Chapter 15

GEOMETRICAL FIGURES

Using the Scale

When you go to the market to buy clothes, the shopkeeper generally uses an iron rod or scale to measure the cloth. You have also used the scale in your compass box several times to measure lengths. Look at the scale of your compass box carefully and try to find out the answers to the following questions:

There are two kinds of measuring units on a scale. Find out into how many small parts/ divisions are the units of both kinds divided? What is the measure of the smallest division?

We use the scale on many occassions. Can you draw three line segments in your notebooks that measure 3.5 cm, 4.2 cm and 8.9 cm respectively.

Draw more line segments of different measures. List the situations in your daily life when you need to use a scale.

Drawing A Circle

You must have used the compass to draw circles. You also know what a circle is and what kind of figures or objects are circular. Let us make a list of objects around us that are circular. You have already made such a list before, so this time your list ought to be longer.

Knowing About the Compass

1) How many arms does a compass have?

2) Are the arms of the same length?

3) What is the pointed arm used for? Should the point be inclined when you use the compass?

4) While drawing a circle, if the pointed arm shifts from its position, will you be able to draw a proper circle?

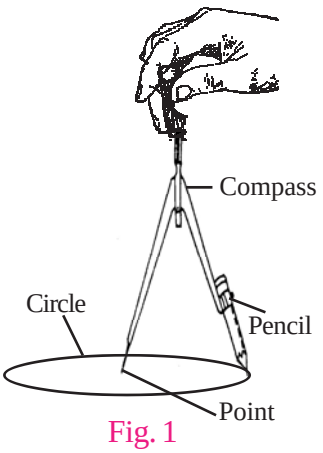


Fig. 1

You now understand how the compass works and how it is used. Draw in your notebook circles of radii 3.2 cm, 4.7 cm and 5.1 cm respectively. Think of more measures of radius and draw a few more circles yourself.

You have also learnt to use the divider in the lesson on line segments . Can you tell the uses of the compass and the divider?

The Protractor

Your geometry box has a protractor too. Look at it carefully and answer the questions given below:

i) What is the shape of the protractor?

ii) Into, how many divisions is the semicircular part of the protractor divided?

iii) Can you draw angles of 47°, 95° and 170° in your notebooks?

The Setsquare

By now, you know about the scale, the compass, the divider and the protractor in your geometry box. Is there any other instrument in your geometry box?

Take out the two triangular instrument that remain in your geometry box and keep them on your notebook. Now trace the outline of these instruments with the help of your pencil that you get the shape of the instrument on the paper.

Measure the angles of the two triangular shapes. You will find that one angle of each of the instruments is of 90°. The remaining two angles are of 45° each in one instrument and in another instrument the angles are of 30° and 60°.

These two instruments are known as **setsquares**.

Now with the help of the setsquares draw an angle of 90° on any line on your notebook and verify the measure with the protractor.

If the angle made by the setsquare is not exactly of 90°, how different is it? Think of the reason for the difference.

You know that the setsquare is useful for making angles of 90°. Let us construct some more figures using the setsquare.

Drawing a perpenidcular on a given line segment from a point that is not situated on the line.

Suppose PQ is a line segment and M is a point outside the line segment.

Steps of Construction

1) Put the scale on the paper in such a way that it is aligned to the line segment PQ (Fig 2).
2) Keep one perpendicular side of the setsquare along the scale. Be careful that the scale doesn't slide or move. The other side of the setsquare is now perpendicular to the scale.
3) Hold the scale tightly on the paper and slide the setsquare along the scale in such a way that the perpendicular side of the setsquare touches the point M (Fig 4).
4) Draw a line segment from point M along the perpendicular side of the setsquare.
5) This line segment would be perpendicular or PQ.

