MATHEMATICS

Class-VIII

Topic-16

INTRODUCTION TO GRAPH

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CH-16
INTRODUCTION TO GRAPH

TERMINOLOGIES

Rectangular coordinates, origin, x-axis, y-axis, abscissa, ordinate, rectangular axis, quadrants, linear graphs, x-coordinate, y-coordinate, ordered pair.

INTRODUCTION

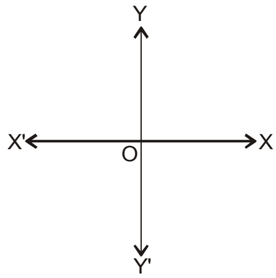
In our daily routine, we all use, newspapers, TV channels and ratio etc. in order to get information in the form of data and these datas can be represented graphically, i.e., on the bar graph, pie chart, histograms etc. But before proceeding, we will discuss, how one can locate the positions of a point and the plotting of point in the plane.

16.1 INTRODUCTION TO GRAPHS

(a) Co-ordinate System

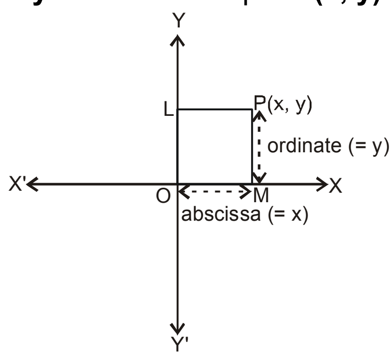
In Cartesian co-ordinate system we represent any point by **ordered pair (x,y)**, where **x** and **y** are called **X** and **Y** co-ordinate of that point respectively.

Take two perpendicular lines **X'OX** and **Y'OY** intersecting at the point **O**. **X'OX** and **Y'OY** are called the co-ordinate axes. **X'OX** is called the **X-axis**, **Y'OY** is called the **Y-axis** and **O** is called the origin. Lines **X'OX** and **Y'OY** are sometimes also called rectangular axes.



(b) Co-ordinates of a point

Let **P** be any point as shown in figure. Draw **PL** and **PM** perpendiculars on **Y- axis** and **X- axis**, respectively. The length **LP (or OM)** is called the x **- coordinate** or the **abscissa of point P** and **MP** is called the **y-coordinate** or the **ordinate of point P**. A point whose abscissa is **x** and ordinate is **y** named as the point **(x, y) or P (x, y).**



The two lines **X'OX** and **Y'OY** divide the plane into four parts called **quadrants**. **XOY, YOX', X'OY'** and **Y'OX** are, respectively, called the first, second, third and fourth quadrants. The following table shows the signs of the coordinates of points situated in different quadrants :

Quadrant	X - coordinate	Y - coordinate	Point
First quadrant	+	+	(+, +)
Second quadrant	–	+	(–, +)
Third quadrant	–	–	(–, –)
Fourth quadrant	+	–	(+, –)

NOTE :

(i) Abscissa is the perpendicular distance of a point from **y-axis**.
(i.e., positive to the right of **y-axis** or negative to the left of **y-axis**)

(ii) **Ordinate** is positive above **x-axis** or negative below **x-axis**.

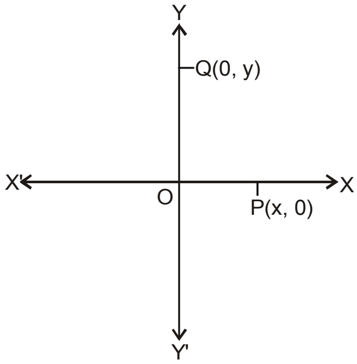
(iii) **Abscissa** of any point on **y-axis** is zero.

(iv) **Ordinate** of any point on **x-axis** is zero.

(v) Co-ordinates of the **origin** are **(0,0)**.

(c) Points on Axis

If point P lies on **X-axis** then clearly its distance from **X-axis** will be **zero**, therefore we can say that its **Y-coordinate** will be **zero**. Similarly if any point Q lies on **Y-axis**, then its distance from **Y-axis** will be **zero** therefore we can say its **X-coordinate** will be **zero**.



(d) Plotting the Points

In order to plot the points in a plane, we may use the following algorithm.

Step I : Draw two mutually perpendicular lines on the graph paper, one horizontal and other vertical.

Step II : Mark their intersection point as **O** (origin).

Step III : Choose a suitable scale on **X-axis** and **Y-axis** and mark the points on both the axis.

