7 Parallel Straight Lines

By studying this lesson you will be able to

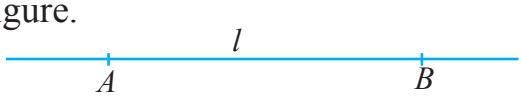
- identify parallel straight lines,
- identify that the gap between a pair of parallel straight lines is the perpendicular distance, that is, the shortest distance between the two lines,
- examine whether a given pair of straight lines is parallel or not by using a straight edge and a set square,
- draw parallel lines using a straight edge and a set square, and
- draw rectilinear plane figures containing parallel lines using a straight edge and a set square.

7.1 Straight line segment

Activity 1

(1) Draw a straight line using a straight edge. Name this straight line l.

(2) Mark the two points A and B on the straight line l as shown in the figure.

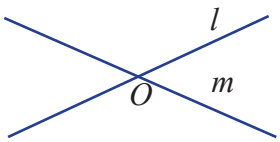


The portion AB of the straight line l is defined as the straight line segment AB. The two points A and B are defined as the two end points of the straight line segment AB.

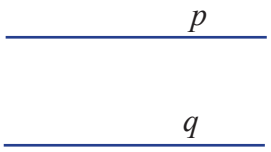
The convention is to use capital letters of the English alphabet to name straight line segments.

7.2 Parallel straight lines

Examine the two pairs of straight lines given below which are drawn on the same plane.



The straight lines l and m intersect each other at O.



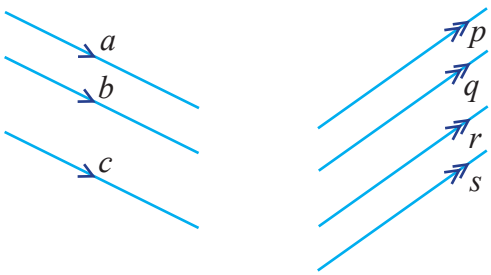
The straight lines p and q do not intersect each other.

Two straight lines which do not intersect each other are called **parallel straight lines**.

Accordingly, the two straight lines p and q are parallel, while the two straight lines l and m are not parallel.

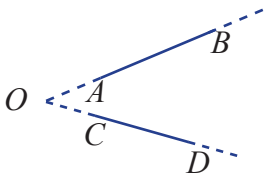
When several straight lines do not intersect each other, they are defined as straight lines which are parallel to each other.

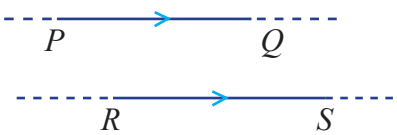
To indicate that several lines are parallel to each other, arrowheads are drawn on the straight lines in the same direction and sense, as shown in the figure.



Accordingly, in the above figure, a, b and c are parallel to each other and p, q, r and s are parallel to each other.

Let us check whether each of the following pairs of straight line segments are parallel to each other or not.





The two straight lines on which the straight line segments AB and CD lie, intersect at O. However the two straight lines on which the straight line segments PQ and RS lie, do not intersect.

Accordingly, PQ and RS are parallel straight line segments while AB and CD are not.

We indicate the fact that PQ and RS are parallel straight line segments using the notation "PQ // RS".

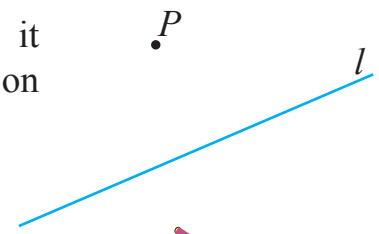
7.3 Perpendicular distance

• The perpendicular distance from a point to a straight line

The following is a figure of a set square. Let us consider how the perpendicular distance from a point to a straight line is found using a set square.

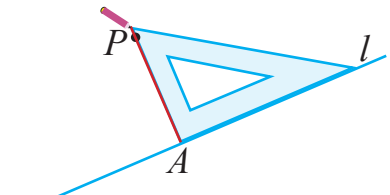
Activity 2

(1) Draw a straight line and name it l. Mark a point P which is not on l.

