PRACTICAL GEOMETRY

INTRODUCTION

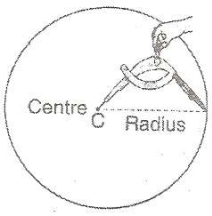
Geometric constructions are made with the aid a ruler or straightedge and compasses only. Drawings are made with the aid of additional instruments, such as protactor and ruler.

Construction of a Circle when its Radius is Known

Suppose you are asked to draw a circle of radius 3 cm. do as follows :

STEP 1.

Mark a point C with your pencil. This point will be the centre of the circle.



STEP 2.

Open the compass for the required radius, i.e., 3 cm, by putting the steel point on C and opening the pencil upto 3 cm.

STEP 3.

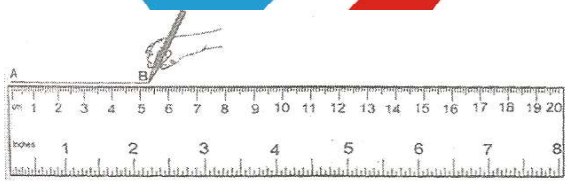
Hold the paper with one hand and swing the pencil leg of the compass around to draw a circle.

Construction of a Line Segment of a Given Length :

Suppose you have to draw a line segment 5.3 cm long.

Method 1. using ruler only

1. Mark any point in your exercise book and label it as A.



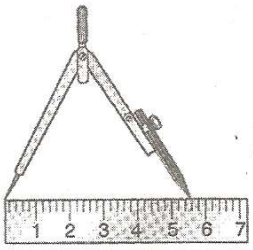
2. Place the ruler in such a way that the zero mark on the ruler coincides with A.

3. Now count 5 complete centimetres and 3 small divisions after the 5 cm mark and mark a point corresponding to this division on the exercise book.

4. Join A to this point as shown.

5. Label the second point as B.

Then AB is the required segment of length 5.3 cm.



Method 2. Using ruler and compass

STEP 1.

Draw any line segment which is longer than 5.3 cm.

STEP 2.

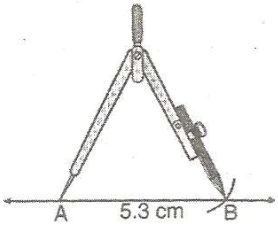
Mark a point on this line near one end as shown. Label it A.

STEP 3.

Use your compass to measure 5.3 cm on your ruler.

STEP 4.

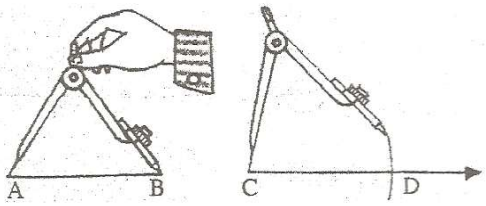
Put the point of the compass on the line segment at A and draw an arc to cut the line as shown. Then AB = 5.3 cm.



To construct a line segment congruent to a given line segment AB

STEP 1.

Draw a ray through any end point C. Open your compass so that the metal tip is on A and the pencil point is on B.



STEP 2.

Keep the compass opening same. Put the metal tip on the end point C of the ray and mark off a line CD congruent to AB.

Perpendicular Lines

Perpendicular lines are lines that intersect at right angles. The symbol $\perp$ means "is perpendicular to".

Drawing Perpendicular Using Ruler and a Set- Square

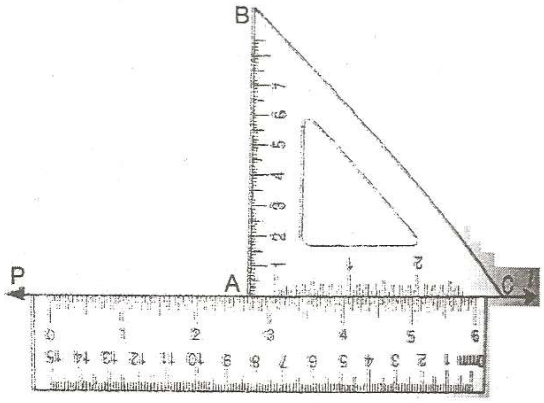
CASE 1 : To constant a line perpendicular to a given line l at a point P lying on it.

