MATHEMATICS

Chapter 15: Introduction to Graphs

Introduction to Graphs

Graphical Representation of Data

Graphical methods used to present data is very efficient in organizing the data and understand them. There are various graphical methods which are mentioned below:

While comparing among categories, the method which is appropriate is the bar graph.

While comparing parts of a whole, pie-chart is the ideal method.

When data is provided in intervals, a histogram can be used for easier understanding.

In the case of the data changing continuously over a period of time, a line graph will be useful

When an unbroken line is represented, it is done with the help of a linear graph

Introduction to Graphs

Graphs are visual representation of data collected. It's purpose is to show numerical data in physical form so that it can be understood quickly, easily and clearly.

Bar Graph

A bar graph is used to show comparison among two or more different categories. Parallel vertical bars (rectangular in shape) are used to represent the data on a bar graph.

For example: The graph here represents a student's marks in maths in the first, second and third terms respectively.
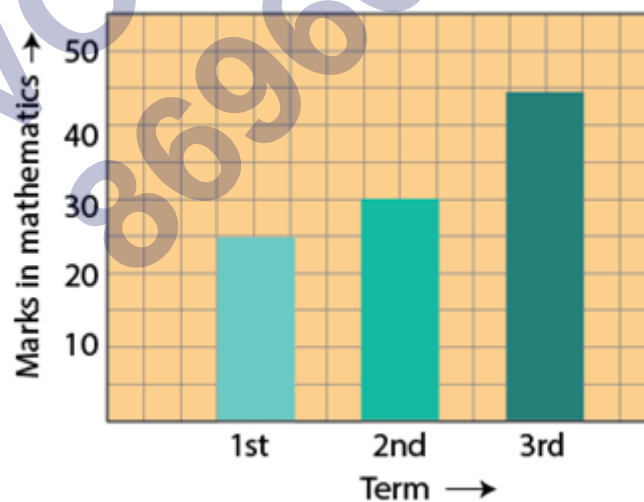

A bar graph can also have two or more bars to represent the same category like the example below.

(1)
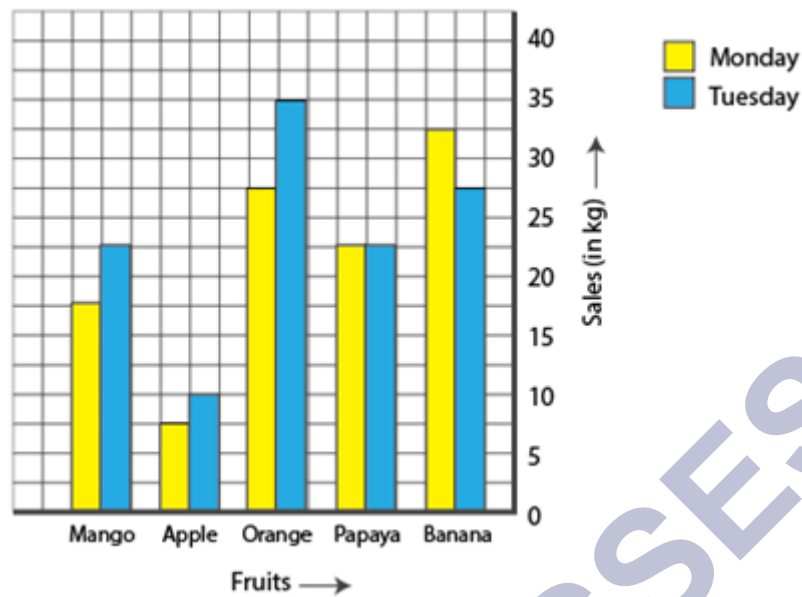
Pie Charts

A pie-graph is used to represent the parts of a whole. A circle is used to represent the whole.

The pie graph below is used to represent people's choice of television channels. The circle as a whole here is represented by all the people who took part in the survey. Since it is a whole, the sum of all percentages represented in a pie graph must add up to 100%.
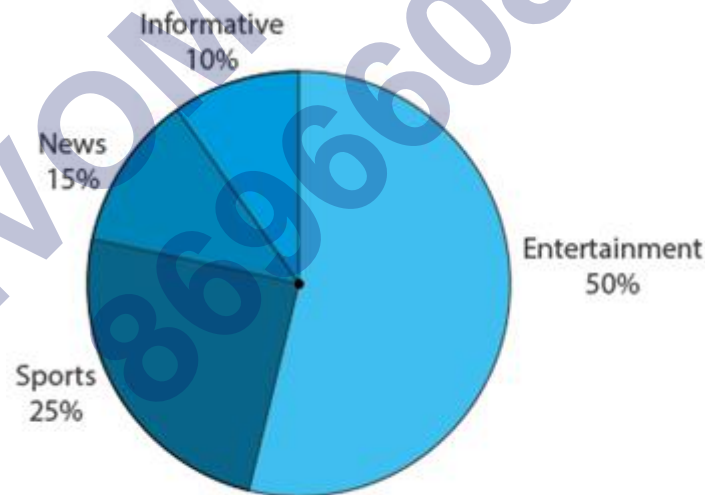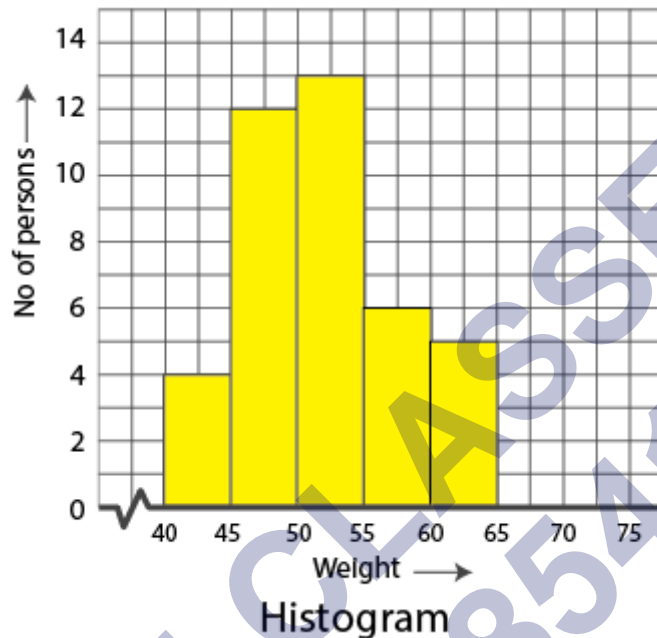

