides of a triangle are given, we follow the following steps for constructing a triangle :

S.No.	Steps of Construction	Construction
1.	Draw a line segment (with the help of ruler), of a given length equal to one side of a triangle. Let us name it as AB.	
2.	From one end point A, draw an arc whose distance from A is equal to second side.	
3.	From second end point B, draw another arc whose distance from B is equal to third side and which cuts the first arc at a point C.	
4.	Join AC and BC.	

The triangle so obtained is the required triangle.

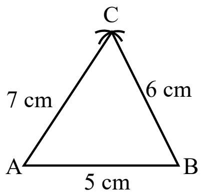
It is important to note that the sum of two sides of a triangle is always greater than the third side.

Thus we can say that we cannot construct a triangle when the sum of any two sides is less than or equal to the third side.

❖ EXAMPLES ❖

Ex.1 Construct a triangle ABC such that side AB = 5 cm, BC = 6 cm and AC = 7 cm.

Sol.

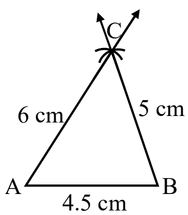


1. Draw a line segment AB of length 5 cm.
2. With centre A and radius 7 cm draw an arc of the circle.
3. With centre B and radius 6 cm draw another arc intersecting first arc at C.
4. Join AC and BC as shown in figure.

ΔABC is the required triangle.

Ex.2 Construct a triangle ABC in which AB = 4.5 cm, AC = 6 cm, BC = 5 cm.

Sol.

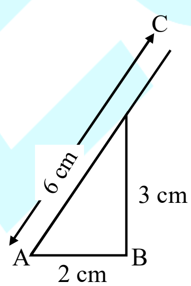


1. Draw a line segment AB of length 4.5 cm.
2. With centre A and radius 6 cm draw an arc of the circle.
3. With centre B and radius 5 cm draw another arc intersecting the first arc at C.
4. Joint AC and BC as shown in figure.

ΔABC is the required triangle.

Ex.3 Construct a triangle ABC where AB = 2 cm, BC = 3 cm and AC = 6 cm.

Sol. Before constructing the required triangle, let us first draw a rough sketch of the triangle.



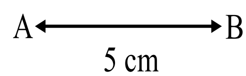
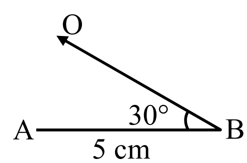
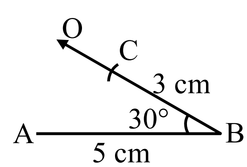
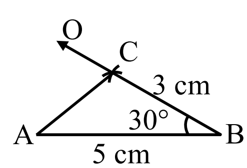
By plotting the rough sketch, we find that it is not possible to construct this triangle. Because the sum of any two sides of a triangle is always greater than third side but in the given triangle, the sum of the lengths of the two sides AB (2 cm) and BC (3 cm) is less than the length of the third side AC (6 cm).

$$AB + BC < AC$$

Therefore, the three given sides of the triangle do not satisfy the triangle inequality. Hence, it is not possible to construct the given triangle.

➢ SIDE-ANGLE-SIDE (SAS) TRIANGLE CONSTRUCTION

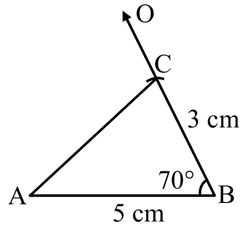
When the length of two sides and the measure of included angle is given, we follow the following steps for constructing a triangle.

S.No.	Steps of Construction	Construction
1.	Draw a line segment AB of the triangle with help of ruler.	
2.	Draw $\angle OBA$ of measure equal to the given $\angle B$.	
3.	From any point on $\overrightarrow{BO}$, cut off line segment equal to second side. Mark the cut off point as C.	
4.	Join AC. The triangle so obtained is the required triangle.	

❖ EXAMPLES ❖

Ex.4 Construct ΔABC, where AB = 5 cm, BC = 3 cm and $\angle ABC = 70°$.

Sol.

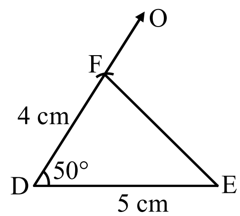


1. Draw AB = 5 cm and $\angle ABC = 70°$.
2. Cut off BC = 3 cm from $\overrightarrow{BO}$.
3. Join AC.

ΔABC is the required triangle.

Ex.5 Construct a ΔDEF in which DE = 5 cm, DF = 4 cm, and $\angle D = 50°$.

Sol.

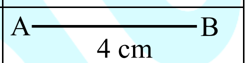
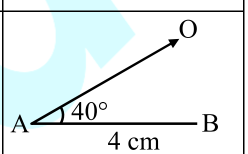
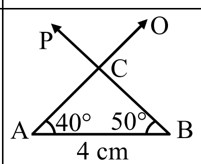


1. Draw DE = 5 cm and $\angle EDF = 50°$.
2. Cut off DF = 4 cm from $\overrightarrow{DO}$.
3. Join EF.

ΔDEF is the required triangle.

➢ ANGLE-SIDE-ANGLE (ASA) TRIANGLE CONSTRUCTION

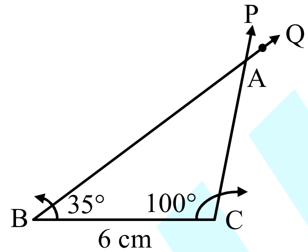
When the measure of two angles and length of included side is given, we follow the following steps for constructing a triangle :

S.No.	Steps of Construction	Construction
1.	Draw the given line segment say AB	
2.	Draw $\angle OAB$ of measure equal to $\angle A$.	
3.	Draw $\angle PBA$ of measure equal to $\angle B$. Let the ray $\overrightarrow{AO}$ and Ray $\overrightarrow{BP}$ intersect at C. Then ΔABC is the required triangle.	

