Chapter-15

Introduction to Graphs

You are already familiar with different types of graphs. In our daily life the use of these graphs is of utmost importance. Through graphs numerical facts can be displayed in visual form so that the facts can be understood easily and clearly in a short time. We have seen the uses of graphs in newspaper, television, magazine, advertisements etc.

In this chapter, we shall study different types of graphs, co-ordinates of a point and other uses of graphs.

Review of various graphs.

15.1 Pictograph :

The data of students of class VI, VII and VIII in the year 2019, of a particular school are shown in the pictograph as follows :

Year	Class	No of students	= Represents 10 Students
2019	VI	🧍🧍🧍🧍🧍🧍	
	VII	🧍🧍🧍🧍	
	VIII	🧍🧍🧍🧍🧍🧍🧍	

From the above pictograph, we get the following information –

In the year 2019 in the school

(i) there are 60 students in class VI

(ii) there are 40 students in class VII

(iii) there are 70 students in class VIII

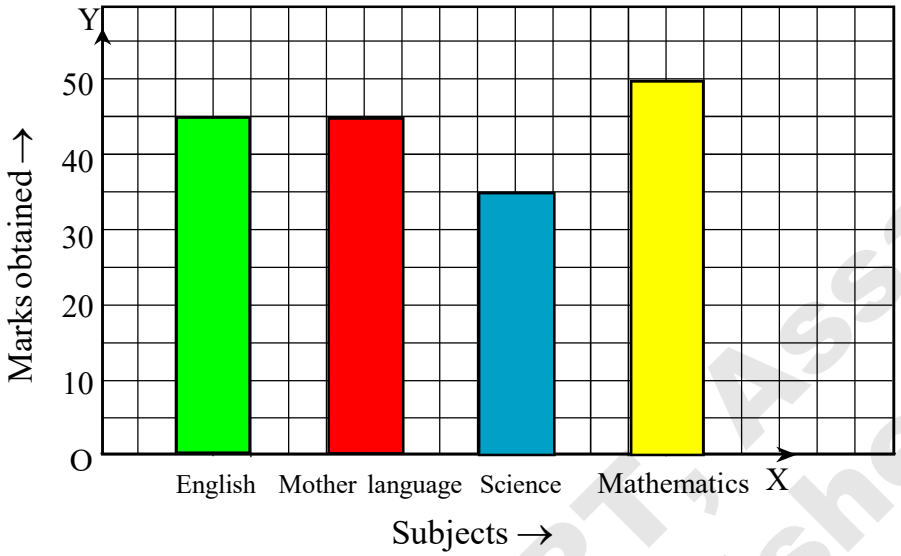
(iv) the number of students in class VIII is highest and that in class VII is lowest

(v) the total number of students in the three classes is 170

The presentation of data using this type of picture or symbol is called **Pictographs**. This is one of very simple and easy methods to express data.

15.2 Bar graph :

Marks obtained by a student in four subjects in third periodic evaluation are shown below with the help of a bar graph :



Points to be observed from the above graph are as follows –

- ☆ How many subjects are shown? – 4 subjects
- ☆ In which subject is the highest marks obtained? – Mathematics
- ☆ In which subject is the lowest marks obtained? – Science
- ☆ In which subjects are the marks equal? – English and Mother language

How is the graph prepared?

(i) Draw two straight lines $\overrightarrow{OX}$ (horizontal) and $\overrightarrow{OY}$ (vertical). The line $\overrightarrow{OX}$ indicates subjects and the line $\overrightarrow{OY}$ indicates the marks obtained.

(ii) The lines $\overrightarrow{OX}$ and $\overrightarrow{OY}$ are marked at equal distances conveniently so that data can be represented. This distance is called *unit*.

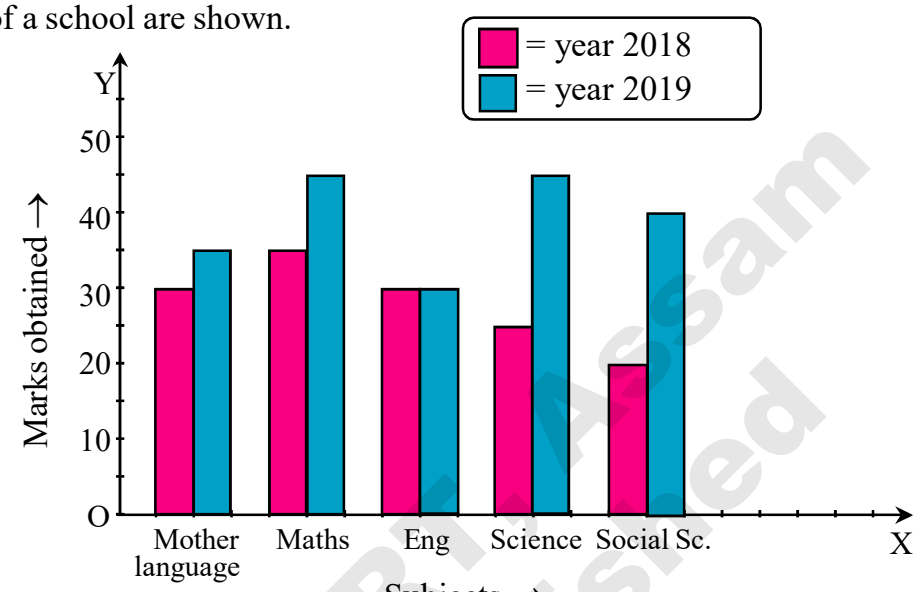
(iii) The width of the rectangular bars is equal. In such diagrams the width of each bar is equal.

(iv) Distance between every the two bars is also equal.

Bar graph is used to represent data. Bar graphs consist of two or more parallel, vertical or horizontal rectangular bars.

15.3 Double Bar graph :

Double bar graph is used for a comparative study of two or more data. In the following diagram marks obtained by a student in various subjects in fourth periodic test held in the year 2018 and 2019 of a school are shown.



Study of the graph :

(i) This is a comparative study of the marks in five subjects obtained by a student of a school in the year 2018 and 2019.

(ii) The student obtained more marks in 4 subjects in the year 2019 compared to the year 2018.

(iii) The student obtained equal marks in English in both years.

(iv) In the year 2018, he scored the lowest 20 marks in social science whereas he has been able to enhance his marks to 40 in the year 2019.

(v) In the year 2019, he obtained maximum 45 marks in both Science and Mathematics.

What have we seen in the graph? :

(i) Different subjects are shown along $\overrightarrow{OX}$ (horizontal line) and marks obtained in those subjects along $\overrightarrow{OY}$ (vertical line).

(ii) Is the same colour used to show the marks in the bars for both the year?

☆ For the year 2018 the colour ■ and for the year 2019 the colour ■ are used for the bars.

(iii) Have you seen any difference between Bar graph and Double bar graph?