Pie graph

Histogram

A histogram is nothing bujt a bar graph, that is used to group numbers into ranges. It shows data in intervals like the case of the table below.

Weight (kg)	40-45	45-50	50-55	55-60	60-65

(2)

| No.of persons | 4 | 12 | 13 | 6 | 5 |

The x–axis of the graph is labelled from 40-65, as Weights (in kg), in intervals of 5. The y–axis is labelled as No. of persons.


Histogram

A histogram is used to represent continuous data. In the graph above, it presents the data available for all values between 40 and 65.

Linear Graph

A graph where all the data points can be plotted on a single straight line is called a linear graph.

For any two variables, the relation can be drawn by constructing the table of values if the rule for that relation is mentioned. At least two points coordinates should be known to plot a straight line graph. These points must fit the rule.

For example, take the points W(2,6), X(3,5), Y(5,3) and Z(6,2). Upon plotting the points on the graph, we see that all of them can be connected by a straight line.

(3)

Linear graph
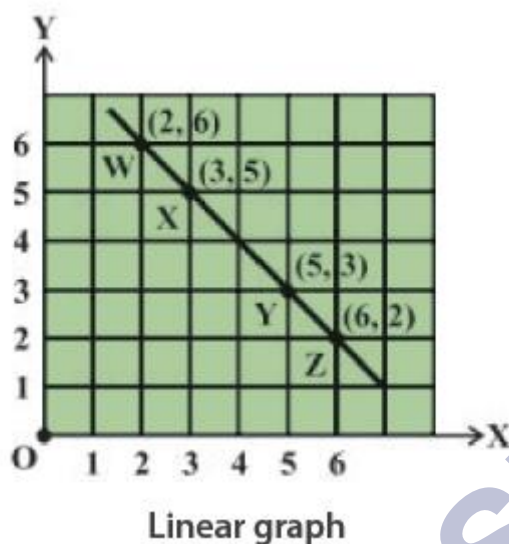
Application of Graphs

Depending on how the values of a variable change with respect to another, we have two types: independent and dependent variable.

Independent (or control) variable is one where it's value doesn't change with respect to another quantity.

Dependent variable is one where the value does change with respect to another quantity.

For example, consider quantity of electricity consumed and the electricity bill. The quantity of electricity consumed doesn't depend on any other quantity, hence it is an independent variable. The electricity bill however, can change with respect to the amount of electricity consumed, hence it is a dependent variable.

Graphs help to establish the relation between these two types of variables visually with the help of the cartesian plane.

Line Graph

A line graph is one that is used to plot data that changes over a period of time.

Consider a table of the kind as shown here:

Time	6 AM	10 AM	2 PM	6 PM
Temperature	37	40	38	35

Here as observed, the temperatures constantly varies over a period of time. So a line-graph can be used to chart the increase and decrease of temperature over the course of 12 hours from 6AM to 6PM. Time is on the x-axis and temperature will be on the y-axis.

(4)

Line graph
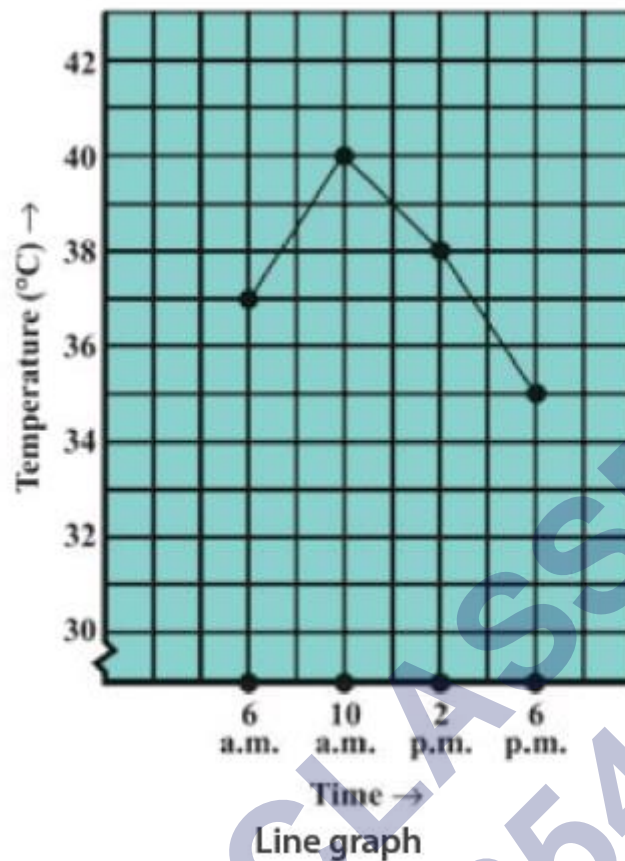
Cartesian Plane and Coordinate Axes

A cartesian plane is formed and defined by two perpendicular number lines : the x−axis, which is horizontal and the y−axis, which is vertical. These are called the coordinate axes.

