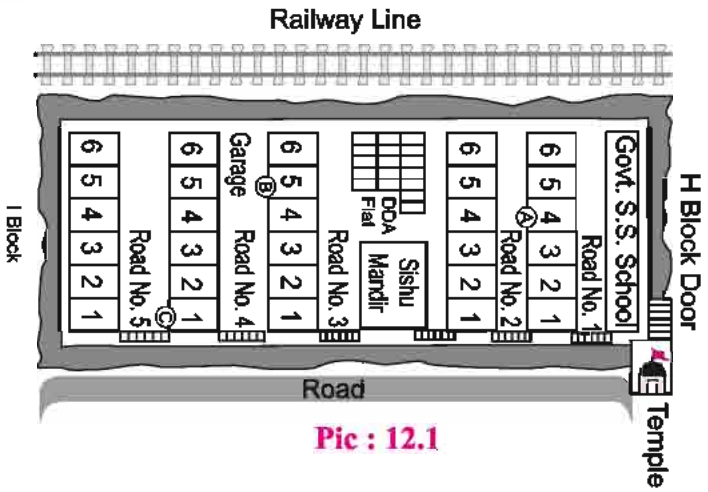
Chapter

# 12 Linear Graph

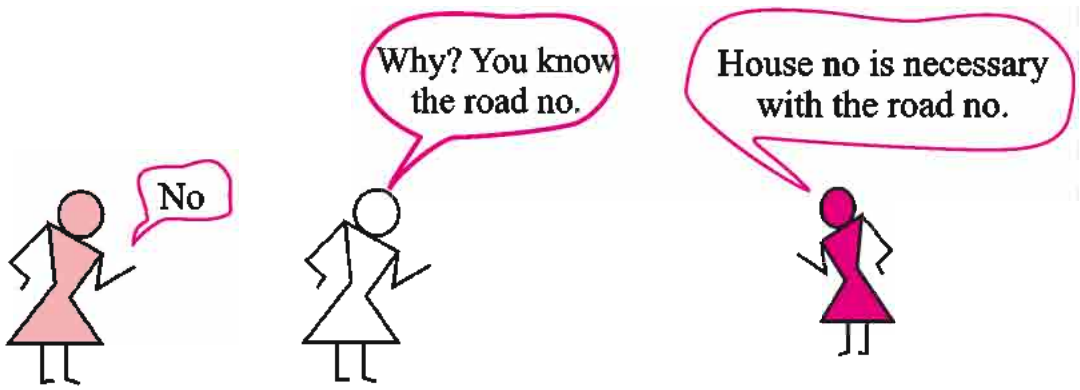
**12.1** You have studied in previous classes about the number lines. On number line one can determine the location of any point and describe the position of that point ,but in our daily life, there are lot of situations where location of a point has to be interpreted with references to more than one lines.

**Activity 1:** Consider the following conditions.




**Pic : 12.1**

In figure 12.1, a map of a colony is given where 6-6 houses are located on each road. Your relatives live in this colony. You were informed that they live on road no.- 2. Can you tell their residence address easily?




In figure, A indicates that house which is situated on road no.-1 and number of that house is 4. Similarly, B indicates that house which is situated on road no. - 3 and number of that house is 5. Thus, to find out the correct location of any place, two independent information are needed.

**Activity 2:**

Reeta and Shyam are standing together. Reeta took a paper and mark a point A on that paper and asked Shyam to tell the location of that point A.


Pic : 12.2

**Shyaam:** It is situated on the left side of the paper.

**Reeta:** From this, location of a point A is not clear. For this, it would be necessary to tell that how far it is located from the left and how above it located from the bottom.

**Shyaam:** (Measuring by the scale). Well, it is located 2 cm from the left and 8 cm above from the bottom.

**Reeta:** Yes, now the location of a point will be found out.

**Teacher:** For this, two constant lines that is left corner and bottom line of the paper is fixed to determine the position of the point.