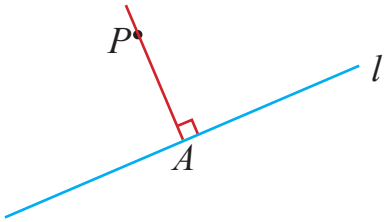


(2) As shown in the figure, place the set square such that one edge which forms the right angled corner lies on l and the other edge passes through the point P.

(3) Mark the point A on l as indicated and join AP.



The angle marked at A is a right angle. **We say that the straight line segment AP is perpendicular to l.**

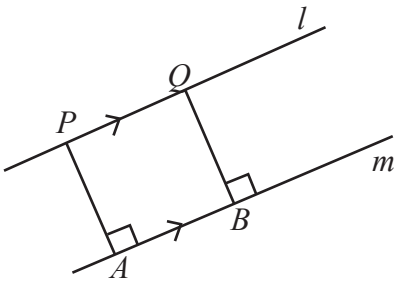


(3) Observe that the point on l which is closest to P is A. Measure AP.

The length of the straight line segment AP is defined as the **perpendicular distance** from the point P to the straight line l. The length of AP is the **shortest distance** from the point P to l.

• The perpendicular distance between two parallel straight line

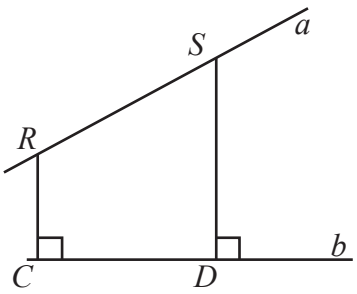
The perpendicular distances from the two points P and Q that lie on the line l to the straight line m are equal to each other. That is, $PA = QB$.



$\therefore l$ and m are two parallel straight lines.

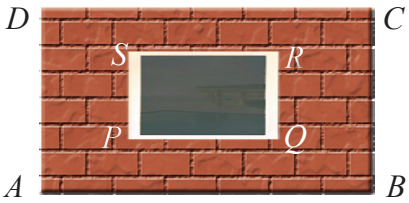
However, the perpendicular distances from the two points R and S on a to the straight line b are unequal. That is, $RC \neq SD$.

$\therefore$The straight lines a and b are not parallel to each other.



- The distance from every point on a straight line to a parallel straight line is a constant. This constant distance is defined as the **perpendicular distance** between the two parallel straight lines.
  This perpendicular distance is also defined as the **gap** between the two parallel straight lines.
- Straight lines which lie on the same plane and which are a constant distance from each other are parallel to each other.

The figure given below depicts a wall of a room and a window in the wall. Since the wall is rectangular in shape, the opposite edges are parallel.



- That is, the horizontal edges which are represented by the straight line segments AB and DC are parallel to each other.
- Similarly, the vertical edges which are represented by the straight line segments AD and BC are parallel to each other.
- The straight line segments PQ and SR, represent the horizontal edges of the window. They are parallel to each other.
- The straight line segments PS and QR, represent the vertical edges of the window. They are parallel to each other.

There are several locations in the environment where such parallel edges can be observed.

- The horizontal panels of a ladder
- The beams of a roof
- The straight line segments of a 100 m running track

are some examples.

Exercise 7.1

(1) Write down the names of two objects that can be observed in the classroom that have parallel edges.

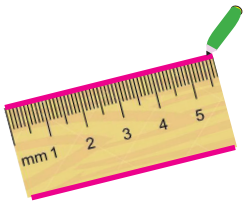
(2) Write down the names of two objects in your day to day environment that have parallel edges.

(3) Name four locations where parallel lines can be observed in architectural designs.

(4) Describe several arrangements and tasks which involve parallel straight lines.

7.4 Drawing parallel lines using a straight edge and a set square

As shown in the figure, place the ruler on a page of your exercise book and draw two straight lines along the edges of the ruler. Now you have obtained a pair of parallel straight lines.



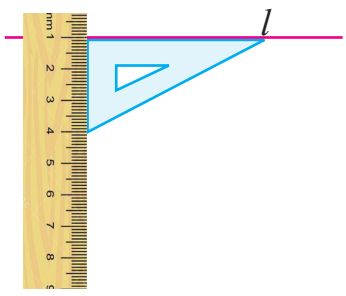
- **Drawing a straight line parallel to a given straight line using a straight edge and a set square**

Activity 3

(1) Draw a straight line using a straight edge and name it l.