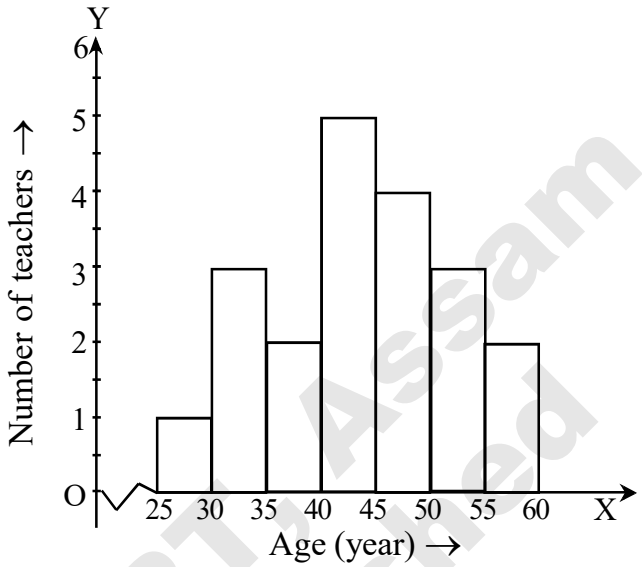
☆ Yes, in a bar graph one bar for one subject is used while in double bar graphs two bars are used for one subject. Widths of those bars are equal and there is no gap between the two bars. On the other hand equal distances are maintained for the different subjects.

Such graphs are called double bar graph since two different information are presented using two bars together.

15.4 Histogram :

In the following diagram, data of the ages of 20 teachers in a Girls Middle English School are presented

Categoris of ages	Number
25 to less than 30	
30 to less than 35	3
35 to less than 40	2
40 to less than 45	5
45 to less than 50	4
50 to less than 55	3
55 to less than 60	2
Total	**20**



[The broken line ⩘ means that there is no teacher in the age category 0 to 25 years]

Study of graph :

(i) Along $\overrightarrow{OX}$ divisons of ages and along $\overrightarrow{OY}$ number of teachers in a particular age category are shown.

(ii) Data regarding age of 20 teachers of the school are presented

(iii) There is minimum number of teachers (1 number) between the age group of 25-30 and maximum number of teachers (5 number) in the age group 40-45.

(iv) There are equal number of teachers (3) of same age in the age categories 30-35 and 50-55.

(v) There are only two teachers in the age group 55-60.

What have we found observing the graph

(i) Is there any gap among the divisions of age?

☆ No, the class length of 5 years is used continuously.

(ii) Is there any difference between the bars?

☆ No, there is no difference between the bars and the widths of the bars are equal like any other Bar Graph.

Thus the presentation of the bars (without any gap) representing data with continuous class intervals is called ***Histogram***. As the graph looks like columns from a distance, it is called Histogram.

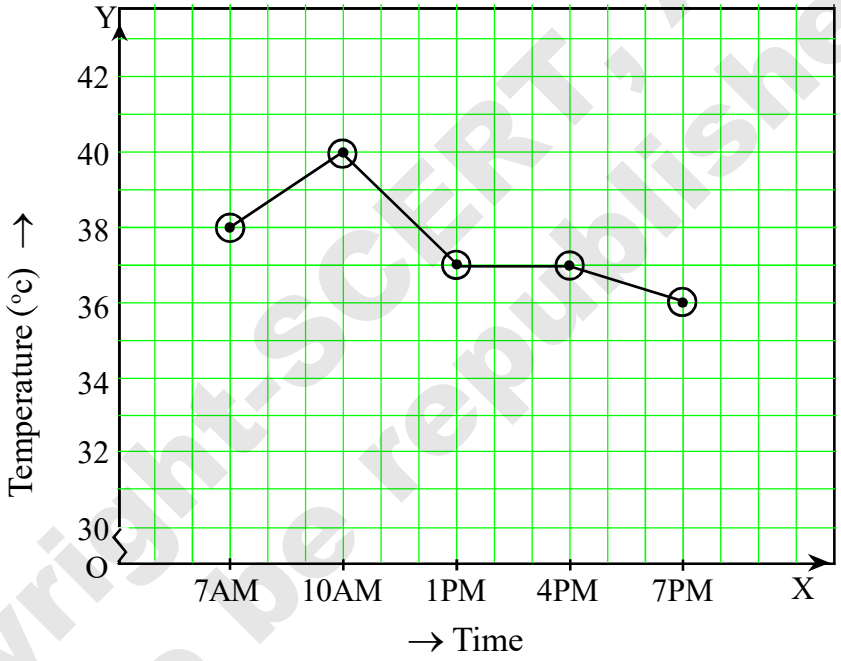
15.5 Line Graph :

The line graphs are used to highlight periodical changes of data over a certain length of time. In a graph paper two axes are considered with one axis denoting time and another denoting the corresponding data. Points obtained in this manner are continually joined by line segments to get the line graph. Let us try to understand it by the following example.

Example - 1 : Look at the diagram given below :

The body temperatures of a sick girl recorded in every three hours are as follows:

time	7 am	10 am	1 pm	4 pm	7 pm
temperature (°C)	38	40	37	37	36



Study of the graph :

(i) The graph displays the body temperatures of a sick girl for 12 hours in a day.

(ii) In the graph the temperatures recorded from morning 7 O'clock to evening 7 O'clock are shown.

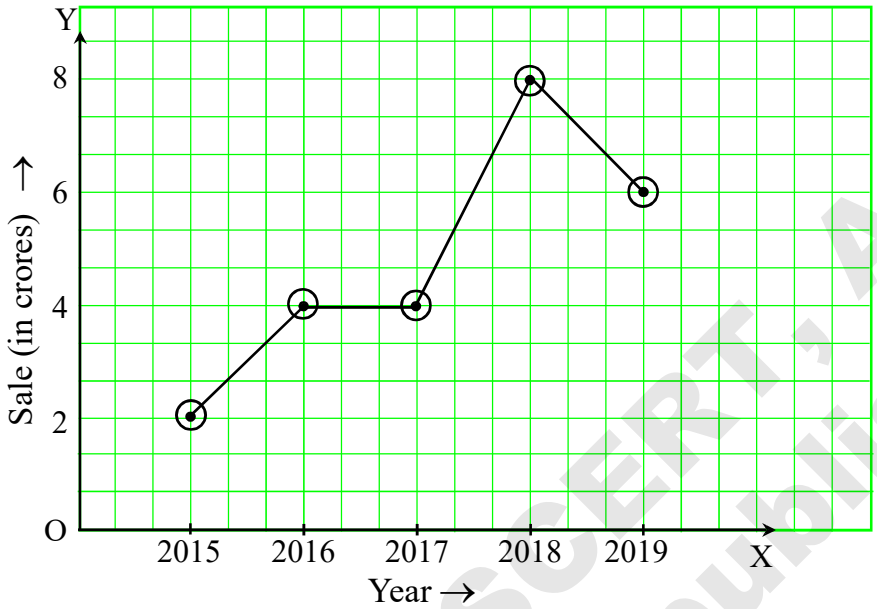
(iii) The temperature is maximum (40°C) at 10 am, and at 7 pm it comes down to 36°C.