STEP 1.

Place a ruler on the paper with one of its long edges lying along the line l.

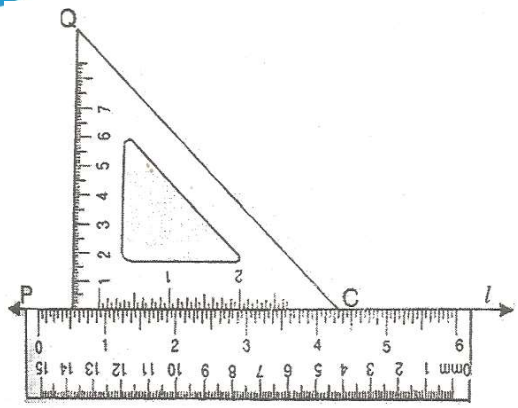
STEP 2.

Holding the ruler fixed, place a set-square ABC with the arm AC of its right angle A in contact with the ruler.



STEP 3.

Slides the set-square along the edge of the ruler until A conincides with P.



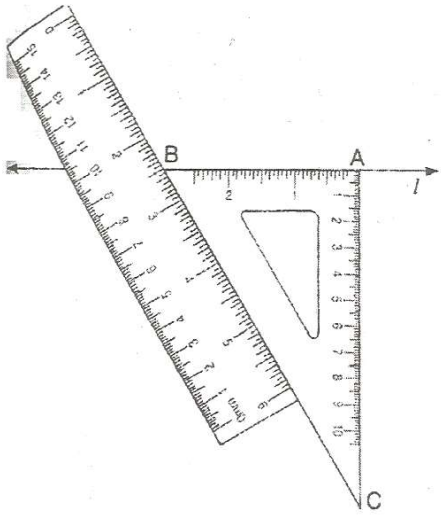
STEP 4.

Holding the set-square fixed in this position, draw with a sharp pencil a line PQ along the edge AB. Then PQ is the required line perpendicular to the line l.

CASE 2 : To construct a line perpendicular to a given line l and passing through a given point P lying outside the given line.

SETP 1.

Place either of the set-squares so that one edge AB of the right angle A lies along l.

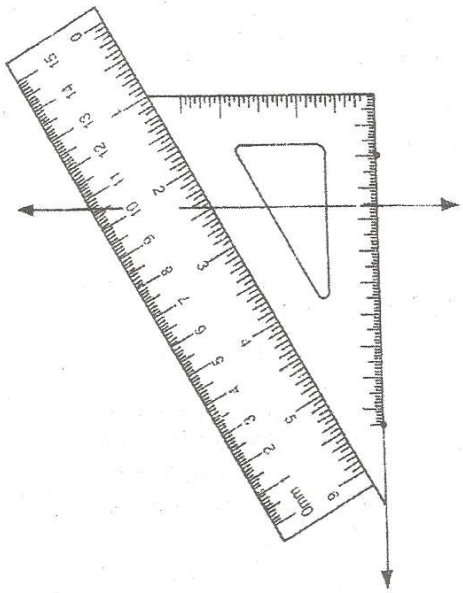


STEP 2.

Now hold the set-square fixed and place a ruler along the edge opposite to the right angle of the set-square.

STEP 3.

Holding the ruler firmly, silde the set-square along the ruler until the edge AC passes through the given point P.



STEP 4.

Draw line PQ along the edge AC of the set-square.

Then PQ is the required line perpendicular to the given line. l, through the point P not lying on it.

To Draw a perpendicular to a Given Line with a Rular, and compass :

CASE 1. At a point on the line.

Let AB be a given line and P be the point on it.

SETP 1.