The point at which the two axes meet is called the zero or origin of the cartesian plane.

The two coordinate axes help to plot any point on the cartesian plane.
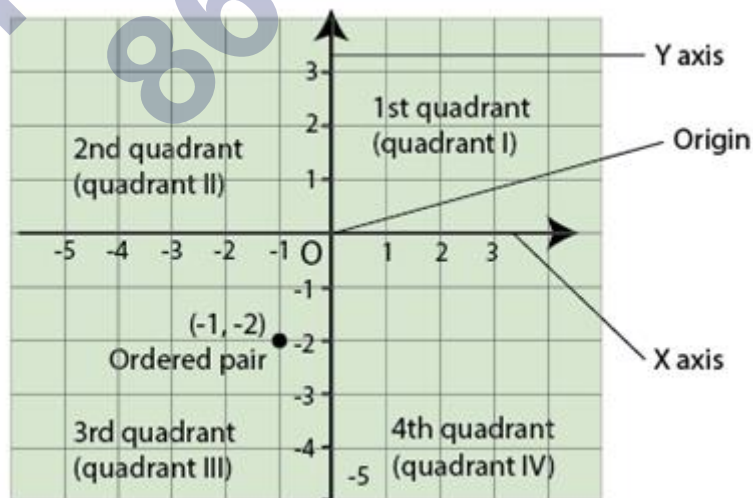
Representation of Point on the Plane

Ploting a point on the plane.

(5)

An ordered pair of numbers are used to represent any given point on a cartesian plane. They are written in the form (x,y), where the value of x represents the x-coordinate of the point and the value of y represents the y-coordinate of the point.

In simple terms, the x and y coordinates explain how far from the origin the point is with respect to the x–axis and y–axis respectively.

For example, consider a point (3,4). Here 3 is the x-coordinate while 4 is the y-coordinate. This means the point (3,4) lies 3 units from the origin on the x–axis and 4 units from the origin on the y–axis. The point is then plotted as shown below.
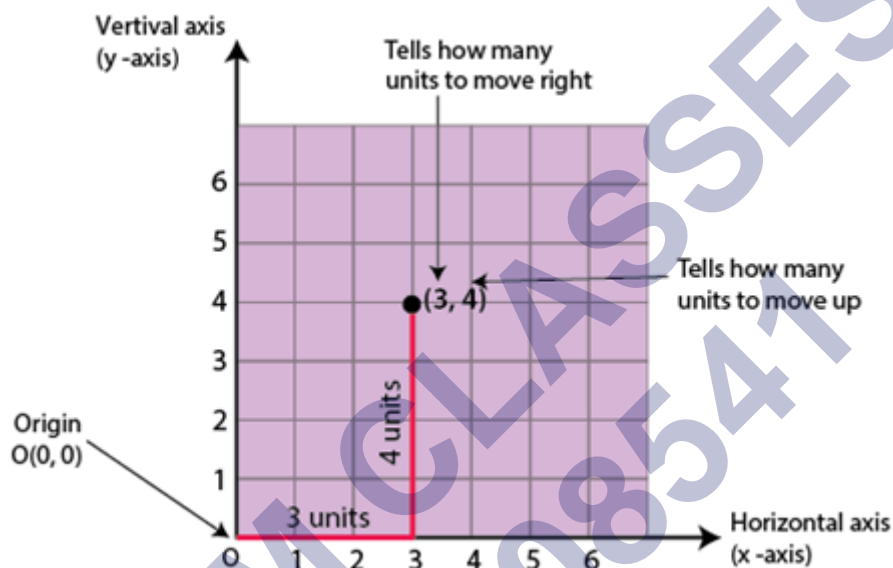
Coordinates of A Point in Three Dimensions

In order to locate the position of a point in space, we require a rectangular coordinate system. After choosing a fixed coordinate system in 3D, the coordinates of any point P in that system can be given by an ordered 3-tuple (x, y, z). Also, if the coordinates (x, y,z) are already known then we can easily locate the point P in space.