**Activity 3:**

30 selected students are standing at a fixed place for exercise in a play ground as shown in figure below. Actual position of these students can be determined with the help of the following three information:

i) Position of physical Teacher T.

ii) The vertical column in which he/she is standing.

iii) The horizontal row in which he/she is standing.

There are 5 columns and 6 rows in front of physical Teacher and he has to tell the position of students A,B,M,K then he will express it in this way-

A ⟶ 3, 4

B ⟶ 2, 3

M ⟶ 3, 2

K ⟶ 4, 2

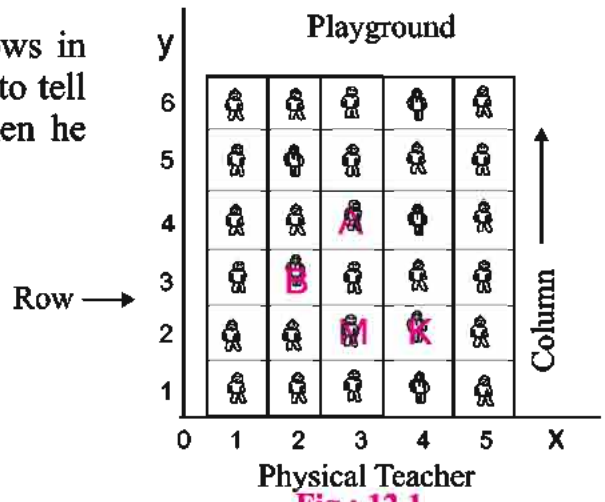


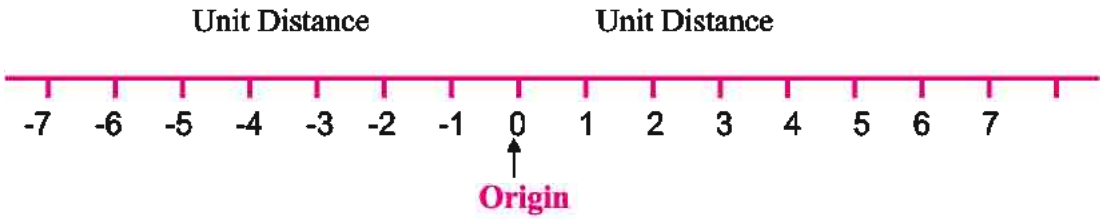

Fig : 12.1

Here it is important to note that first number represent the column and second number represent row. Note the position of student A, he is standing at third column and fourth row similarly, note the position of student B, M and K.

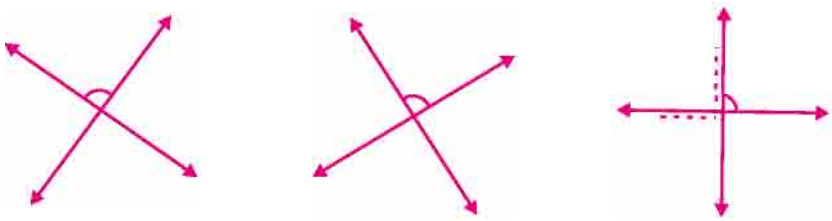
By the above example you see that the position of an object, placed on the floor, can be represented by the two perpendicular lines. If object is in a point form, then it is necessary to determine the distance of a point from the bottom line and from the left corner of the paper. Into the connection of standing for the exercise it is required to know the number of column and rows.

## 12.2 Cartesian System

On a number line distances from a fixed point in one direction is marked positive and in another direction it is marked negative. Point, from where distances are marked, is called origin. To mark the points on a line at equal distance, we use number line to represent numbers. If '1' unit distance represent number '1' then '3' unit distance will represent number '3' where '0' is origin.