(iv) The temperature starts decreasing from 10 am and between 1 pm to 4 pm there is no change in temperature.

To draw a line graph, horizontal and vertical lines are taken in a graph paper. Generally

$\overrightarrow{OX}$ is taken as horizontal axis and $\overrightarrow{OY}$ is taken as vertical axis . In order to present the data as per to our need and convenience appropriate units are taken in both the axes. Time related data are usually represented along the horizontal axis. At last, the located points are serially joined by straight line segments.

Example 2 : Data of annual sale of a company for last five years are shown below.



Scale
Along Y-axis : length of sides of 3 small squares = Rs. 2 crores.
Along X-axis, length of sides of 3 small squares = 1 year.

Study of the graph :

(i) In the graph, years are represented along X-axis (or horizontal axis) and the Y axis (or vertical axis) shows the amount of sales in crores.
(ii) The sale of the company in the year 2015 is the lowest and in the year 2018 sale is the highest.
(iii) The annual sale in the years 2016 and 2017 are same.
(iv) The sale in the year 2019 is less in comparison to the sale in the year 2018.
(v) The difference between the maximum sale and minimum sale of the company is (8-2) = Rs. 6 crores.

Example 3 : In the graph given in the next page, the total runs scored by the two batsmen P and Q in ten different cricket matches held in the year 2019 are represented. Now, study the graphs and answer the following questions.

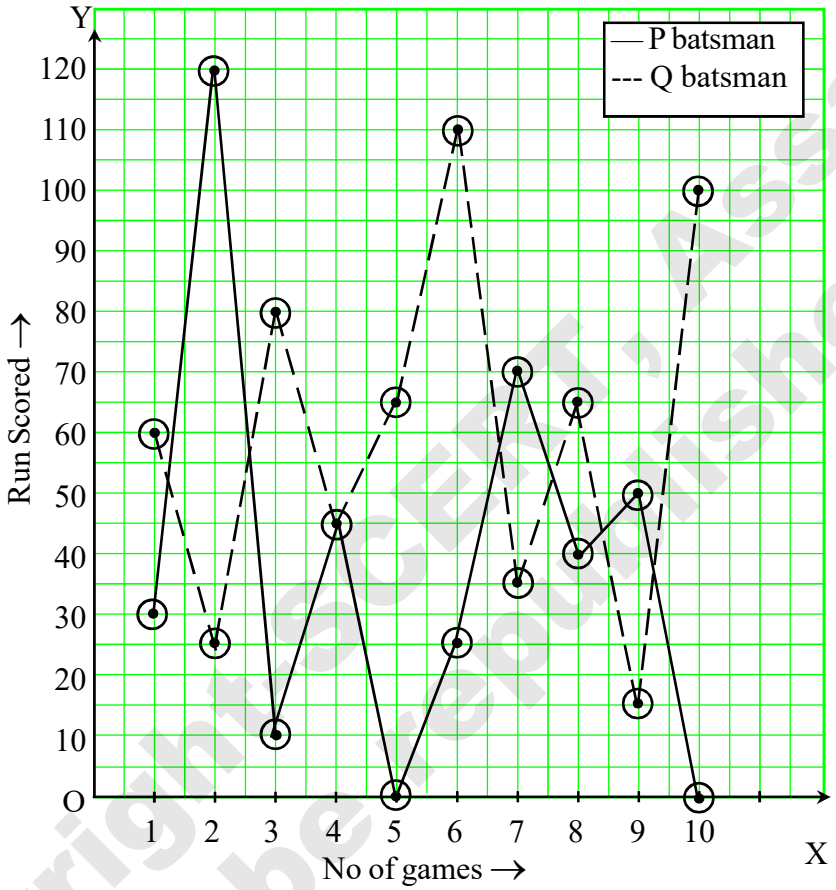
(i) What are the data represented in the two graphs?
(ii) What are the data represented in the two axes?
(iii) Whose data are represented in the graph by the line _ _ _ _ ?

(iv) In which match both the batsmen scored equal number of runs?

(v) Is there any batsman who did not score a single run in a match?
If there is any one, who is the batsman and in how many matches it happened?

(vi) Whose performance is better in these match?

(vii) What are the highest and lowest runs scored by batsman P.



Solution :

(i) In the graph, the data of the runs scored by the batsman P and Q in 10 different cricket matches held in the year 2019 are represented

(ii) The horizontal axis (X axis) indicates the number of matches and the vertical axis (Y axis) indicates the number of runs scored by both the batsmen.

(iii) _ _ _ graph indicates the data of the runs scored by batsman Q.

(iv) Both batsmen scored equal number of runs in the 4th match.

(v) Yes, batsman P could not score a single run in 5th and 10th matches.

(vi) The overall performance of batsman Q in these matches was better.

(vii) The highest score of the batsman P was 120 run and the lowest run was 0.

Exercise 15.1

1. A car went from Lakhimpur to Guwahati. A line graph of distance covered and time required is shown below. Study the graph and answer the following.

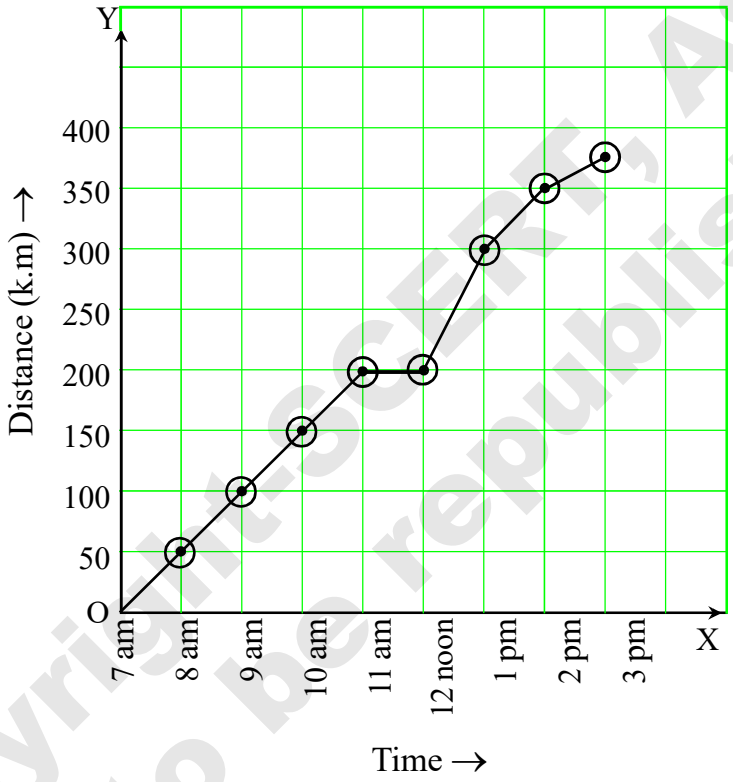
   (i) What data does the two axes represent?