Step IV : Obtain the coordinates of the point which is to be plotted. Let the point be **P (a,b)**. To plot this point start from the origin and units move along **OX**, **OX'** according as **'a'** is positive or negative respectively. Suppose we arrive at point **M**. From point **M** move vertically upward or downwardthrough units according as **'b'** is positive or negative. The point where we arrive finally is the required point **P (a, b)**.

Illustration 16.1

Plot the point (3, 4) on a graph paper.

Sol. Let X'OX and Y'OY be the coordinate axis. Here given point is P (3,4), first we move 3 units along OX as 3 is positive then we arrive a point M. Now from M we move vertically upward as 4 is positive. Then we arrive at P (3, 4).

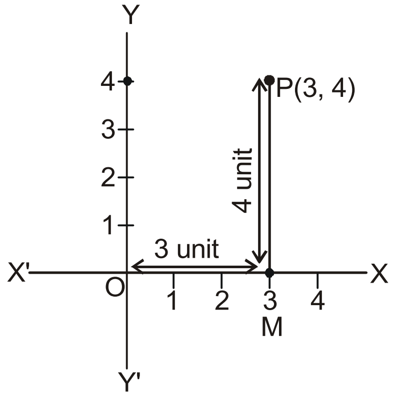


Illustration 16.2

Write the quadrants for the following points :

(i) A (3, 4) **(ii)** B (– 2, 3) **(iii)** C (– 5,– 2)
(iv) D (4, – 3) **(v)** E (– 5,– 5)

Sol. **(i)** Here both coordinates are positive therefore point A lies in Ist quadrant.
(ii) Here x is negative and y is positive therefore point B lies in IInd quadrant.
(iii) Here both coordinates are negative therefore point C lies in IIIrd quadrant.
(iv) Here x is positive and y is negative therefore point D lies in IVth quadrant.
(v) Here both coordinates are negative therefore point E lies in IIIrd quadrant.

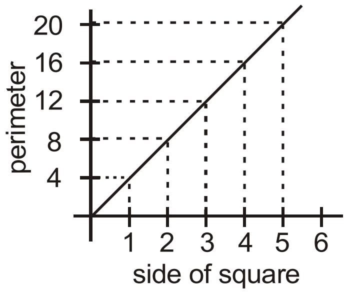
(e) Plotting of Graphs

(i) Perimeter vs. side of a square

Let us find the perimeter of squares having sides 1 cm, 2 cm, 3 cm, 4 cm, 5 cm, 6 cm and tabulate the result.

Side of square (cm)	Perimeter of the square (4xside) cm	(Side, perimeter)
1	4	(1,4)
2	8	(2,8)
3	12	(3,12)
4	16	(4,16)
5	20	(5,20)
6	24	(6,24)

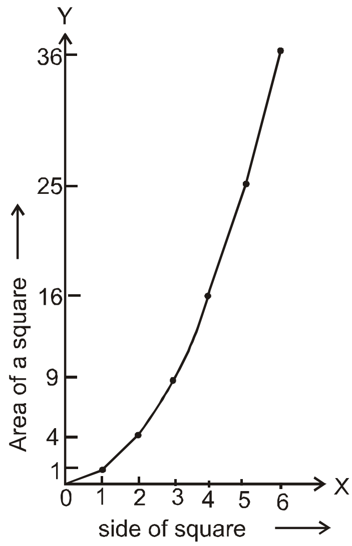
Draw coordinate axes, Take side of the square along x-axis and perimeter of square along y-axis. Then plot the point and joint them successively to obtain the required graph given below.



(ii) **Area vs. side of a square :** Let us find the area of squares having sides 1 cm, 2 cm, 3 cm, 4 cm, 5 cm, 6 cm and tabulate the result.

Side of square (cm)	Area of square (side × side) cm^2	(Side, area)
1	1	(1, 1)
2	4	(2, 4)
3	9	(3, 9)
4	16	(4, 16)
5	25	(5, 25)
6	36	(6, 36)

Draw coordinate axis, Take side of the square along x-axis and perimeter of square along y-axis. Then plot the point and joint them successively to obtain the required graph given below.



(f) Reading of graphs

So far we have been plotting the points. We have also seen that when these points are joined sometimes we get a line and sometimes we do not get a line. If the points when joined together lie on a straight line, we get a graph called **linear graph**.
In this section, we shall learn in general the reading of linear graphs and then reading of distance vs. time graphs.