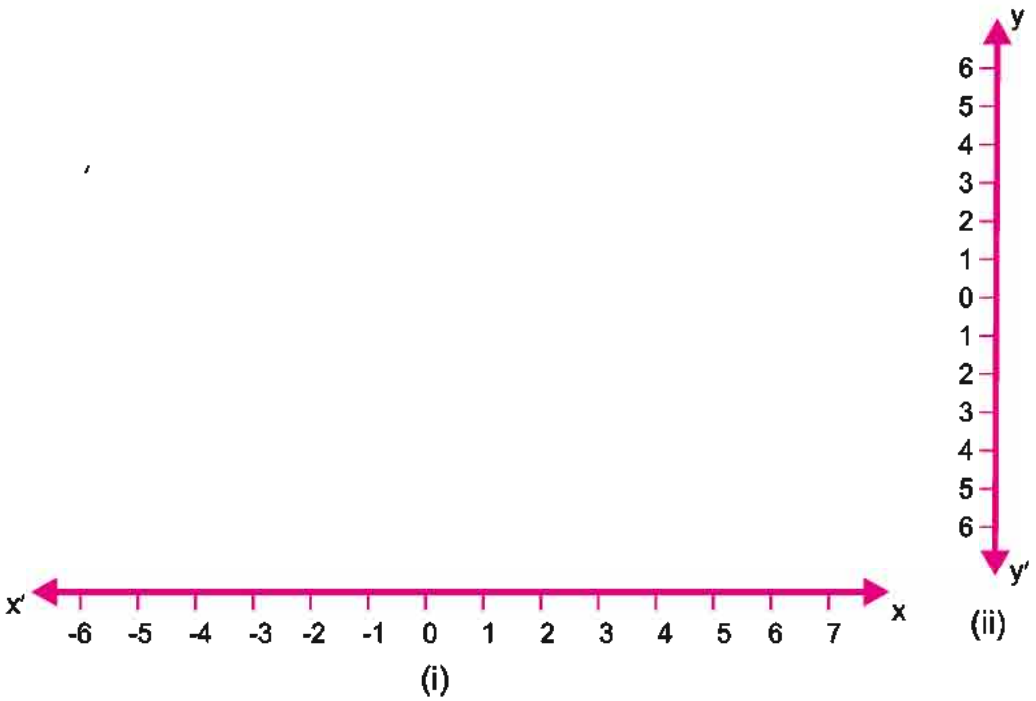

Dakarte considered representing a model in which he draws two lines perpendicular to each other in a plane and determining the position of the points in a plane with respect to these lines. Perpendicular lines may be in any directions as shown in figure 12.2 (i), (ii) and (iii). But in this chapter, when we will consider two lines in a plane to determine the location of a point, then one line will be horizontal and another will be vertical, as shown in figure (iii).



(i) (ii) (iii)

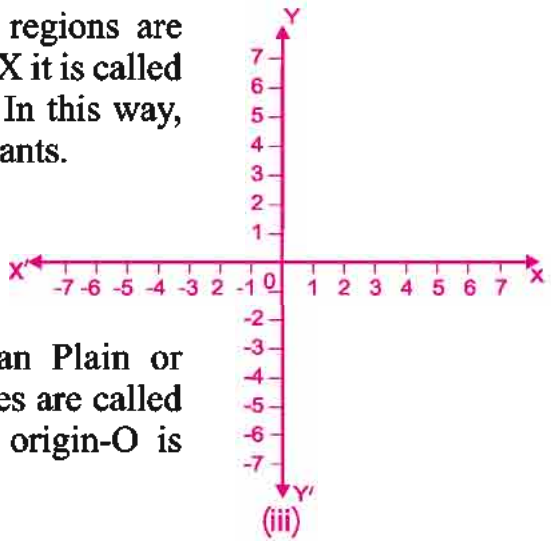
Fig : 12.2

In fact, we can obtain these lines in this way. Have two number lines and give them name X'X and Y'Y. Keep X'X horizontally. See figure (i) and numbers are written on this in a way as written on number line. Do these activities with Y'Y( see figure(ii). Difference is only that Y'Y is vertical not horizontal.