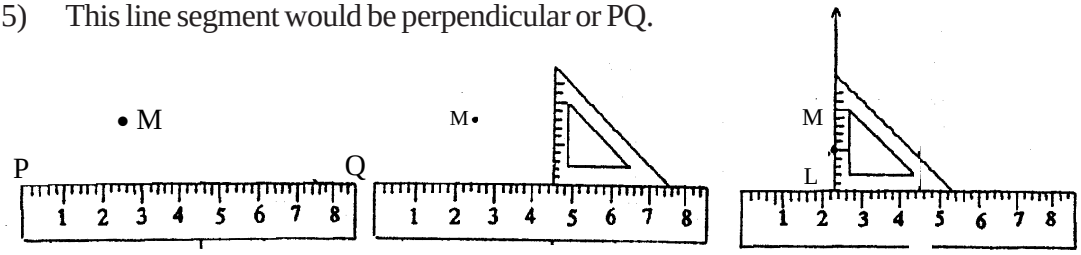


Fig 2 Fig 3 Fig 4

Drawing Parallel Lines with the Help of Setsquare and Scale

You have learnt that the perpendicular distance between two parallel lines is always the same. You have also learnt to draw perpendicular on a line segment with the help of setsquare.

Can you draw a parallel line with respect to the line in your notebook with the help of setsquare and scale? Try to do so, Write how you draw the parallel line.

Draw A Line Parallel to The Given Line Segment From A Point Outside the Line Segment.

Steps of Construction

P is a point outside line AB. We need to draw a line parallel to AB from point P.

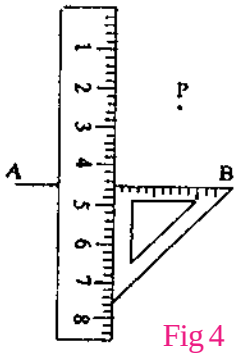


Fig 4

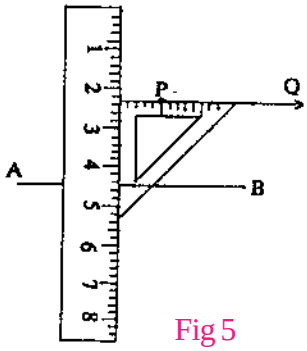


Fig 5

1) Place one perpendicular side of the setsquare along the line AB.

2) Keep the setsquare fixed and place the scale along the other perpendicular arm of the setsquare (fig 4).

3) Hold the scale in a way that it doesn't move.

4) Slide the setsquare along the scale till the perpendicular arm of the setsquare touches the point P.

5) Finally, keeping the setsquare at that point draw a straight line along the side of the setsquare through P. This line PQ will be parallel to AB. You can verify it by measuring the distance between PQ and AB at different points.

The Theory of Construction

Drawing a line parallel to another line means drawing a perpendicular on the given line and then drawing another perpendicular to the drawn perpendicular. Do you agree with this? As it is shown in fig 6, RQ is perpendicular to line AB, and RS is again perpendicular to RQ. So now AB and RS are parallel.

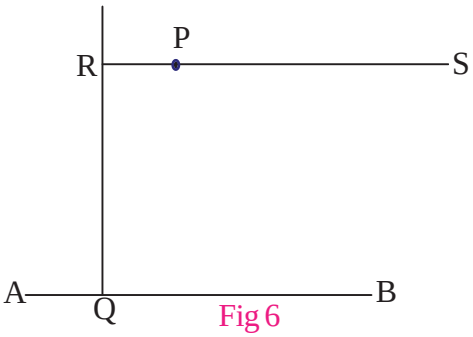


Fig 6

Drawing a Parallel Line at a Particular Distance from the given Line

Suppose we need to draw a line parallel at a distance of 6cms.

1) Draw line AB.
2) Use setsquare and scale to draw a perpendicular on AB (fig 7).
3) Take a point R on PQ in such a way that the distance between Q and R be 6cm.
4) Draw a perpendicular RS on R with the help of setsquare. RS will be parallel to AB and the distance of RS from AB will be 6 cm.