(i) Let us plot the following points for the multiples of 4 and join them.

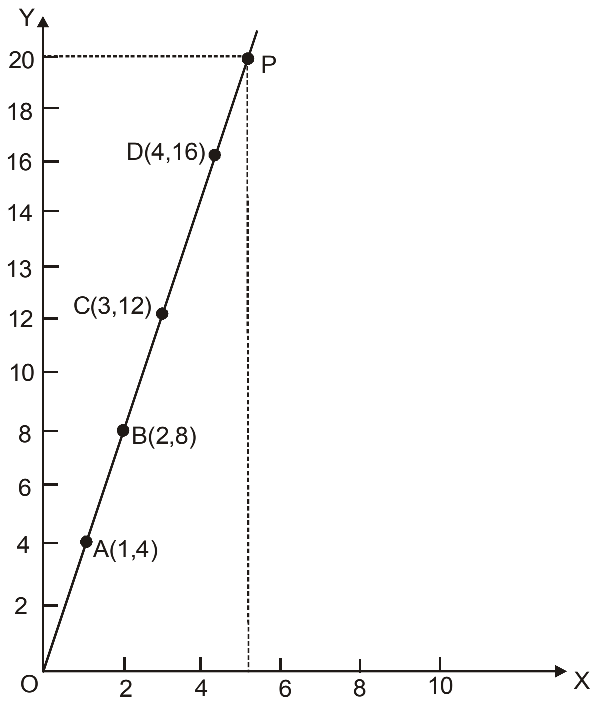
X	1	2	3	4
Y	4	8	12	16

We plot the points (1, 4), (2, 8), (3, 12), (4, 16) and then join them.

Now from the graph we can find 4×5 .

For that we locate number 5 on the x-axis and from there draw a perpendicular (go parallel to y- axis) which touches the graph at P. From P we draw a line parallel to x-axis which meets y-axis at the point marked 20.

Thus, $4 \times 5 = 20$.



Now we solve a few examples on drawing and reading of linear graphs.

Illustration 16.3

The following table gives the body temperature in °F corresponding to °C. Draw graph using this table and answer questions that follow :

Temperature (°C)	0	10	20
Temperature (°F)	32	50	68

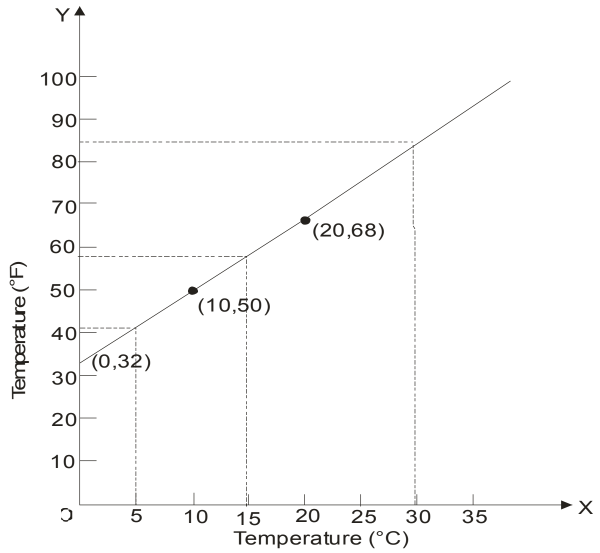
(a) What will be the temperature in °F when it is 15° C ?

(b) What will be the temperature in °C when it is 86° F?

(c) How many °F is equivalent to 5° C ?

Sol. Draw coordinate axis. Let 2 small divisions on x-axis represent 1° C and 1 small division on y-axis represent 1°F.

Plot the point (0,32) (10,50) and (20,68) and join them. Produce the line.



(a) When temperature is 15°C, the corresponding temperature is 59°F.

(b) Temperature corresponding to 86°F is 30°C.

(c) 5°C = 41°F.

Illustration 16.4

The given graph describes the distances of a car from a city P at different times when it is travelling from City P to City Q, which are 350 km apart. Study the graph and answer the following :

(i) What information is given on the two axis ?

(ii) From where and when did the car begin its journey ?

(iii) How far did the car go in the first hour ?