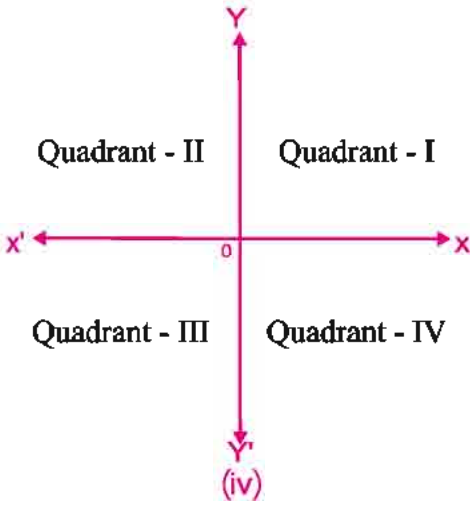



Combine the two straight lines in such a way that both of lines intersect each other at origin see figure (ii). Horizontal line X'X is called X axis and the vertical line Y'Y is called Y axis. Point, where X'X and Y'Y intersect each other is called origin. It is represented by O because positive numbers are mentioned in OX and OY directions. Therefore, OX and OY is called the positive axes of X-axis and Y-axis respectively. Similarly, OX' and OY' is called the negative axes of X-axis and Y-axis respectively.

In figure (iii), we see that both these axes divide the plane into four regions. These four regions are called Quadrants. Anti-clock wise from OX it is called I,II,III and IV quadrant (see figure (iv)). In this way, this plane contains two axes and four quadrants.




This plane is called the Cartesian Plain or Coordinate Plain or XY-plane and the axes are called Coordinate axes. X- axis,Y- axis and origin-O is jointly called Frame of Reference.

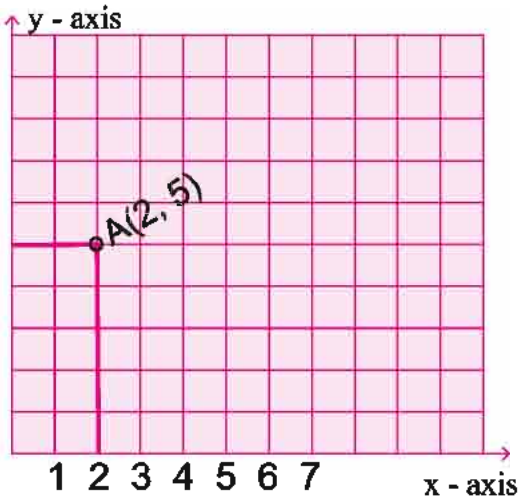



## 12.3 Coordinates:

Imagine that you go to the stadium to watch the cricket match and want to arrive at your reserve seat. For this, you required two numbers. First, row number and second column number. Location of point A(2,5) can be determined by 2 unit from left corner and 5 unit from lower corner.

On squared paper, number 2 is called the x-coordinate and number 5 is y-coordinate. So we can say that point (2,5) are the coordinates. Vertical distance of a point from the x-axis is called Ordinate. Similarly, the vertical distance of a point from the y-axis is called abscissa of that point. In this way, abscissa is 2 and ordinate is 5 of point A.

While writing coordinates, it is represented by small bracket (), first abscissa then comma after that ordinate. In this way, coordinates are (x,y).

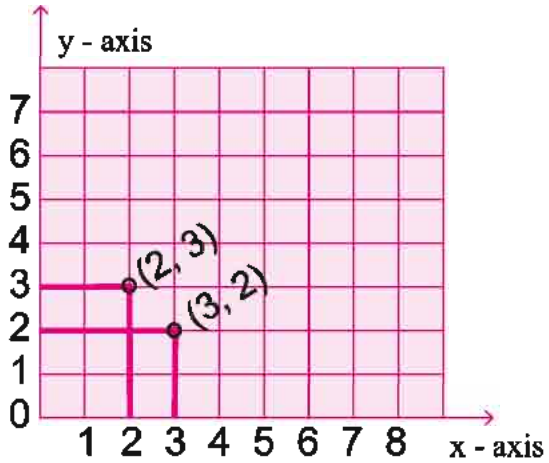



Graph 12.1

For origin, abscissa and ordinate is zero (0). Coordinates of origin are (0,0). Coordinates (x,y) and (y,x) are not equal as they represent the different points on Cartesian plane.