   (ii) What is the total distance covered and total time taken by the car?

   (iii) At what time the car had maximum speed?

   (iv) Did the car stop on the road? If so,for how much time it stopped?

   (v) At what time, the speed of car was equal?



2. The line graph of the electricity bills of the last six months of a family is given in next page. Study the graph and answer the following.

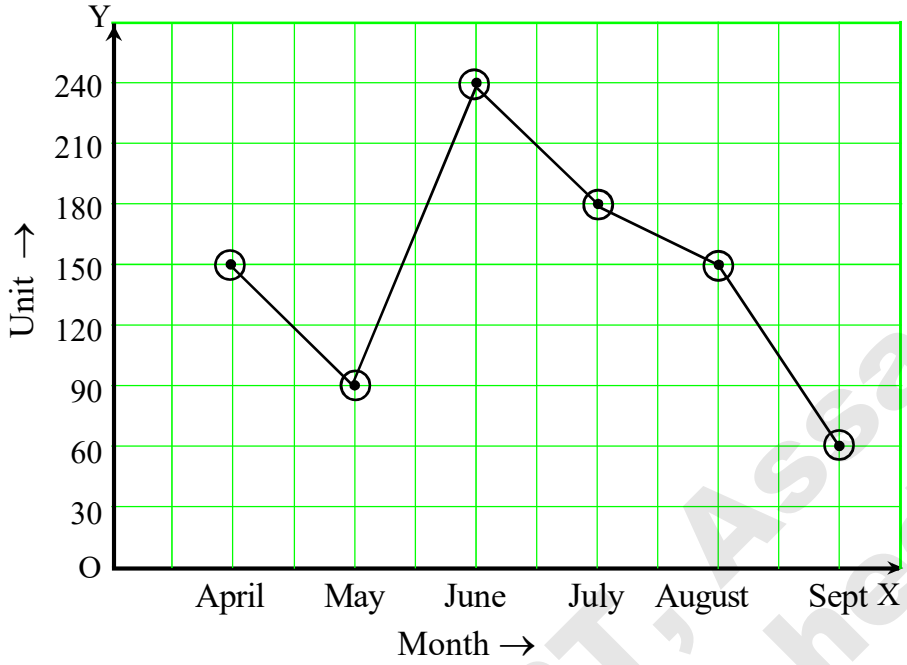
   (i) What does the graph represent?

   (ii) What does the Y axis indicate?

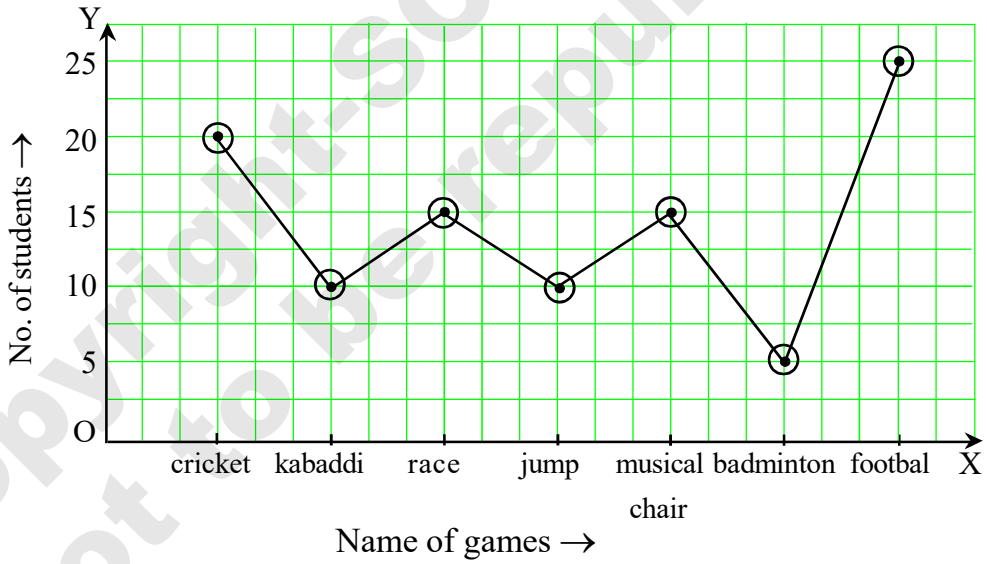
   (iii) In which month maximum unit of electricity is consumed?

   (iv) In which month minimum unit of electricity is consumed?

   (v) In which months equal units are consumed?



3. A line graph of 100 students of a school who likes different games is given. Study the graph and answer the following.



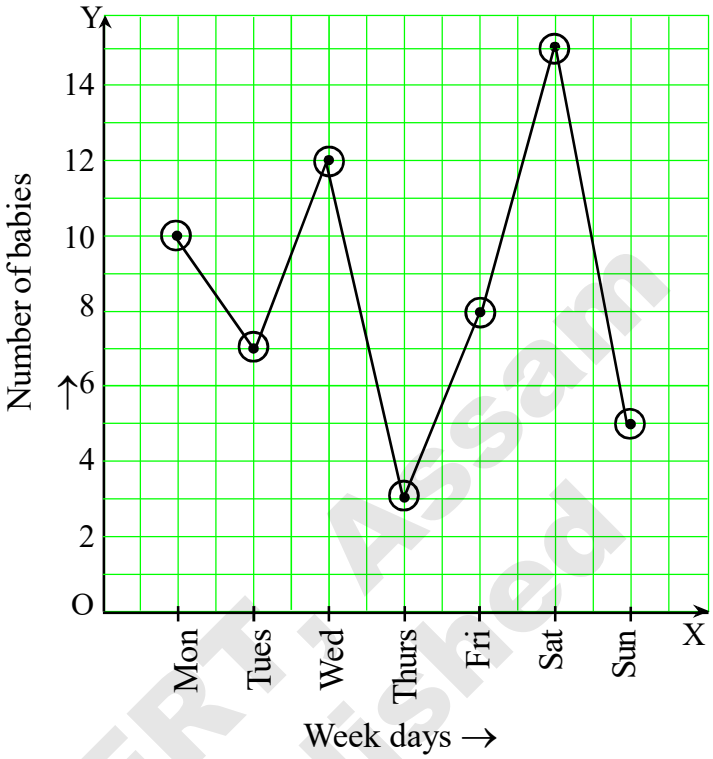
(i) How many games are given in the data highlighted in the graph? :

(ii) Which game is liked by most of them?