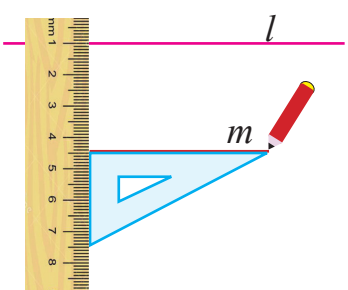
(2) Place the set square such that one edge which forms the right angled corner lies on the straight line l.

As shown in the figure, place the straight edge such that it touches the other edge which forms the right angled corner of the set square.



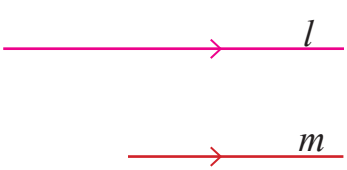
(3) Keeping the straight edge fixed, move the set square along the straight edge.

(4) Stop moving the set square and draw a straight line along the edge which forms the right angled corner and is not touching the straight edge.

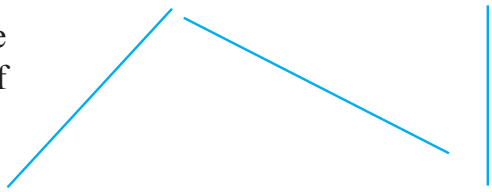


(5) Name this straight line m.

Now you have obtained a straight line m which is parallel to the straight line l.



➢ Copy the straight lines in the figure and draw a line parallel to each of them.

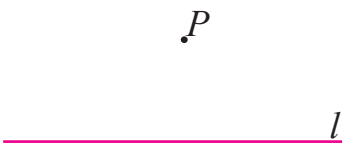


Only one line can be drawn parallel to a given line on a plane, through a point on the plane which does not lie on the given line.

- **Drawing a straight line parallel to a given straight line, through a point which is not on the straight line, using a straight edge and a set square**

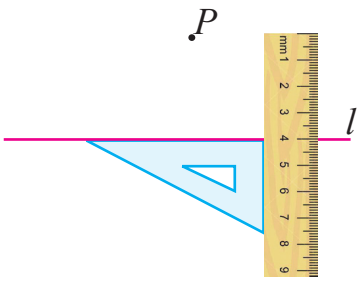
Activity 4

(1) As indicated in the figure, name a point P that does not lie on the straight line l.



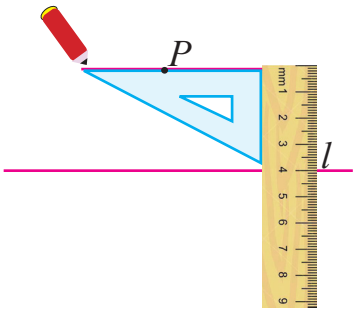
(2) Place the set square such that one edge which forms the right angled corner lies on the straight line l.

As shown in the figure, place the straight edge such that it touches the other edge which forms the right angled corner of the set square.



(3) Keeping the straight edge fixed, move the set square along the straight edge.

(4) When the edge of the set square which was lying on the straight line l touches the point P, draw a straight line along it.



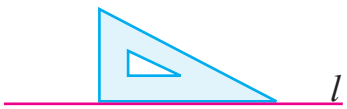
Now you have obtained a straight line through the point P, which is parallel to the straight line l.

• Drawing a line parallel to a straight line at a given distance from the straight line, using a ruler and a set square

Activity 5

Let us draw a straight line which is parallel to the straight line l through a point at a distance of 2.5 cm above it.

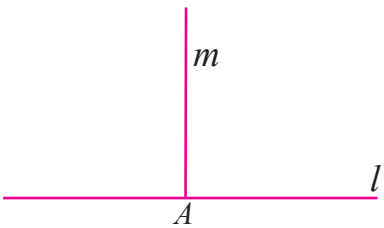
(1) Draw a straight line l as shown in the figure.



(2) Place the set square such that one edge which forms the right angled corner lies on the straight line l.