**Do this also:**

Plot the point(2,3) on a graph paper. Is it that point which represents (3,2)?



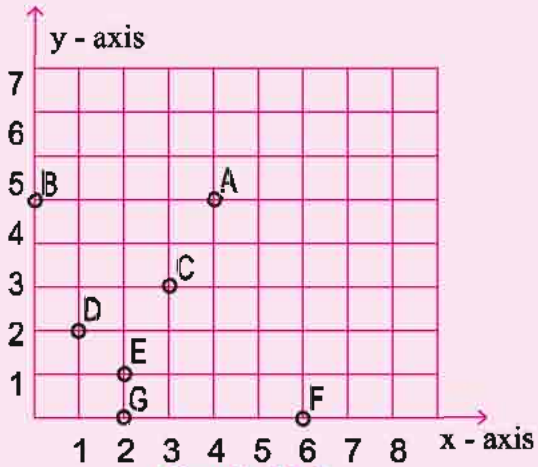

Graph 12.2

Sameer – location of both points are different.

**Do and Learn:**

1. Looking at the graph 12.3, for the location of the following points, select the proper alphabets.

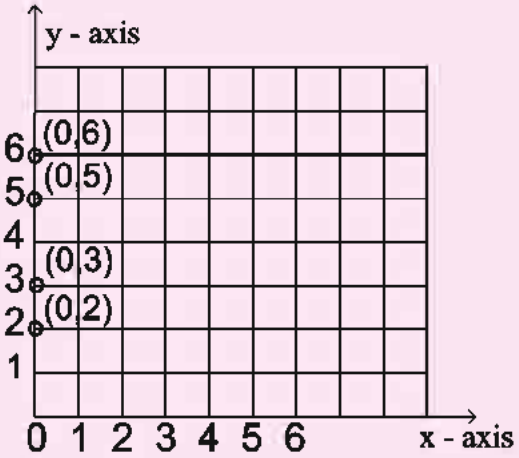
(i) (2,1)
(ii) (0,5)
(iii) (2,0)
(iv) Coordinates of point A
(v) Coordinates of point B



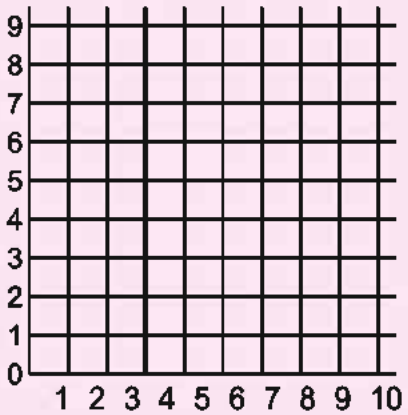

Graph 12.3

2 Plot the following coordinates on squared paper and check whether all are in a straight line. If yes, then give the name to these lines.

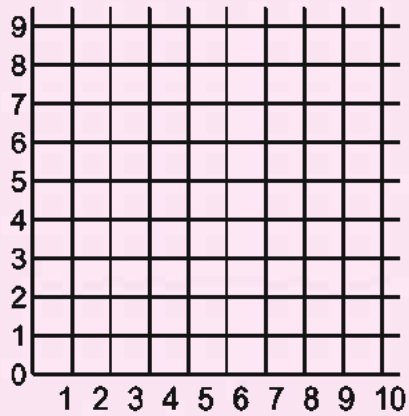
Graph 12.4 (i) (ii) (iii) (iv)



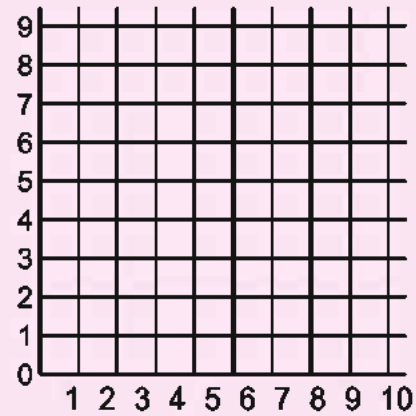

(i) (0,2); Q(0,5); R(0,6); S(0,3)