(iii) Which game is liked by very few of them?

(iv) What are the games that are liked by equal number of students.

4. In the adjoining graph the number of children born in a week in a hospital is shown. Study the graph and answer the following questions.



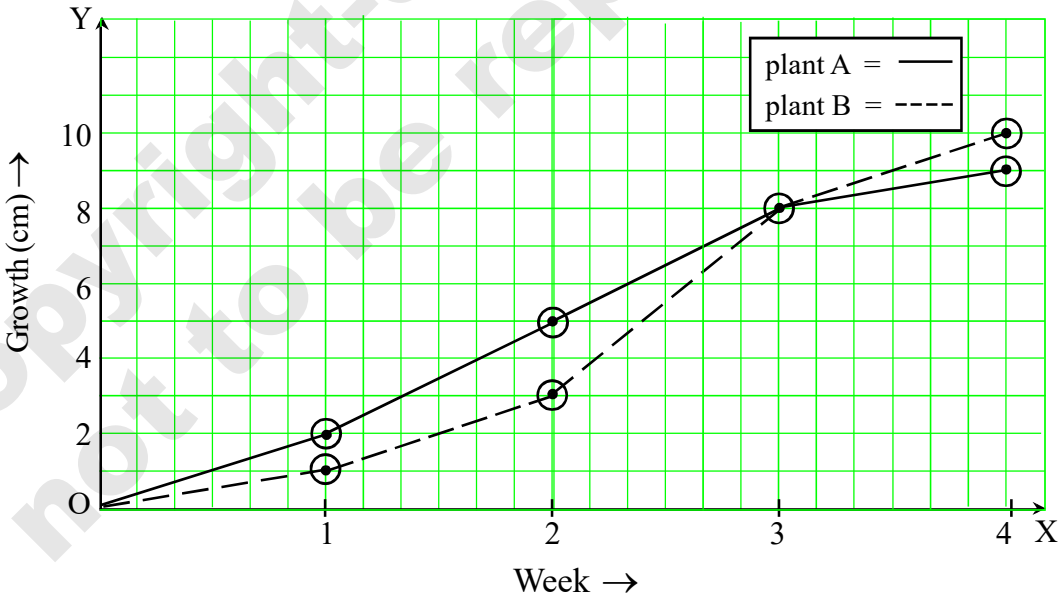
(i) What does X axis indicate in the graph?

(ii) In which day of the week, maximum number of children borned?

(iii) In which day were maximum number of children borned?

(iv) What is the total number of children born in the week?

Group Activity : While doing a project, Medhashree and Meghashree nurtured two different plants A and B to grow in a laboratory. Every week, growth of the two plants were measured. At the end of one month, the description of the collected data is as follows–



(i) How high was plant A in (a) 1st week (b) 2nd week (c) 3rd week?

(ii) How high was plant B in (a) 1st week (b) 2nd week (c) 4th week?

(iii) Are the changes of growth of the plants A and B in 2nd and 4th week same? If not, what are the changes?

(iv) In which week, the growths of the two plants are equal?

(v) Which plant has the better growth at the end of 1st month?

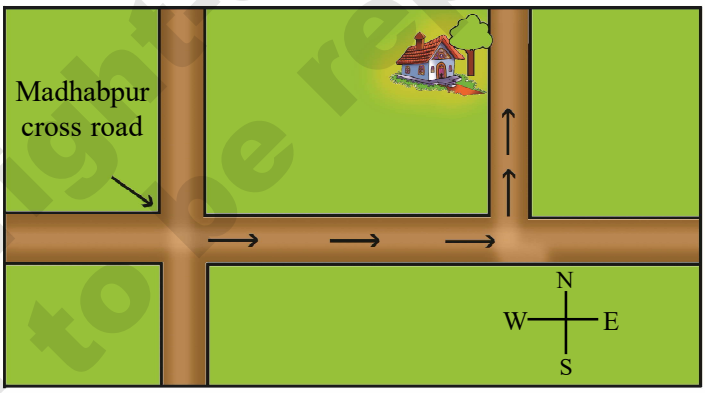
15.6 Linear Graph :

Some line segments are connected in a line graph. Sometimes this line graph may be a completely continuous line. Such continuous line graph is called a *linear graph*. To draw a linear graph, points are located in a graph paper. Now, let us discuss how to locate points conveniently and easily in a graph paper–

15.6.1 Position of points

Observe the following conversation :

Teacher : Urmi, where is your home?
Urmi : In Madhabpur, Sir
Teacher : In which area of Madhabpur?
Urmi : Sir, it is towards the east direction from Madhabpur crossroad.
Teacher : How far is it?
Urmi : Sir, our house can be reached by going 200 meters towards east of Madhabpur and then turning to the north.
Teacher : Your house is on the left or on the right of the road?
Urmi : Our house is on the left of the road near a bakul tree Sir!

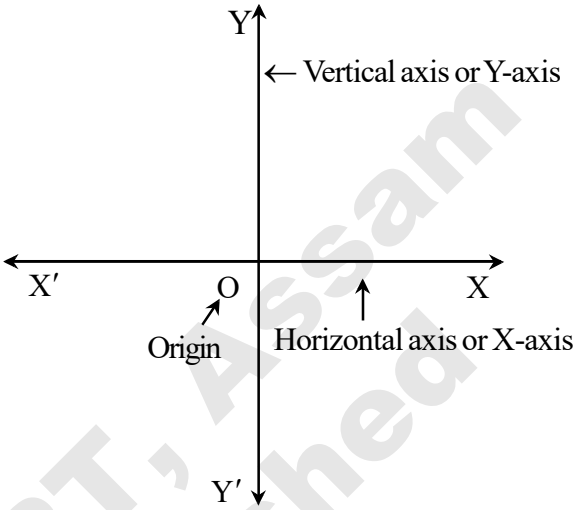


That means to find out Urmi's house at first you have to go 200 m in the east direction from Madhabpur crossroad, then going 150 m. in the north direction you will get it near a *bakul tree*.

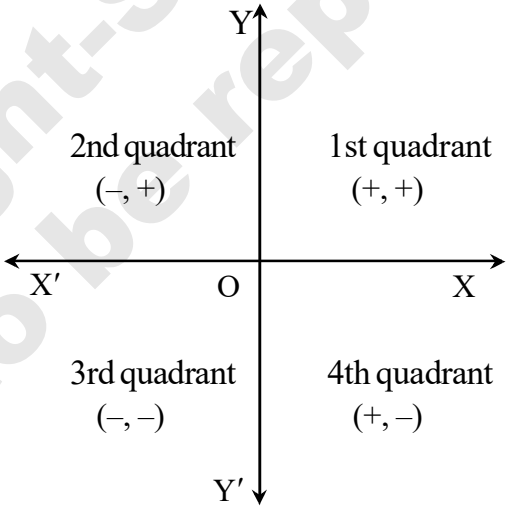
That is, to know the location of a particular place we must have a place known to all of us. From that place to go to the particular place about which we must have a clear description of the direction, distance, and whether to the left or to the right. If the description is not correct and proper then it will be difficult to reach the particular place.