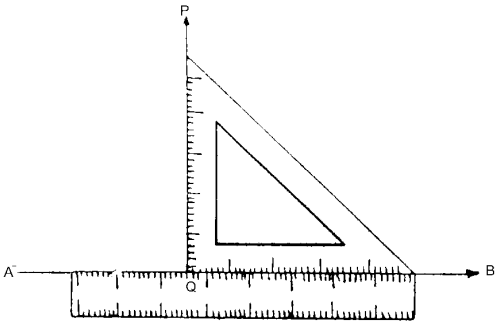


Fig 7

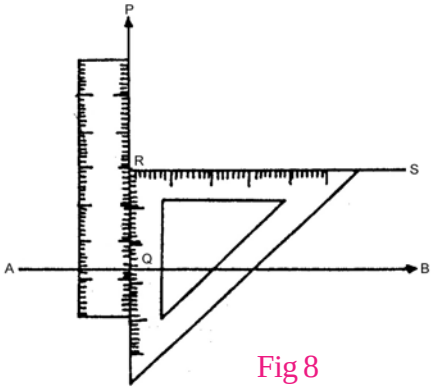


Fig 8

Practice 1

1. Draw a line segment of 3cm and construct parallel lines at the given distances.

   (i) 1.5cm (ii) 2.0cm (iii) 2.2cm (iv) 3.1cm

Using the Scale and Compass to Bisect a Line Segment

Let us do an activity

Activity 1

Draw a line segment AB of any measure. Keeping the point of the compass on A, stretch the other arm upto B and draw a circle taking A as the centre. Now draw another circle of the same measure taking B as the centre. Mark the points and name them.

Now reduce the stretch of the compass, place the point of the compass on A and draw a circle, then draw another circle of same measure by placing point of the compass on B.

Mark the points at which the two circles intersect and name them as R and S.

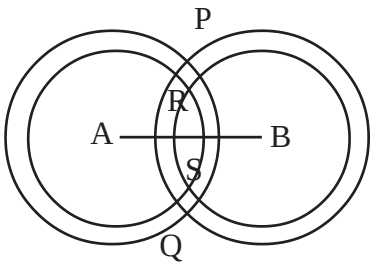


Fig 9

Similarly, go on reducing the stretch of the compass and go on drawing intersecting circles from point A and B. Keep marking the intersecting points. Now can you answer the questions below?

1) You are reducing the radii of the circles gradually. Will two circles of same radius that are being drawn from point A and B always intersect each other? If not, till what measure will the circles drawn at point A and B intersect each other?

2) Are the point P, Q, R, S, T, U etc. that you have got colinear? Can you tell why they are so?

3) In what ratio does line PQ bisect line AB?

4) What angle does line PQ make with line AB?

While doing the activity you must have found that the length of the radii get reduced to less than half. Consequently, the radii or circle drawn from point A and B go on reducing and they do not intersect or cut across each other.

Thus, you can say that if you want to draw a bisecting line for a line segment of a given measure, we need to stretch the compass at more than half of the line's distance and draw circles or arcs with the end points of the given line segments as the two centre. Now, if the intersecting pointsbisecting a line of the circles or the arcs are joined, we get a line bisecting the original line which is also perpendicular on it?

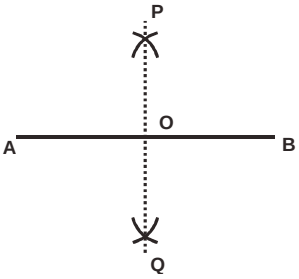
ACTIVITY 2

1) Given are two points A and B in the picture. Join them.

A B

2) Keeping the point of the compass at A measure more than half of the length of AB and draw arcs on both sides of the line.

3) Repeat the process with placing the compass on point B and draw arcs on both sides of the line in such a way that the arcs intersect each other. Name them as P and Q.



4) Now join PQ.

5) Name the point at which line segment PQ cuts AB on O. Now measure AO and OB and see if AO = OB?

6) Measure ∠POB. Is ∠POB = 90°? The line PQ obtained like this would be the bisector of line AB.

Making Angles of Different Measures Using the Compass

ACTIVITY 3

1) Draw a circle of any radius and name its centre.

2) Take a point A on the circle. Keep the compass on point A and draw an arc on the circle with the same measure as the radius.

3) Place the compass on the point where you have drawn the arc and draw another arc with the same radius.

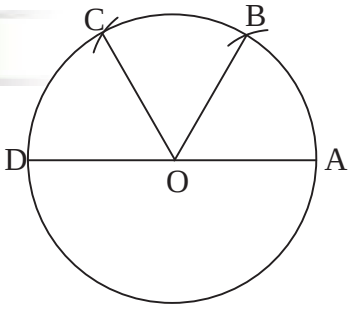


Fig 10

4) Repeat this process of drawing arcs on the circle.

Find the Answer to the Questions Below :

1. In how many arcs the circle can be divided equal to the measure of the radius?
2. Join the intersecting points of all the arcs to the centre of the circle. What is the measure of the angle that is being made by joining two consecutive arcs?
3. Are all the angles of the same measures?
4. If all the angles are of equal measures, what is the measure of one angle?