(ii) A(1,1); B(1,2); C(1,3); D(1,4)




(iii) K(1,3); L(2,3); M(3,3); N(4,4)




(iv) W(2,6);X(3,5); Y(5,3); Z(6,2)

Graph 12.4

## Exercise 12.1

1.Fill in the blanks by seeing the graph 12.5 given below:

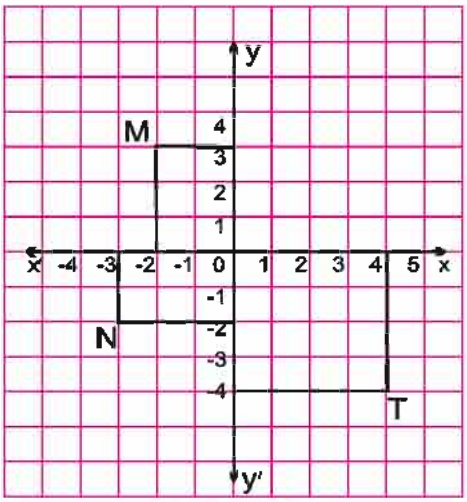
(i)Distance from x-axis of a point M is .....unit.

(ii)Distance from y-axis of a point M is .....unit.

(iii)Distance from y-axis of a point N is .....unit.

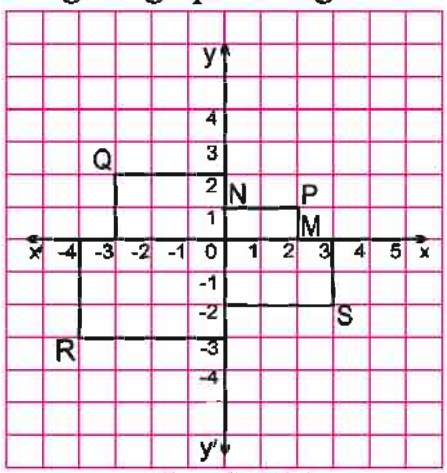
(iv)Point T is plotted on quadrant.....

(v)Distance from x-axis of a point T is .....unit.




Graph 12.5

2. Fill in the blanks by seeing the graph 12.6 given below:




Graph 12.6

(i)Abscissa .....and ordinate.....are of point P. Therefore, the coordinates of point P are.....

(ii)Abscissa .....and ordinate.....are of point Q. Therefore, the coordinates of point Q are.....

(iii)x-coordinate.....and y-coordinate .....are of point R. Therefore, the coordinates of point R are.....

(iv)x-coordinate .....and y-coordinate .....are of point S. Therefore, the coordinates of point S are .....

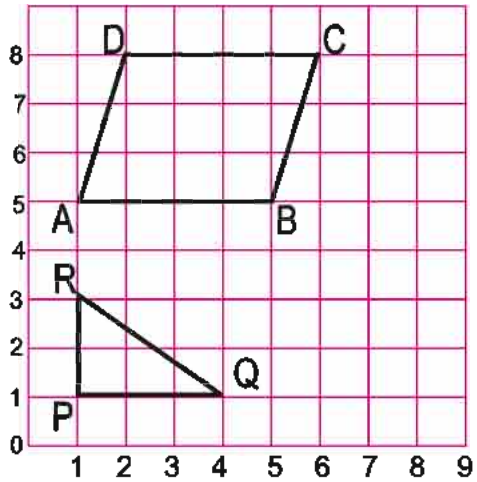
3. Plot the following points on squared paper and check whether they all are situated on straight line.

(i) A (1,1); B(1,2); C(1,3); D(1,4)

(ii) K (1,3); L(5,3); M(5,5); N(1,5)

(iii) P (2,6); Q(5,5); Y(5,3); Z(6,3)

4. Draw the following graph-12.7 on graph paper, write the answer of the questions given below.




Graph 12.7

(i) Write the coordinates of vertices of parallelogram ABCD. Find the length of side AB and DC.

(ii) Find the coordinates of vertices of triangle PQR also find the length of base PQ.