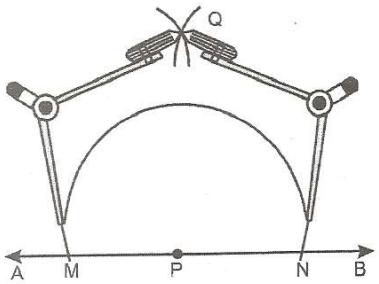
With P as centre and any suitable radius draw an arc to cut the line AB at points M and N.

SETP 2.

With M and N as centres and radius of more than half MN, draw two arcs to cut at Q.

SETP 3.

Join PQ.



Then ray PQ is the perpendicular to the line AB at P.

CASE 1. From a point outside the line.

STEP 1.

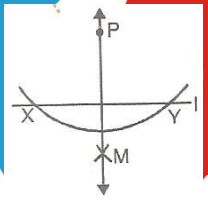
With P as centre and a suitable radius, draw an arc to cut the line l at X and Y.

STEP 2.

With X and Y as centres and a radius of more than half XY, draw two arcs to cut at M.

STEP 3.

Join PM. Then PM ⊥ l.



The Perpendicular Bisector of a Line segment :

In a plane, the perpendicular bisector of a segment is the line that is perpendicular to the segment at its midpoint, Line l is the perpendicular bisector of segment AB.

Construction of Perpendicular Bisector of a Segment :

Using ruler and compass, to construct the perpendicular bisector of a given line segment.

STEP 1.

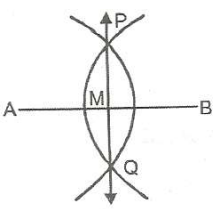
Open the legs of compass to more than half the length of AB. With A as centre (i.e., place the metal-tip of compasses at A), draw arc 1.

STEP 2.

With B as centre and the same radius (i.e., the same opening of the compass), draw arc 2 to cut the first arc. Name the points of intersections as P and Q.

STEP 3.

Draw the line through P and Q by joining P, Q. This line bisects the given line segment AB and is called the bisector of AB.



Let PQ cut AB at M. Then M is called the middle point or simple midpoint of AB.

The line PQ is the perpendicular bisector or the right bisector of AB.

To Construct an Angle Equal to a Given Angle ABC :

STEP 1.

Draw any ray QR. This ray will become one side of the angle and its end point Q will become the vertex of the angle.

STEP 2.

Put the metal tip of your compass on the vertex of ∠ABC.

Draw an arc.

STEP 3.

Without changing the opening of the compass, put the metal tip of the compass on Q. Draw an arc of sufficient length which crosses the ray as shown.

STEP 4.

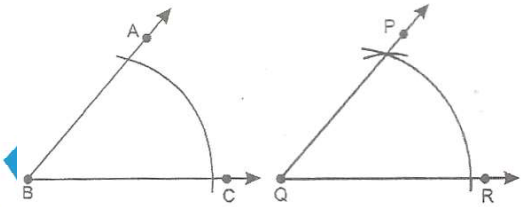
Open the compass so that the metal tip and pencil point are on the points where the arc cuts the arms of ∠ABC.

STEP 5.

Without changing the opening of the compass put the metal tip on the point where the arc cuts QR. Draw another arc that crosses the previous arc at, say, P.

STEP 6.

From point Q draw a ray through the intersection of two arcs, then ∠PQR = ∠ABC. Check your construction with your protractor.



To Bisect a Given Angle ABC

STEP 1.

With B as centre and a suitable radius, draw an arc that intersects BA and BC. Name the points of intersection as P and Q.

STEP 2.

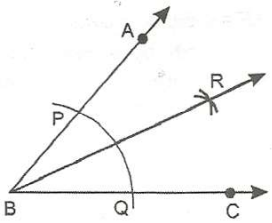
With P as centre and a radius greater than half PQ draw an arc.

STEP 3.

With Q as centre and the same radius draw another arc to cut the first arc. Name the point of intersection of the two arcs as R.

STEP 4.