Three-Dimensional Coordinate System

Let there be a point P in space as shown in the figure below. If we drop a perpendicular PB on the XY plane and then from point B, we drop perpendiculars BA and BC on the x-axis and y-axis respectively. Assuming the length of the perpendiculars BC, BA and PB as x, y and z respectively. These lengths x, y and z are known as the co-ordinates of the point P in three-dimensional space. It must be noted that while giving the coordinates of a point, we always write them in order such that the co-ordinate of x-axis comes first, followed by the co-ordinate of the y-axis and the z-axis. Thus, for each point in space there exist an ordered 3-tuple of real numbers for its representation.
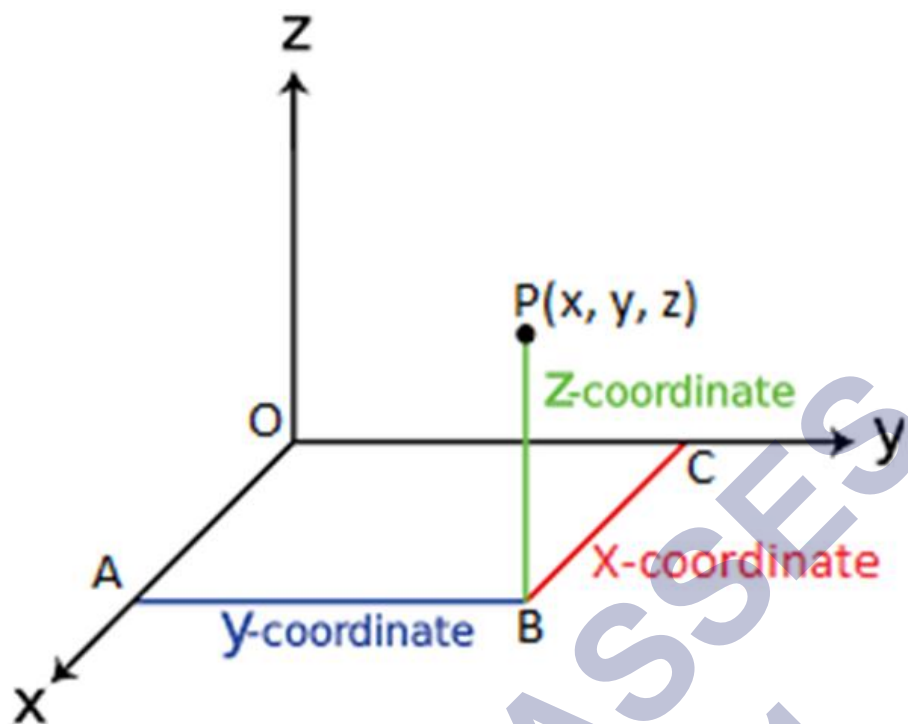
(6)

Figure 1 Co-ordinates of a point in space

In the figure given above the co-ordinates of P are given by (x, y, z). The coordinates of the origin O is (0, 0, 0) Also the coordinates of the point A is given by (x, 0, 0)as A lies completely on the x-axis. Similarly, the coordinates of any point on y-axis is given as (0, y, 0) and on the z-axis, the coordinates are given as (0, 0, z). Also the coordinates of any point in three planes XY, YZ and ZX will be (x,y,0), (0,y,z) and (x,0,z) respectively.

In questions, where we are asked to locate a point,i.e. when the co-ordinates of the point are given, then we have to draw three planes parallel to XY, YZ and ZX plane meeting the three axes in points A, B and C as shown in the figure. Let OA = x , OB = y and OC = z. Then the coordinates of the point are given as (x,y,z).
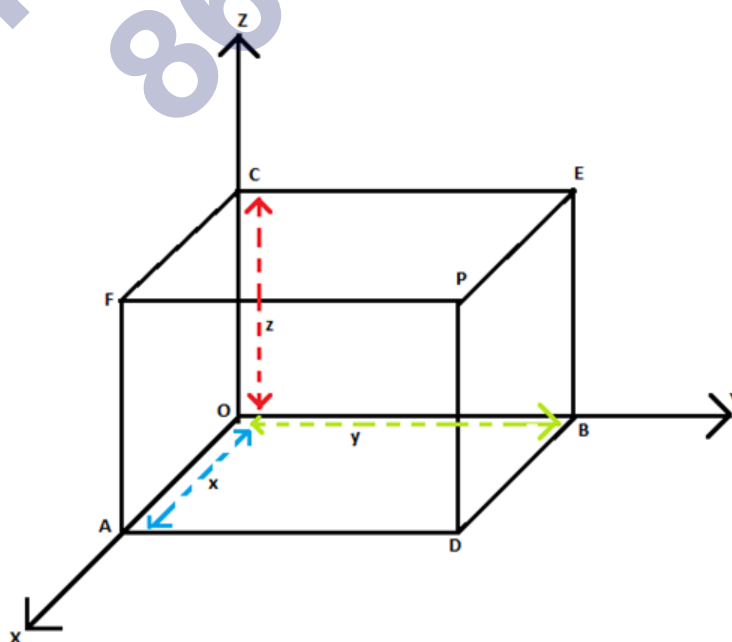
(7)

The planes ADPF, BDPE and CEPF intersect at point P which corresponds to the ordered triplet (x, y, z).