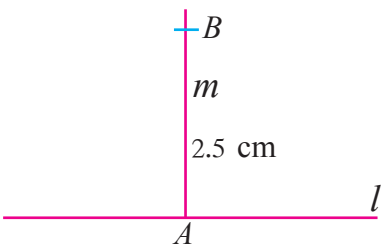
(3) Draw a straight line along the edge which forms the right angled corner and does not lie on the straight line l.

Name this straight line m.



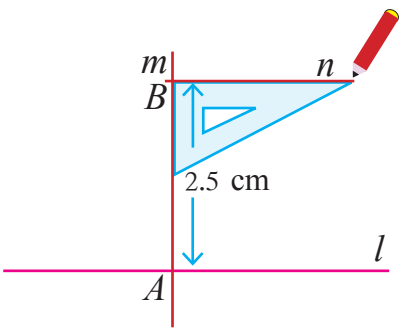
(4) Name the point at which the straight line m meets the straight line l as A.

(5) Mark the point B on the straight line m, at a distance of 2.5 cm from A.



(6) Place the set square such that the right angled corner coincides with B and one of the edges which forms the right angled corner lies on m, and draw the line n along the other edge which forms the right angled corner.

Now you have obtained a straight line n which is parallel to the straight line l and which lies at a distance of 2.5 cm from l.



(7) Draw in a similar manner, the straight line which is parallel to the straight line l and which lies 2.5 cm below l.

Exercise 7.2

(1) (i) Draw a straight line segment of length 6 cm and name it AB.
(ii) Mark a point P which does not lie on the straight line segment.
(iii) Draw a straight line passing through P parallel to AB, using a ruler and a set square.
(iv) Find the gap between the two straight lines by using a straight edge and a set square.

(2) (i) Draw a straight line segment. Name it PQ.
(ii) Mark a point A below PQ such that the perpendicular distance from A to PQ is 4.8 cm.
(iii) Draw a straight line segment which passes through A and is parallel to PQ.

7.5 Examining whether two straight lines are parallel

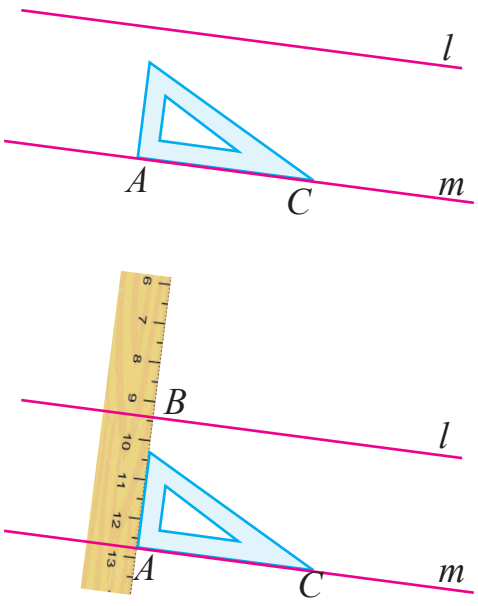
To determine whether two straight lines in the same plane are parallel or not, it is necessary to check whether the perpendicular distances from any two points on one line to the other line are equal or not.

Activity 6

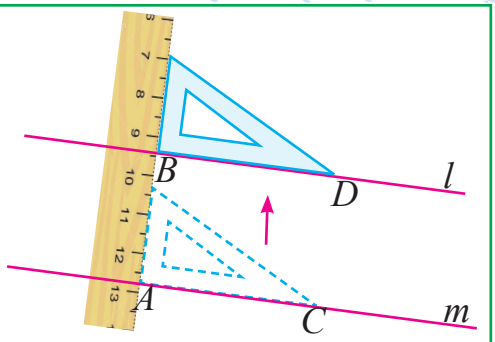
Let us examine whether the two straight lines l and m are parallel.

(1) As shown in the figure, place the set square such that one edge which forms the right angled corner lies on the straight line m.

(2) Place the straight edge such that it touches the other edge which forms the right angled corner of the set square as indicated in the figure. Name the point at which the straight edge meets the line l as B.



(3) Keeping the straight edge fixed, move the set square along the straight edge as shown in the figure, until the right angled corner coincides with the point B on the straight line l.