5. Write the True or False in front of each statement.

(i) Location of a point on graph paper is represented by the number pair.

(ii) Linear graph shows the change in data with respect to time-interval.

(iii) Point having x-coordinate zero and y-coordinate non-zero, is located on y-axis.

(iv) Point having y-coordinate zero and x-coordinate 5, will be located on y-axis.

(v) Coordinates of origin are (1,1).

**Some Applications:**

In daily life, you observed that facilities as much you consume, as you have to pay for that. If you consume much of electricity then you have to pay the electricity bill in that amount. If you consume less electricity then you would have to pay less.

Here one quantity affects the other. We say that quantity of electricity is an independent variable while the electricity bill is a dependent variable. The relationship between these variables can be represented by the following graph.

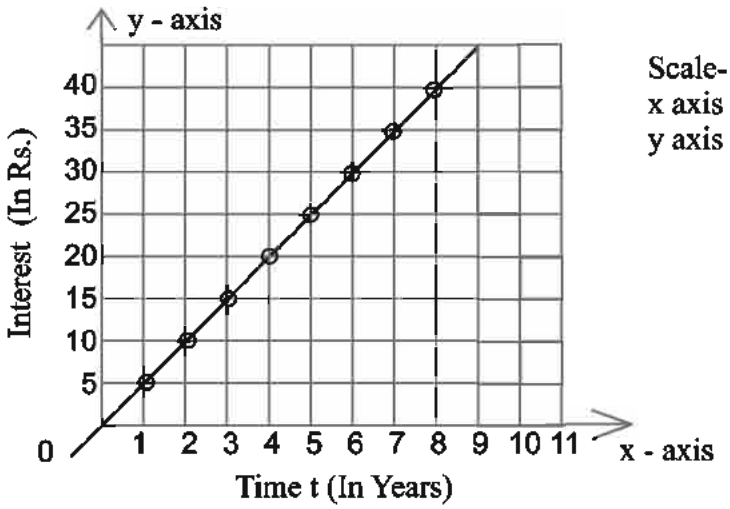
## 12.4 Representation of some real relationship by the Graph

**Example -1:** Represent the relationship by the graph between the time and simple interest at given principal amount and by the given rate of interest.

**Solution:** Let simple interest is 5% per year rate of interest at Rs. 100/-on given principle amount. This relationship is represented by Interest = 5 × Time. With respect to different values of time (t), interest (I) = 5 × time(t) is calculated and write below in tabular form.

| Time t (In Years) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Interest I = 5t (In Rs.) | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |

By plotting the obtaining points (1, 5); (2, 10);(3, 15);(4, 20);(5, 25);(6, 30);(7, 35);(8, 40) on graph paper, relationship between years and interest are obtain. This graph shows a straight line.



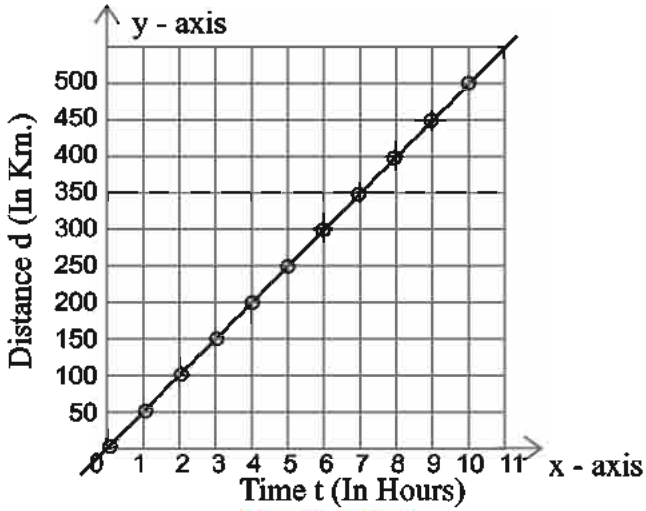

Scale-
x axis = 1 cm = 1 year
y axis = 1 cm = 5 Rs.