To determine the octant in which a point lies, the signs of the coordinates of a point are helpful. The following table depicts the sign of the coordinates of a point and the octant in which it lies.
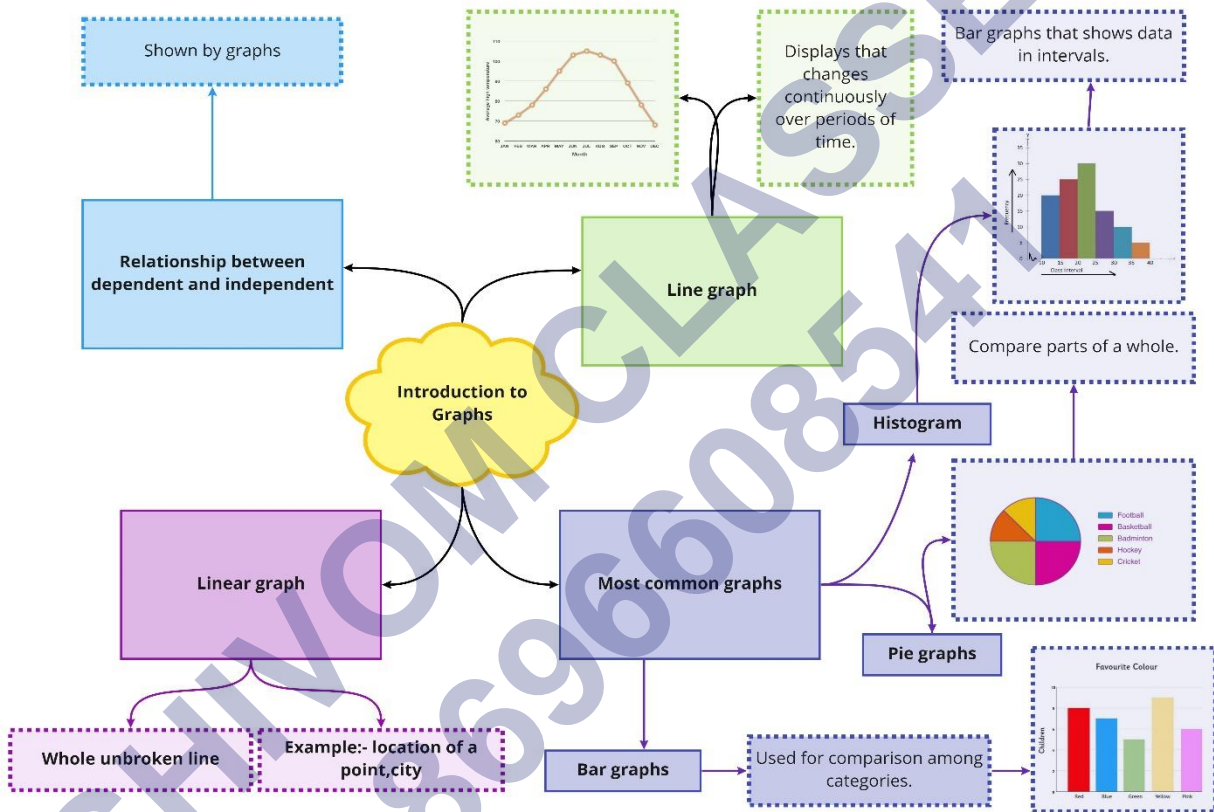
Octants / Co-ordinates	I	II	III	IV	V	VI	VII	VIII
x	+	−	−	+	+	−	−	+
y	+	+	−	−	+	+	−	−
z	+	+	+	+	−	−	−	−

How to Plot the Points in Three-dimensional Plane?

The following points illustrate how to plot the points in the three-dimensional coordinate system:

- Locate the point "x" on the X-axis
- From the point x, moving parallel to the Y-axis, locate the point "y".
- Similarly, from the determined point, moving parallel to the Z-axis, locate the point "z".
- This is the final coordinate point in the three-dimensional plane, which we are looking for.

(8)

Class : 8th Mathematics
Chapter-15 Introduction to Graphs

Shown by graphs

Relationship between dependent and independent

Introduction to Graphs

Line graph

Displays that changes continuously over periods of time.

Bar graphs that shows data in intervals.

Compare parts of a whole.

Histogram

Linear graph

Most common graphs

Pie graphs

Whole unbroken line

Example:- location of a point,city

Bar graphs

Used for comparison among categories.

Favourite Colour

(9)

Important Questions

Multiple Choice Questions:

Observe the following bar graph and answer the related questions:
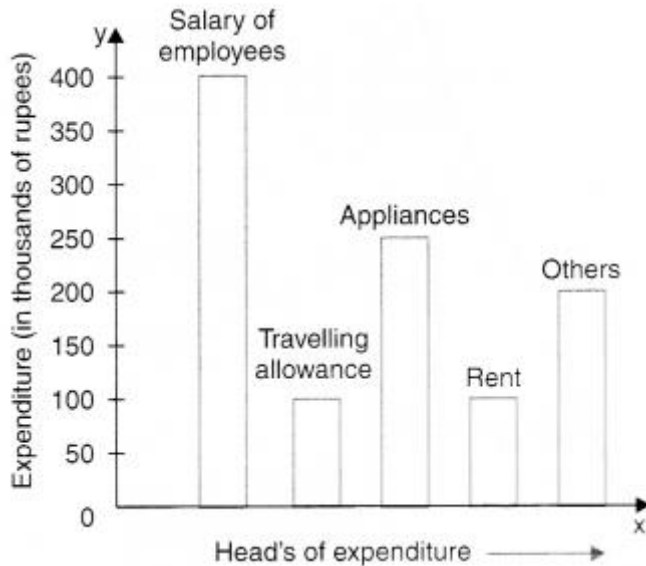
Question 1. On which head, is the expenditure maximum?

(a) Travelling allowance

(b) Rent

(c) Appliances

(d) Salary of employees.

Question 2. On which head/heads, is the expenditure minimum?

(a) Travelling allowance/rent

(b) Appliances

(c) Salary of employees

(d) Others.

Question 3. On which two heads, is the expenditure same?

(a) Salary of employees and others

(b) Travelling allowance and rent

(c) Appliances and rent

(d) Appliances and others.

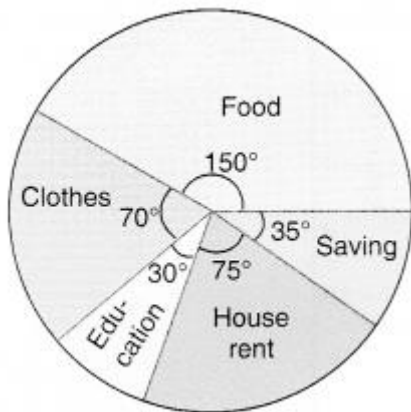Question 4. What is the difference of expenditures (in thousands of rupees) on salary of employees and rent?

(a) 100

(10)

(b) 200

(c) 300

(d) 400.

Question 5. What is the sum of the expenditures (in thousands of rupees) on travelling allowance and rent?