(4) Check whether the edge of the right angled corner which was initially on the straight line m, now coincides with the straight line l.

If it coincides, then the perpendicular distances from the two points B and D to the straight line m will be equal, and hence l and m are two parallel straight lines.

If it does not coincide, then the straight lines l and m are not parallel to each other.

7.6 Drawing rectilinear plane figures using a set square and a straight edge

Activity 7

(1) Draw a rectangle of length equal to the length of 6 squares and breadth equal to the length of 4 squares on your square ruled exercise book.

(2) Establish that the distance between the two longer sides of the rectangle is a constant value by counting squares. Confirm this by measuring the distance between the two longer sides using a ruler.

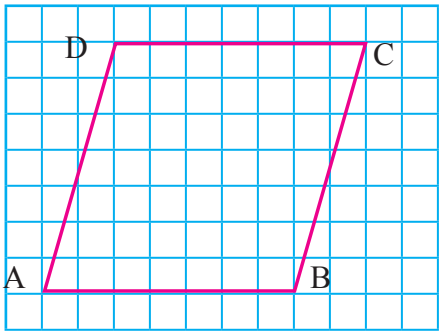
- If the distance is a constant value, then the straight line segments which represent the two longer sides of the rectangle are parallel to each other.
- It can be seen similarly that the two straight line segments drawn to represent the shorter sides of the rectangle are also parallel to each other.

Activity 8

(1) Draw the straight line segments AB and DC on a square ruled paper such that their lengths are equal to the length of 7 squares.

(2) Complete the figure $ABCD$ by drawing the straight line segments AD and BC.

(3) Using a set square and a straight edge, show that AD and BC are parallel to each other and find the gap between them.



Activity 9

(1) Draw a straight line segment and mark the points A and B on it such that $AB = 6$ cm.

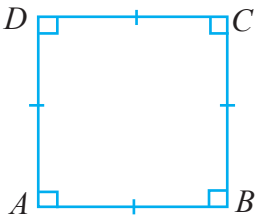
(2) Using a set square, draw two straight lines through the points A and B, perpendicular to the given line.

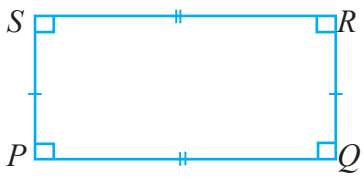
(3) Mark the points C and D such that $AD = 6$ cm and $BC = 6$ cm.

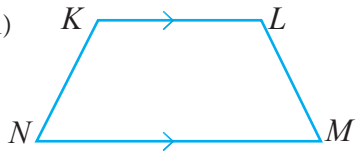
(4) Complete the figure $ABCD$ using a straight edge. What is the name given to a quadrilateral of the shape $ABCD$?

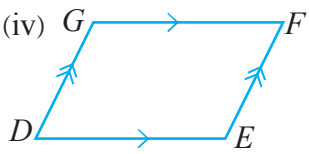
Exercise 7.3

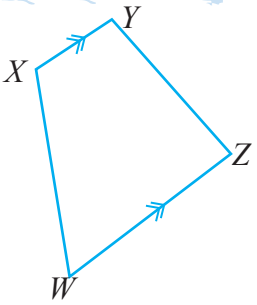
(1) Draw each of the following figures using a straight edge and a set square.

(i) 

(ii) 

(iii) 

(iv) 

(v) 

(2) Write down for each of the above figures whether each pair of opposite sides is parallel or not.

(3) Using a straight edge and a set square,
(i) draw a square of side length 5 cm.
(ii) draw a rectangle of length 8 cm and breadth 5 cm.

(4) (i) Draw a straight line segment AB such that $AB = 6$ cm.
(ii) Draw the straight line segment BC such that if forms an obtuse angle with AB at B.
(iii) Draw a straight line through C parallel to AB in the direction of A.
(iv) Mark the point D on this straight line such that $CD = 6$ cm. Join AD to obtain the parallelogram $ABCD$.

Summary

- Two straight lines in a plane which do not intersect each other are called parallel straight lines.
- Two straight lines in a plane which are at a constant distance from each other are parallel to each other.
- The gap between two parallel straight lines is a constant.