While finding the answers to the above questions, you have found that on a circle, six arcs equal to the measure of its radius can be cut. The consecutive intersect points on the circumference of the circle make 60° angles with the centre. Each angle made by consecutive intersecting points is of 60°.

Now you make 60° angles with the help of compass and scale. You must have drawn an angle of 60° with the help of compass and scale, let us repeat the process.

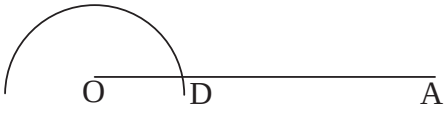


Fig 11

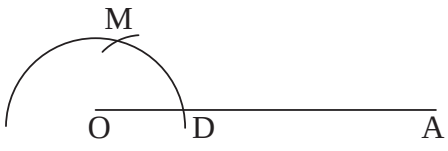


Fig 12

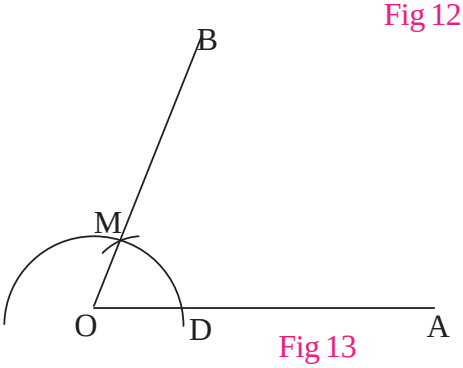
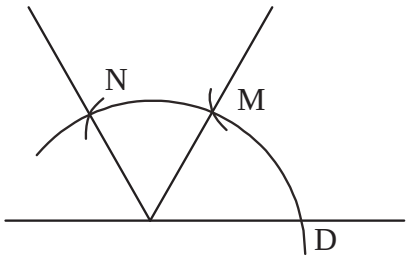


Fig 13

1. Draw a line segment and make an arc from point O, that intersects OA at D (fig 11).
2. Keeping the compass at D, cut another arc of the measure of the radius at M (fig 12).
3. Join OM and extend it (fig 13).
4. ∠AOB = 60°

You have already divided the circle into six equal parts with the measure of the radius of the circle.



Every part makes an angle of 60° with the centre. In the above example you're got an angle of 60° by cutting an arc. Taking the same arc if you make another arc ahead from point M, then you'll get an angle 120° and if you cut arcs thrice, you'll get an angle of 180°.

Practice 2

1. Make an angle of 120° with the help of compass and scale.

Bisecting an Angle

Steps of construction:

1. Take point B on ∠ABC .

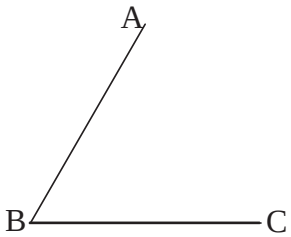


Fig 14

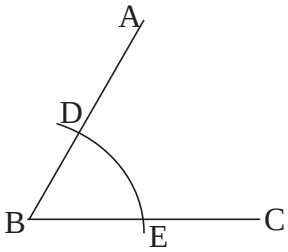


Fig 15

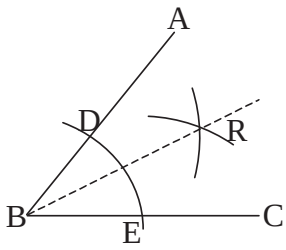


Fig 16

2. Place your compass on point B and draw an arc of any radius to cut AB at D and BC at E.
3. Make another arc taking D as the centre and make another arc E of the same radius, so that both arcs intersect each other at point R (fig 16).
4. Join BR and extend it.
5. The line BR is the bisector of ∠ABC.

Practice 3

1. Make an angle of 52° and draw its bisector.
2. Make an angle of 170° and draw its bisector.
3. Bisect an angle of 60°. Now tell what is the measure of each new angles you got?

Constructing an Angle Equivalent to the Measure of A Given Angle

Suppose ∠AOB is given, we need to construct another angle equal to ∠AOB.