(a) 100

(b) 200

(c) 300

(d) 400.

Observe the following circle-graph and answer the related questions:

Question 6. On which head is the expenditure maximum?

(a) Food

(b) Clothes

(c) House rent

(d) Education.

Question 7. On which head is the expenditure minimum?

(a) Education

(b) House rent

(c) Food

(d) Clothes.

Question 8. If the budget of the family is Rs 10800, what is the saving?

(a) Rs 1050

(b) Rs 1000

(c) Rs 950

(11)

(d) Rs 1200.

Question 9. What is the difference of expenditures on clothes and education if the budget of the family is Rs 10800?

(a) Rs 1200

(b) Rs 1000

(c) Rs 800

(d) Rs 1500.

Question 10. What is the sum of the expenditures on food and education if the budget of the family is Rs 10800?

(a) Rs 5000

(b) Rs 8000

(c) Rs 5400

(d) Rs 6000.

Very Short Questions:

1. What is a pie graph?
2. What is The co-ordinates of origin?
3. What A pictorial representation of data in the form of rectangular bars to show comparison among categories called?
4. On which axis does the point (0,−6) lie?
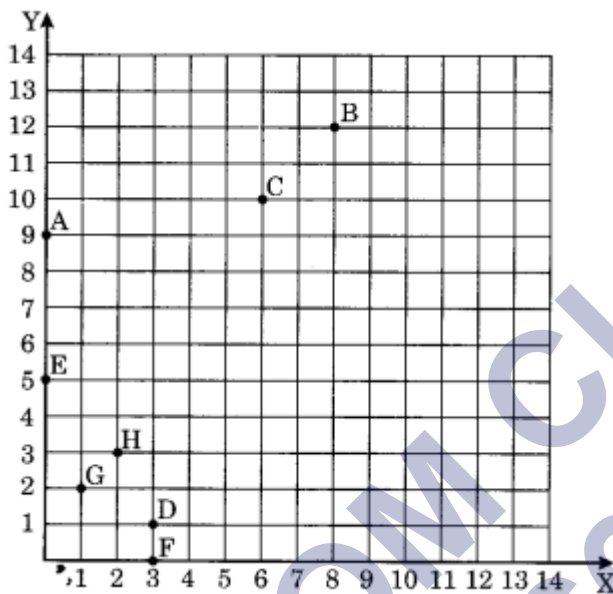5. Give the name of the point where x– axis and y– axis is meet?

Short Questions:

1. Write the coordinates of each point shown is the graph.
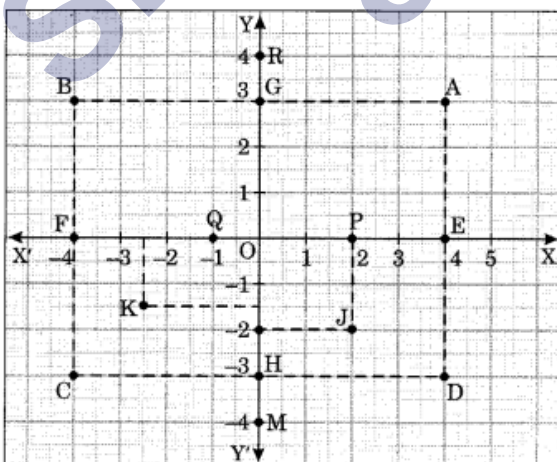
2. From the given figure, choose the letters indicate the location of the points.
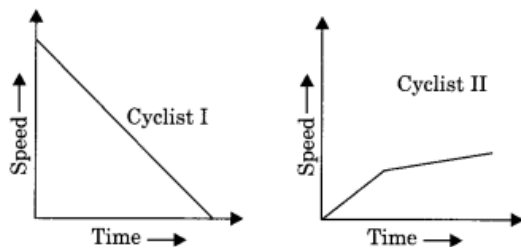
(12)

(i) (3, 1)

(ii) (0, 5)

(iii) (3, 0)

(iv) (1, 2)
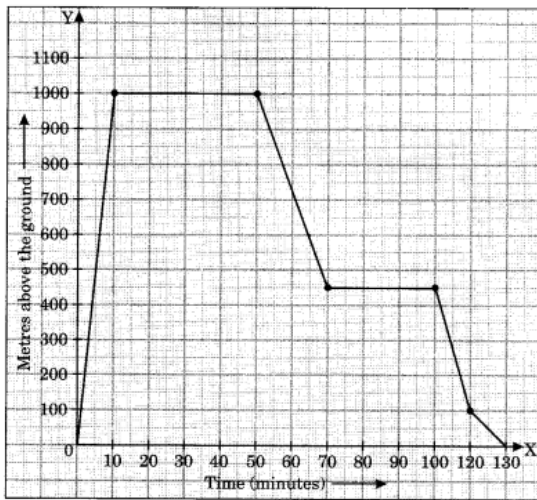
(v) (2, 3)

(vi) (8, 12)

(vii) (6, 10)

(viii) (0, 9)

3. Draw the graph of the following table. Is it a linear graph?

x	3	4	5	6	7
y	12	16	20	24	28

4. The given graphs show the progress of two different cyclists during a ride. For each graph, describe the rider's progress over the period of time.

5. The given graph shows the flight of an aeroplanes.

(13)

(i) What are the scales taken on x-axis and y-axis?

(ii) Upto what height the aeroplane rises?

(iii) What was the speed of the aeroplane while rising?

(iv) How long was the plane in level flight?

(v) How long did the whole flight take?

Long Questions:

1. A bank gives 10% interest on the deposits by the Ladies. Draw a graph showing the relation between the amount deposited and the simple interest earned by the ladies and state following from the graph.