Graph 12.8

**Example-2:** A car travel 50 km distance in 1 hr. Relationship between distance, covered by the car, and time can be obtained by the d = 50 × t. Where time (t) is in hours and distance (d) is in km. Plot this relationship on graph paper. For different values of time (t), distance (d) can be calculated as shown in table below:

| Time (In Hours) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Distance d (In Km.) | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 |

**Sol:** By plotting the coordinates (1,50), (2,100), (3,150), (4,200), (5,250), (6,300), (7,350), (8,400), (9,450), (10,500) on graph paper, a relationship between time and distance can be obtained which is shown by the straight line.




Scale-
on x axis = 1 cm = 1 hr
on y axis = 1 cm = 50 Km.

Graph 12.9

## 12.5 Read the Graph:

Now we draw the graph between time, interest, distance. Similarly, we can draw the graph between multiple of any number (multiple of 3 = 3,6,9, 12.....), side of the square and perimeter etc. Now we see that how to read the given graph. See the following example:

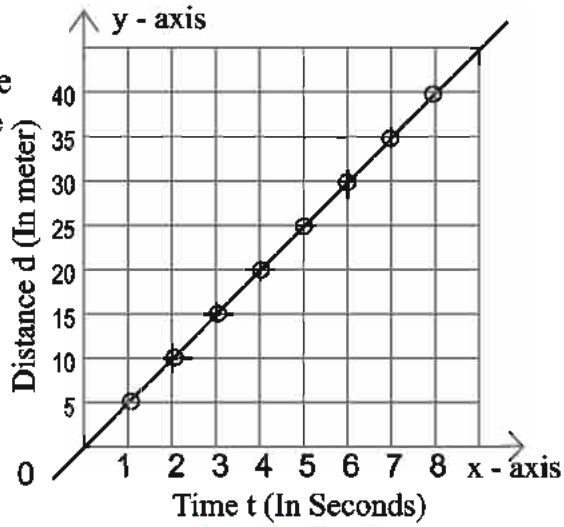
**Example 3:** See the graph carefully and answer the following questions:

1. What is the distance travelled in 2 sec.
2. What is the distance travelled in 6 sec.
3. How much time to go to cover 20m.
4. What is the speed per second of the vehicle?

**Sol:** It is clear from the graph 12.10:

1. Distance covered in 2 sec. = 10 metre
2. Distance covered in 6 sec. = 30 metre
3. When distance = 20 metre
then time = 4 sec.

$$\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{20}{4} = 5 \text{ meter/sec.}$$




Graph 12.10

## Exercise 12.2

1. Length of a side of an equilateral triangle and square is x cm. Find their perimeter, draw the graph between length and perimeter.

(Hint: Perimeter of $\triangle = x + x + x$ ) cm.

2. Length of a rectangle is double of its breadth. Draw the graph between area and breadth of rectangle.

(Hint: area of rectangle $A = 2x \times x = 2x^2$)

3. According to the following table, draw the graph between time and simple interest.

| **Time** | 1 yr | 2 yr | 3yr | 4 yr |
|---|---|---|---|---|
| **Simple Interest** | Rs. 60 | Rs. 120 | Rs. 180 | Rs. 240 |

4. Draw a graph representing the relation between time and distance.

| **Time** | 2 | 4 | 6 | 8 |
|---|---|---|---|---|
| **Distance** | 10 | 20 | 30 | 40 |

5. According to the following table, draw the graph and explain this graph pass through the origin.

| **Fixed Deposit (in Rs.)** | 1000 | 2000 | 3000 | 4000 | 5000 |
|---|---|---|---|---|---|
| **Simple Interest (in Rs.)** | 80 | 160 | 240 | 320 | 400 |

## We Learnt

1. Line graph, which is completely unfractional line, is called linear Graph.
2. For determining the location of any point on a squared paper, we required x-axis and y-axis.
3. Vertical distance from the x-axis is called abscissa and vertical distance from the y-axis is called ordinate of any point.
4. Relationship between dependent variable and independent variable is shown by the graph.
5. Coordinates of origin is (0,0).