Join BR. Ray BR bisects ∠ABC. Ray BR is called the angle bisector. Check your result with a protractor.



Angles of Special Measures

ANGLE OF 60º

STEP 1.

Draw a ray OX.

STEP 2.

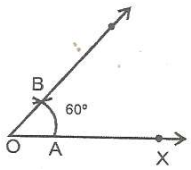
With O as centre and any convenient radius draw an arc above OX, and also cutting OX at A.

STEP 3.

With A as centre and the same radius, draw another arc to cut the first arc at B.

STEP 4.

Join OB. Then ∠AOB = 60º



ANGLE OF 30º

STEP 1.

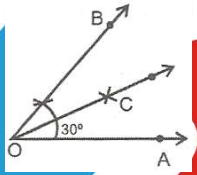
Draw a ray OA.

STEP 2.

With O as the vertex, construct ∠AOB of 60º.

STEP 3.

Bisect ∠AOB. OC is the bisector. Then, ∠AOC = 30º, ∠COB = 30º



ANGLE OF 120º

STEP 1.

Draw a ray OA.

STEP 2.

With O as centre and any convenient radius draw an arc to cut OA at P.

STEP 3.

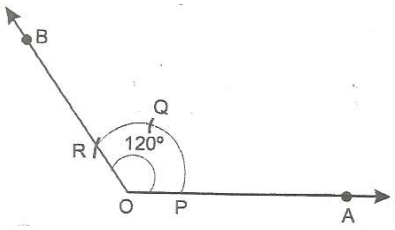
With P as centre and the same radius draw another arc to cut the first arc at Q.

STEP 4.

With Q as centre and the same radius draw another arc to cut the first arc at R.

STEP 5.

Draw the ray OB through O and R. then ∠AOB = 120º



ANGLE OF 150º

STEP 1.

Draw a line AB.

ANGLE OF 90º

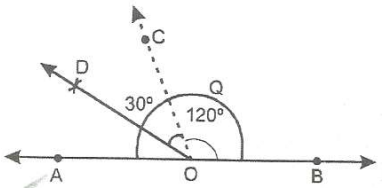
STEP 2.

With any vertex O on AB, construct ∠BOC of 120º

STEP 3.

Bisect ∠AOC. Ray OD is the bisector.

Then ∠BOD = 150º



ANGLE OF 90º

STEP 1.

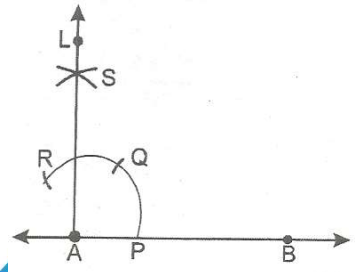
With A as centre and any suitable radius draw an arc cutting AB at P.

STEP 2.

With P as centre and the same radius as before cut the arc of Step 1 at Q. With Q as centre and the same radius cut the arc again at R.

STEP 3.

With Q and R as centres and any convenient radius (same for both) draw arcs cutting at S. Join A to S and produce A to L. Then ∠BAL = 90º., i.e., AL is perpendicular to AB at A.



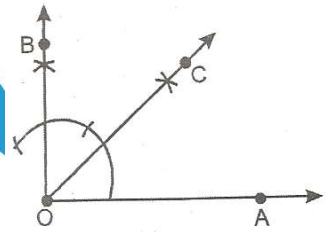
ANGLE OF 45º

STEP 1.

Construct an angle AOB of 90º as in the previous construction.

STEP 2.

Bisect ∠AOB. Let OC be the angle bisector. Then ∠AOC = 45º; ∠COB is also = 45º



ANGLE OF 135º

STEP 1.

Draw a line AB.

STEP 2.

With any point O on line AB as vertex, construct ∠AOC = 90º. Then ∠BOC is also = 90º.

STEP 3.

Bisect ∠BOC. Ray OD is the bisector.

Then, ∠AOD = 90º + 45º = 135º