    (i) The annual interest earned for an investment of ₹ 250

   (ii) The investment one has to make to get an annual interest of ₹ 70.

Sum deposited (in ₹)	100	200	300	500	1000
Simple interest (in ₹)	10	20	30	50	100

2. Draw the graphs for the following table of values, with suitable scales on the axes. Interest on deposits for a year.

Deposit (in Rs.)	1000	2000	3000	4000	5000
Simple interest (in Rs.)	80	160	240	320	400

    (i) Does the graph pass through the origin?

    (ii) Use the graph to find the interest on Rs 2500 for a year.

    (14)

(iii) To get an interest of Rs. 280 per year, how much money should be deposited.

3. Draw the line passing through (2,3) and (3,2). Find the coordinates of the points at which this line meets the x-axis and y-axis.

4. Plot the point (4, 3) on a graph sheet. Is it the same as the point (3, 4)?

5. The histogram given alongside shows the distribution of ages (in years) of 38 teachers in a school. Answer the following questions.

i. What is the most common age group? How many teachers are there in this group?

ii. What is number of teachers who are more than 25 years old but less than 30?

iii. How many teachers are 40 or older?

iv. What is the class size?

(15)
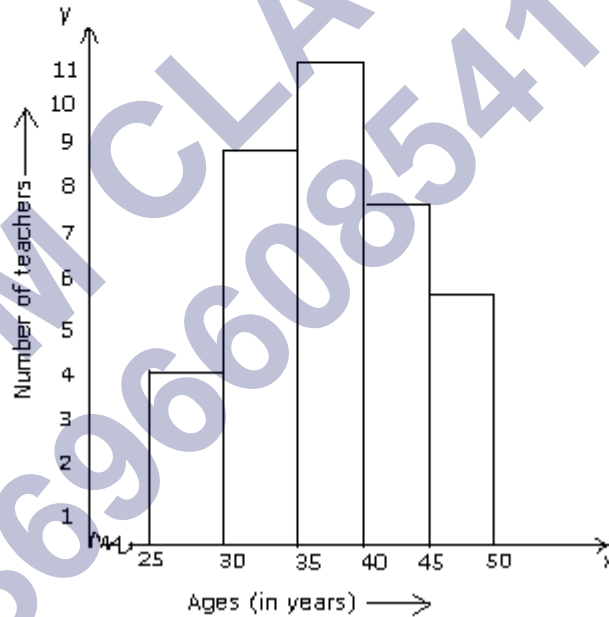
Answer Key-

Multiple Choice Questions:

1. (d) Salary of employees.
2. (a) Travelling allowance/rent
3. (b) Travelling allowance and rent
4. (c) 300
5. (b) 200
6. (a) Food
7. (a) Education
8. (a) Rs 1050
9. (a) Rs 1200
10. (c) Rs 5400

Very Short Answer:

1. Data can be represented by dividing a circle into sectors. This type of representation of data is called a pic graph. It shows us the relation of parts to the whole.
2. (0,0) is The co-ordinates of origin.
3. A pictorial representation of data in the form of rectangular bars to show comparison among categories is called is Bar graph.
4. y− axis does the point (0,−6) lie.
5. The point where x− axis and y− axis is meet is called origin.

Short Answer:

1.

Point	Coordinate
A	(4, 3)
B	(–4, 3)
C	(–4, –3)
D	(4, –3)
E	(4, 0)
F	(–4, 0)
G	(0, 3)
H	(0, –3)
J	(2, –2)
K	(–2.5, –1.5)
M	(0, –4)
O	(0, 0)
P	(2, 0)
Q	(–1, 0)
R	(0, 4)

2. (i) D(3, 1), (ii) E(0, 5), (iii) F(3, 0), (iv) G(1, 2), (v) H(2, 3), (vi) B(8, 12), (vii) C(6, 10), (viii) A(0, 9)

3.
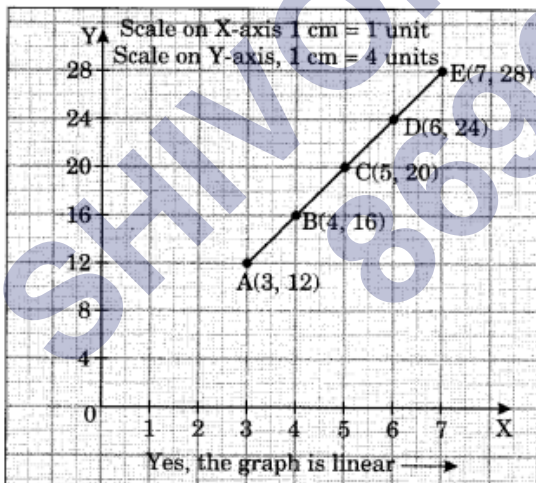
Yes, it is a linear graph.

4. (a) As time passes, the speed of cyclist I decreases steadily.

(b) Speed of cyclist II increases for a short time period, and then increases very slowly..

5. (i) Scale on x-axis, 1 cm = 10 minutes

Scale on y-axis, 1 cm = 100 metres

(17)

(ii) The aeroplane rose upto 1000 metres.

(iii) The speed of the aeroplane while rising was 100 m per minutes.