Similarly, we need two directed lines to determine easily the exact position of a point. The two lines taken in a graph paper are perpendicular to each other. One is horizontal and the other is vertical. These two lines are called axes.

The horizontal axis is $X'OX$ or X axis and the vertical axis is called YOY' axis or Y axis. These two axes are actually number lines. Both axes intersect at a point (say O) is called the origin. The location of the origin O is (0,0). The plane having X axis and Y axis is called 'Cartesian Plane'. The system of determining the location of a point in a plane was first introduced by **Rene Descartes**, a 17th century. French Mathematician and Philosopher. Later the system was named as Cartesian Co-ordinate System in honour of him.



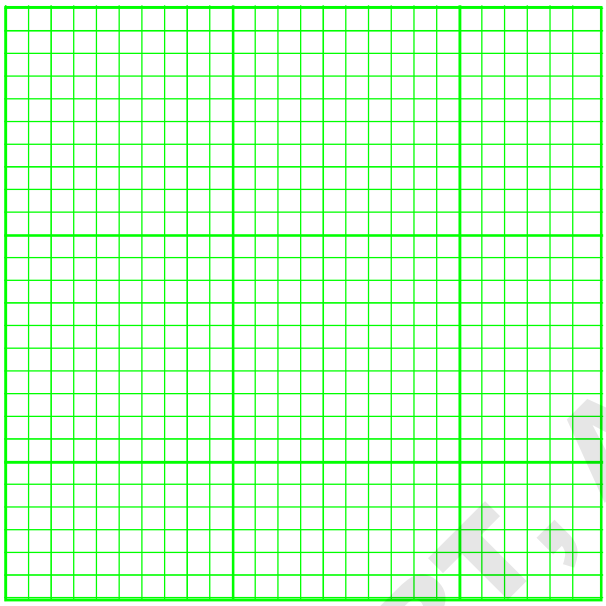
In Certesian system X and Y axes divide the plane into four parts. Each part is called a quadrant. Four quadrants are shown in the figure below. In this Chapter, we shall discuss the determination of the position of a point in the 1st quadrant (+,+) only.



What is a graph paper?

A graph paper is a cartesion plane having square grid. Here as per need and convenience X axis and Y axis are drawn. Taking O as origin, the required points are located. Similarly,

units are determined on the basis of data values and the size of the graph paper.

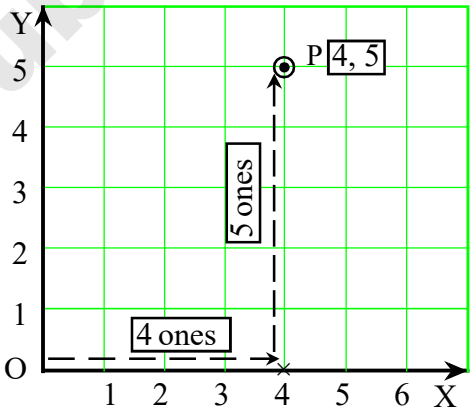


15.6.2 Cartesian coodinates :

Let P be a fixed point in the Cartesian plane. The point P is located at a distance of 4 unit from Y axis and a distance of 5 unit from X-axis. We can say that the point P is located at 4 unit distance along X-axis and 5 unit distance along Y-axis respectively from the origin.

Therefore, the co-ordinates of the point P is (4, 5).

Here 4 is called the *abscissa* or X coordinate and 5 is called the *ordinate* or Y coordinate.



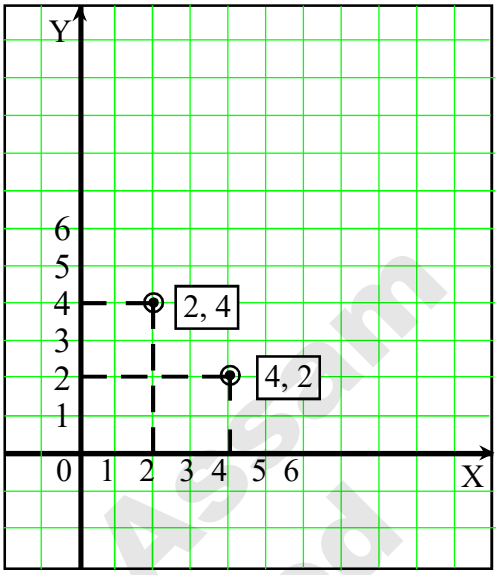
Remenber : The 1st position of the coordinate of a point indicates the value along X-axis and 2nd position indicates the value along Y-axis

Observe the picture above. The point (4, 5) is located in the cartesian plane. The co-ordinates of the point is (4, 5). That is, proceeding from the origin 4 units along X axis and then 5 units along Y axis directly above, we get the location of the point. In this case, we can take unit in the graph paper according to our convenience. Here one side of a square in the graph paper is taken as 1 unit.

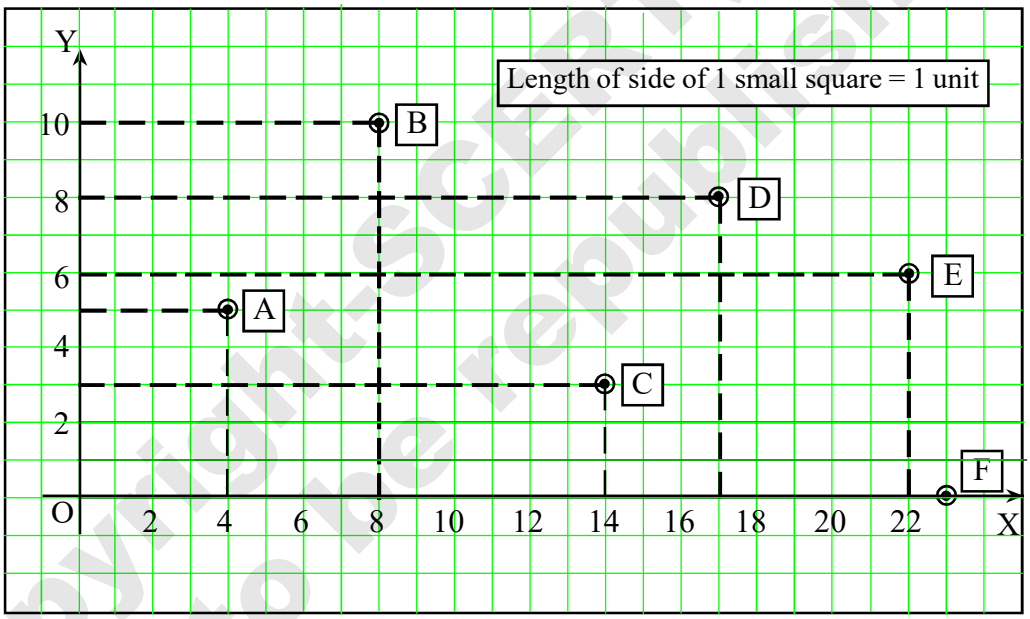
Example 4 : Plot the point (4, 2) in the graph paper. Is this point the same as (2, 4)?