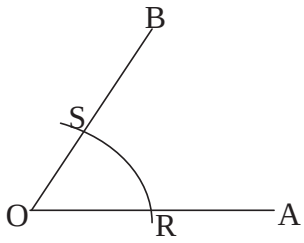


Fig 17

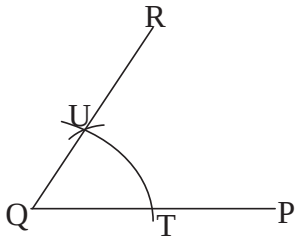


Fig18

1. Draw line QP, we have to make an angle equal to ∠AOB at point Q.
2. Stretch the compass and keep its pointed end at O. Cut an arc in a way that both arms OA and OB get cut at R and S respectively (fig 17).
3. Cut an arc of the same measure with the compass at Q which cuts QP at T.
4. Keeping the compass on R, stretch it to S and use the measure to draw an arc at T that cuts TU (fig 18).
5. Join QU and extend it to R.

Now ∠PQR = ∠AOB

Practice 4

1. Make an angle of 55° with the help of the protractor and also make an equal angle with the help of scale and compass.
2. Draw an angle of 120° with the help of the protractor and draw an equivalent angle with the help of a scale and compass.
3. Given a point P outside the line segment AB. Draw a perpendicualr from P on AB.

Steps of Construction

1. Draw a line AB and take a point P outside AB.
2. Taking P as the centre draw an arc of radius that is convinient which cuts AB on D and E (fig 20).
3. Considering D and E as the centre draw two arcs which cut each other on R.

   Join PR (fig 21) and extend it.

   So, PR ⊥ AB
4. PR and AB meet at Q (fig 22).

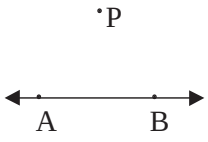


Fig 19

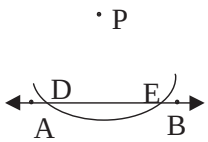


Fig 20

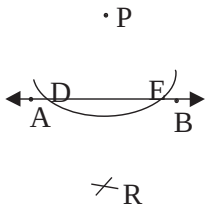


Fig 21

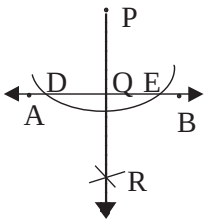


Fig 22

Drawing a perpendicular on AB from point P situated on line segment AB.

Steps of Construction

1. First, draw a line segment AB and make a point P on it.
2. Keep the pointed end of the compass on point P and with any radius draw an arc on line segment AB that cuts AB on the two points Q and R.

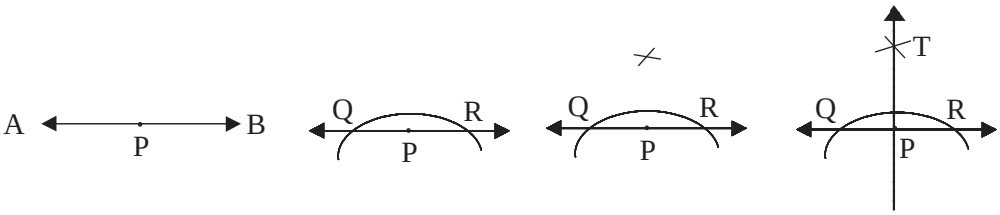


Fig 23 Fig 24 Fig 25 Fig 26

3. Now keep the compass on R and draw an arc with any radius.

4. Repeat the process by keeping the compass at point Q and draw an arc of the same radius, it should be drawn in such a way that it intersects previously at point T.

5. Join point T to P.

The obtained line segment PT, is the perpendicular. Therefore, PT $\perp$ AB.

EXERCISE 15

1. Draw a line segment of 5cm and draw a line parallel to it at a distance of 3cm.
2. Construct the following angles with the help of setsquare.

   (i) 45° (ii) 60° (iii) 30° (iv) 90° (v) 120°
3. Draw line segments of the given measures and bisect them.

   (i) 5cm (ii) 4.5cm (iii) 3.6cm (iv) 5.4cm
4. Draw the following angles with the help of compass and scale.

   (i) 60° (ii) 90° (iii) 120° (iv) 150°
5. Bisect the above angles using the compass and scale.
6. Draw the following angles with the help of protractor and draw equal angles with the help of compass and scale.

   (i) 65° (ii) 92° (iii) 108° (iv) 126° (v) 153°

♦ ♦ ♦