(iv) The time taken by the aeroplane to be in level flight is 40 + 30 = 70 minutes
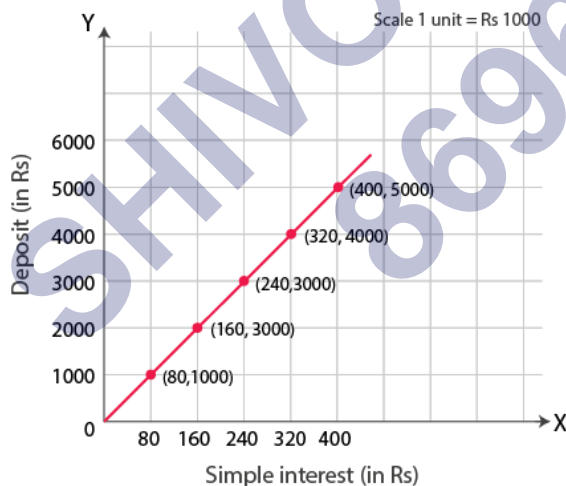
(v) Total flight time is 130 minutes.

Long Answer:

1. Required Graph is as under:
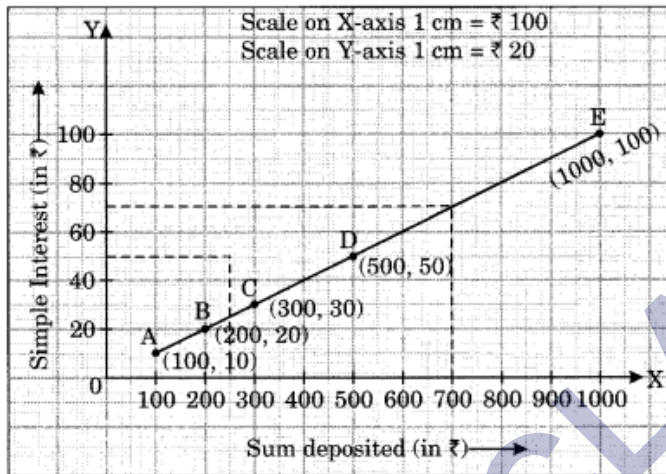
(i) ₹ 25 is Earned as annual interest for an investment of ₹ 250

(ii) ₹ 700 is to be invested to get an annual interest of ₹ 70.

2. Represent "Deposit" on y-axis and "simple interest" on x-axis.

(i) Yes, the graph passes through the origin.

(ii) Interest on Rs. 2500 is Rs. 200 for a year.

(iii) Rs. 3500 should be deposited for the interest of Rs. 280

3. Graph for the Line passes through points (2, 3) and (3, 2) is:

(18)
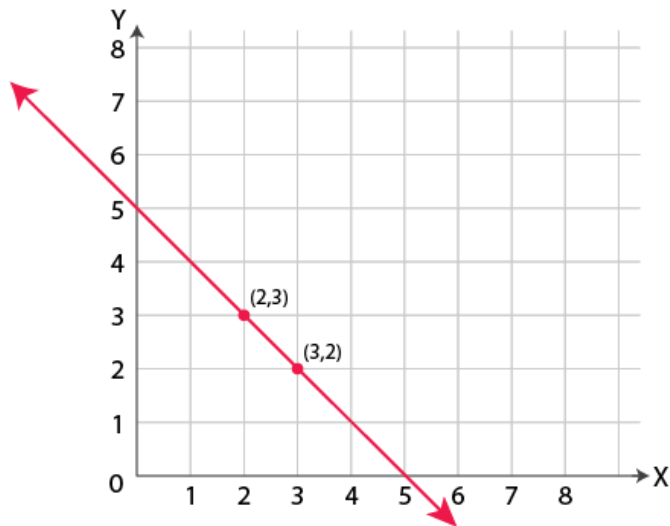
The coordinates of the points at which this line meets the x-axis at (5, 0) and Y axis at (0, 5).

4. Locate the x, y axes, (they are actually number lines!). Start at O (0, 0). Move 4 units to the right; then move 3 units up, you reach the point (4, 3). From Fig 15.13, you can see that the points (3, 4) and (4, 3) are two different points.
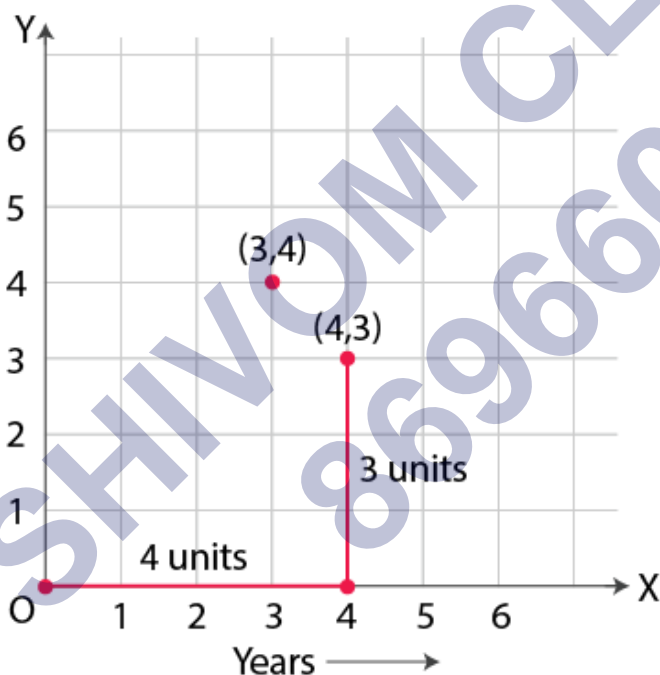
5.
   i. The most common age group 35 – 40. Number of teachers = 11
   ii. 4 teachers
   iii. 8 + 6 = 14 teachers
   iv. 5 years.

(19)