Solution : X-axis and Y-axis are drawn in the graph paper. Now taking side of a small square = 1 unit and taking O (0,0) as origin we proceed 4 units along X-axis and then going 2 units in the perpendicular direction of X-axis i.e in the direction of Y-axis get the point (4, 2)

Then plotting the point (2, 4) in the graph paper using same axis and units, we see that (4,2) and (2,4) are two different points.



Example 5 :Let us complete the table with the help of graph



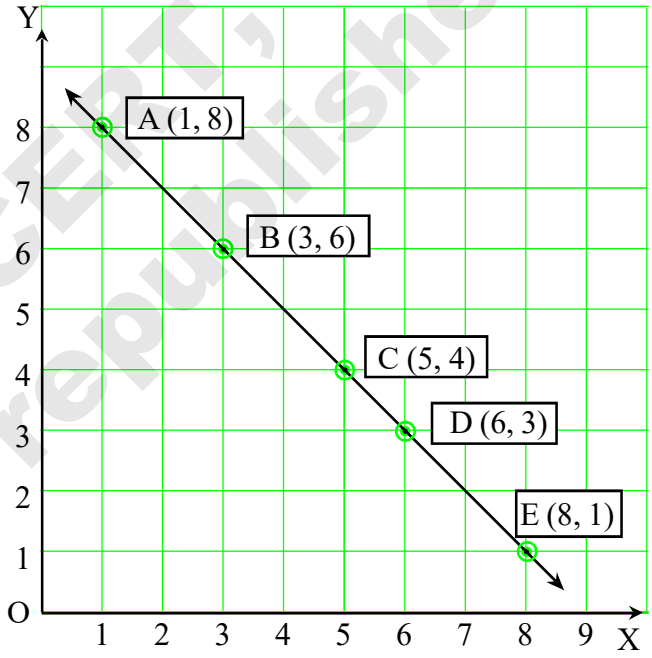
Point	Abscissa	Ordinate	Distance from X-axis	Distance from Y-axis	Coordinate
A	4	5	5	4	(4, 5)
B					
C					
D					
E					
F					

Solution : From the table, abscissa for the point A is 4 and ordinate is 5 and co-ordinate of A is (4, 5). Similarly, the table is completed in case of B, C, D, E. But it will be a slight different for the point F. The point F is at a distance of 23 units from Y-axis and the point is on the X-axis i.e ordinate of the point F is zero. So, the abscissa of F is 23 and the co-ordinate of F is (23, 0)

Point	Abscissa	Ordinate	Coordinate
A	4	5	(4, 5)
B	8	10	(8, 10)
C	14	3	(14, 3)
D	17	8	(17, 8)
E	22	6	(22, 6)
F	23	0	(23,0)

Example 6 : Plot the following points in a graph paper and verify whether the points are in one straight line. A (1, 8), B (3, 6), C (5, 4), D (6, 3), E (8, 1)

Solution : X-axis and Y-axis are drawn in a graph paper. The two axes intersect at the point O. The co-ordinate of O is (0,0). The points A, B, C, D and E are plotted and joined. We get the line segment AE. It is seen that the point are in the same straight line.



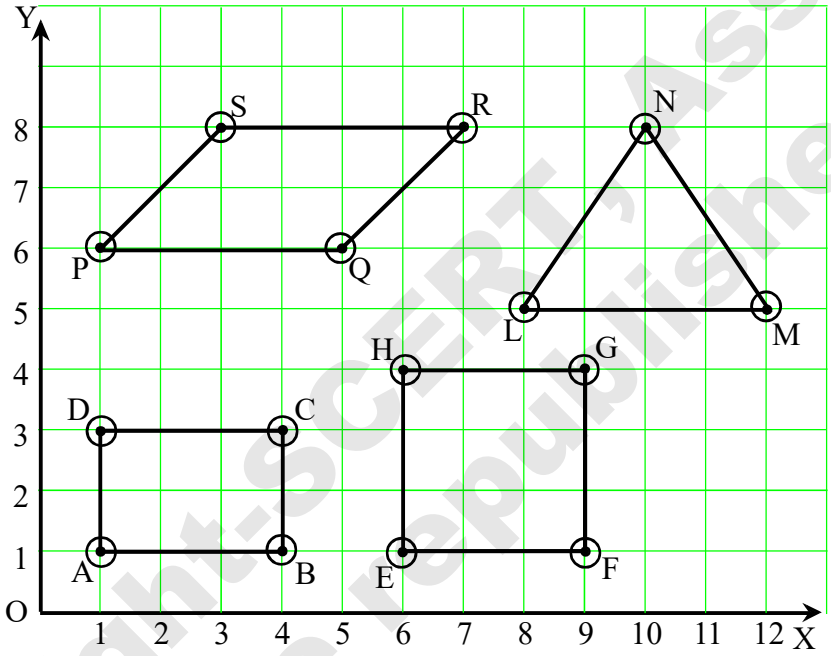
Exercise 15.2

1. Find the abscissa and ordinate of the following points.
   (i) (0, 4) (ii) (5, 9) (iii) (7, 7) (iv) (5, 0)
2. Determine in which axis the following points lies.
   (i) (3, 0) (ii) (0, 8) (iii) (9, 0) (iv) (0, 10)

3. Plot the following points in a graph paper and examine whether the points are in the same straight line.

(i) A (2, 2)	B (3,3)	C (5, 5)	D (6, 6)
(ii) K (4, 0)	L (4, 2)	M (4, 5)	N (4, 6)
(iii) P (1, 2)	Q (4,4)	R (6, 7)	
(iv) S (2, 1)	T (2, 5)	O (5, 5)	P (7, 7)

4. Plot the points (2, 6) and (5, 3) in a graph paper. Find the co-ordinates of the two point where the line joining the given points intersect the X-axis and Y-axis.
5. Write the coordinates of the vertices of the following geometrical figures drawn on the graph paper for example S (3, 8) etc.