❖ EXAMPLES ❖

Ex.6 Draw a triangle ABC in which BC = 6 cm, $\angle B = 35°$, $\angle C = 100°$.

Sol.



1. Draw BC = 6 cm as shown in figure.
2. Draw $\angle CBQ = 35°$
3. Draw $\angle BCP = 100°$.
4. The two rays $\overrightarrow{BQ}$ and $\overrightarrow{CP}$ intersect at A.

Then, ΔABC is the required triangle.

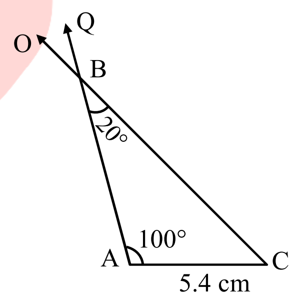
It is important to note that

$$\angle B + \angle C = 35° + 100° = 135°$$

Which is less than 180°. In other words, the sum of two angles of a triangle is always less than 180°.

Ex.7 Construct a ΔABC in which $\angle A = 100°$, $\angle B = 20°$ and CA = 5.4 cm.

Sol.



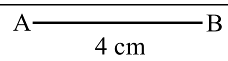
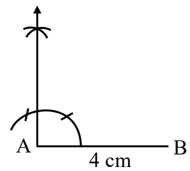
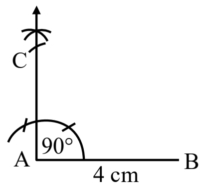
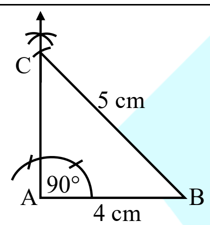
1. Draw AC = 5.4 cm as shown in figure
2. Draw $\angle CAQ = 100°$.
3. We know the sum of three angles in a triangle = 180°

   So, $\angle C = 180° - (\angle A + \angle B)$
   $= 180° - (100 + 20)$
   $= 180° - 120°$
   $= 60°$
4. Draw $\angle ACO = 60°$.
5. The two rays AQ and CO intersect at B. Then ΔABC is the require triangle.

Note : We cannot construct a triangle if the sum of two angles is equal to 180º or greater than 180º.

➢ CONSTRUCTION OF RIGHT ANGLED TRIANGLE WHEN ITS HYPOTENUSE AND ONE SIDE ARE GIVEN

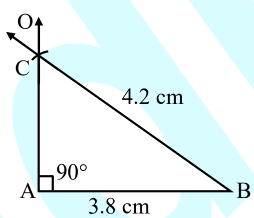
We follow the following steps for RHS triangle construction :

S.No.	Steps of Construction	Construction
1.	Draw a line segment of a given length.	
2.	Draw an angle of 90° on one end of the segment.	
3.	With other end as centre and radius equal to the hypotenuse draw an arc intersecting the perpendicular line at C.	
4.	Join the intersecting point with the other end of the line segment. The triangle so obtained is the required triangle.	

❖ EXAMPLES ❖

Ex.8 Construct a right triangle when its hypotenuse is of length 4.2 cm and one of its side is of length 3.8 cm.

Sol.

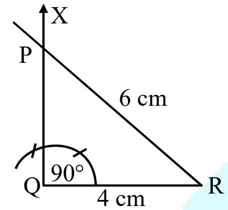


1. Draw a line segment of length 3.8 cm, as shown in figure.
2. Draw $\angle BAO$ of measure 90°.
3. With centre B and radius equal to 4.2 cm, draw an arc intersecting ray $\overrightarrow{AO}$ at C.
4. Join BC.

Thus, ΔBAC is the required triangle.

Ex.9 Construct a right triangle PQR in which $\angle Q = 90°$, PR = 6 cm and QR = 4 cm.

Sol.

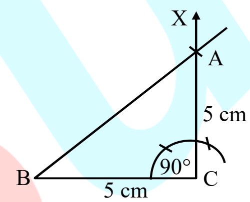


1. Draw a line segment QR = 4 cm.
2. At Q draw $\angle RQX = 90°$.
3. With R as the centre and radius PR = 6 cm (i.e., hypotenuse) draw an arc to intersect ray $\overrightarrow{QX}$ at P.
4. Join PR as in figure,

Thus, ΔPQR is the required triangle.

Ex.10 Construct an isosceles right triangle ABC in which $\angle C = 90°$ and AC = BC = 5 cm.

Sol.

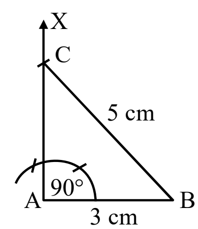


1. Draw a line segment BC of length = 5 cm.
2. Draw $\angle C = 90°$.
3. With centre C and radius equal to 5 cm, draw an arc intersecting ray $\overrightarrow{CX}$ at A.
4. Join BA.

Thus, ΔABC is the required triangle.

Ex.11 Draw a right triangle whose hypotenuse is of length 5 cm and one side of length 3 cm.

Sol.



1. Draw a line segment AB = 3 cm as in figure.
2. Draw $\angle A = 90°$.
3. With centre B and radius equal to 5 cm (hypotenuse) draw an arc intersecting ray $\overrightarrow{AX}$ at C.
4. Join BC.

Thus, ΔBAC is the required triangle.