6. State whether the following statements are true or false. Correct the statement which are false.

(i) A point whose coordinate is (5, 0) will lie on Y axis

(ii) If x-coordinate of a point is zero, but y-coordinate is non-zero, then the point will line on Y-axis

(iii) The coordinate of the origin is (0, 0)

15.7 Use of graph in daily life

Example 7 :Quantity and cost : The following table gives the quantity of petrol and its cost. Draw a linear graph to show the data

Quantity of petrol (in litre)	5	10	15	20
Cost of petrol (in Rs.)	350	700	1050	1400

Solution :

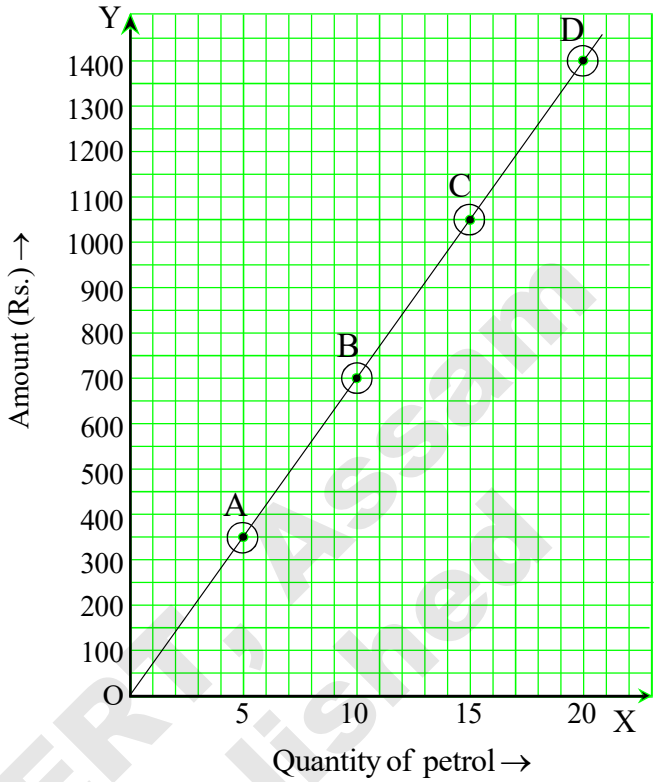
(i) X and Y axis are drawn on the graph paper.

(ii) Quantity of petrol is marked along X axis and cost of petrol is marked along Y axis.

(iii) Each square on X axis = 1 litre and each square on Y axis = Rs. 50 are taken as units.

(iv) Points A (5, 350), B (10, 700), C (15, 1050) and D (20, 1400) from the table are plotted.

(v) A, B, C, D are joined by a straight line. This graph AD is the linear graph.



Does this graph pass through the origin? Why? think about it.

This graph can help us to find the cost of any quantity of petrol. For this you first mark your required amount of petrol on X-axis. Follow the vertical line through that number (amount) till you meet the graph in a point. From this point you take a horizontal line to meet Y-axis. This meeting point provides the answer.

These graphs are always in direct variations.

Example 8 : Principal and Simple interest :

Principal and corresponding simple interest (at the rate of 5% per annum) are given in the following table. Draw a linear graph to illustrate the data.

Principal (Rs.)	1000	2000	3000	4000	6000
Simple interest (Rs)	50	100	150	200	300

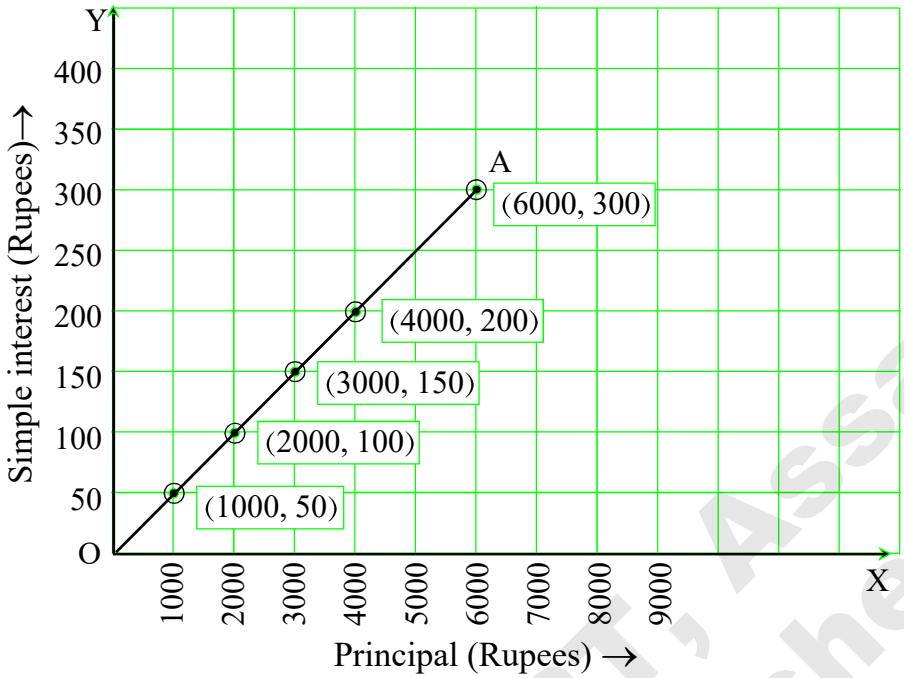
Solution :

(i) In the graph paper Principal is marked on X axis and Simple interest is marked on Y axis.

(ii) Scale : 1 unit = Rs. 1000.00 on X axis, 1 unit = Rs. 50.00 on Y axis.

(iii) According to the data, points (1000, 50), (2000, 100), (3000, 150), (4000, 200) and (6000, 300)are plotted in the graph paper.

(iv) Joining the points we get a line graph $\overline{OA}$ as in the next page.



Complete the following table with the help of the graph given above

Principal (Rupees)	2500		6500	
Simple interest (Rupees)		250		400

Exercise 15.3

1.Draw a linear graph with the data given in the following table using proper scale

(a) Cost of egg–

Number of eggs	1	3	5	6
Cost of egg	6	18	30	36

(b) Distance covered by a car.

Time (hrs)	1	2	3	4	5	
Distance (km)	50	100	150	200		300

Answer the following with the help of graph

(i) How much time will be needed to cover 300 km?

(ii) What is the distance travelled in 5 hrs?

(c) Principal and interest.

Principal (Rs.)	200	500	1000	1500
Simple interest (Rs.)	20	50	100	150

Answer the following with the help of graphs –

(i) What will be the interest for Rs. 400?

(ii) What would be the corresponding Principal for interest of Rs.120?

2. Multiples of 6 are given in the following table. Draw a linear graph with these data

X	1	2	3	4	5
Y	6	12	18	24	30

3. Cubic values of some numbers are given in the following table. Draw a graph. Is this a linear graph?

Numbers	2	3	4	5
Cubic no.	8	27	64	125

1. Graphical representation of data is easier to understand.
2. Comparison among data can be easily done with the help of bar graph.
3. Histogram is a bar graph where class intervals are continuous.
4. In a line graph, two data can be compared easily.
5. Location of a place can be determined with respect to a fixed origin with the help of coordinates.

❑❑❑