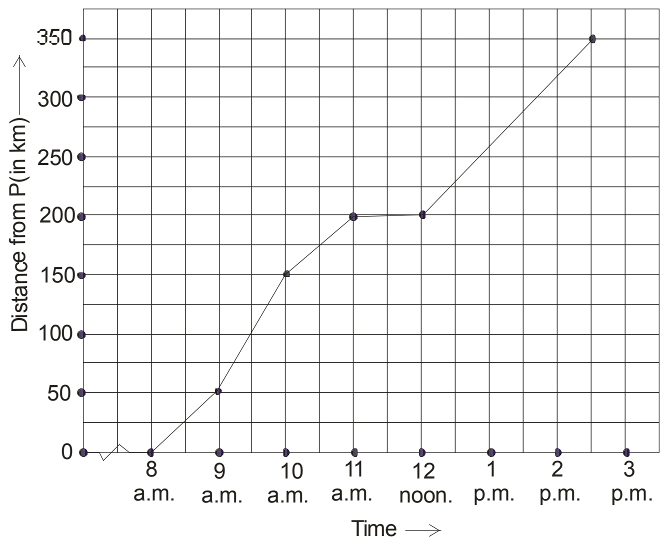
(iv) How far did the car go during :

(a) 2nd hour ? **(b)** the 3rd hour ?

(v) Was the speed same during the first three hours ? How do you know it ?

(vi) Did the car stop for some duration at any place ? Justify your answer.

(vii) When did the car reach City Q ?



S = x is the first term of the quotient.

Sol. **(i)** The horizontal (x) axis shows the time. The vertical (y) axis shows the distance of the car from City P.

(ii) The car started from City P at 8 a.m.

(iii) The car travelled 50 km during the first hour.

(iv) The distance covered by the car during

(a) The 2nd hour (i.e. from 9 am to 10 am) is 100 km (150 – 50)

(b) The 3rd hour (i.e. from 10 am to 11 am) is 50 km (200 – 150)

(v) From the answer to questions (iii) and (iv), we find that the speed of the car was not the same all the time. (In fact the graph illustrate how the speed varied)

(vi) We find that car was 200 km away from city P when the time was 11 a.m. and also at 12 noon. This shows that the car did not travel during the interval 11 am. to 12 noon. The horizontal line segment representing "travel" during this period is illustrative of this fact.

(vii) The car reached City Q at 2.30 pm.

Ask yourself

1. In which quadrants will the following points lie ?

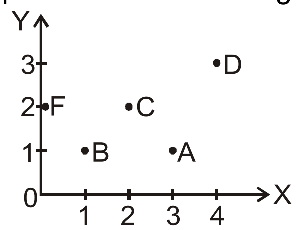
(i) D (– 10, – 10) **(ii)** E (– 10, 10) **(iii)** I $\left(-4\frac{1}{4}, 5\right)$

2. Plot the following points on a graph paper :

(i) N (3, – 6) **(ii)** P (5, 13) **(iii)** Q (– 11, 6)

(iv) R (– 7, – 9)

3. Obtain the co-ordinates of the points shown in the figure below.



4. **(i)** Plot the points (1, 0), (0, 1), (1, 2) on a graph paper.

(ii) Join the points plotted in part (a) above and write the figure you get.

5. Draw a graph of the values of the following formula : C = 3 N

C	0	1	0	4	6
N	3	3	9	12	30

It is a linear graph ?

6. Draw a graph for the given table

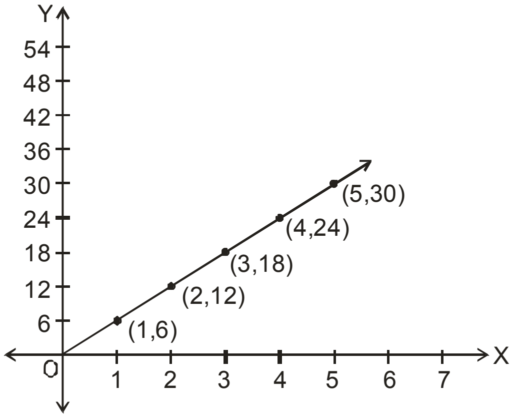
Time taken (in sec.)	0	1	2	3	4	5
Distance travelled (in m)	0	6	12	18	24	30

(i) Is it a linear graph ?

(ii) From the graph above, find the distance covered by the shuttle in 6 seconds and 8 seconds.

(iii) Using the graph find the time taken by the shuttle in convering a distance of 9 m and 54 m.

7. Look at the following time-distance graph and answer the questions that follow the graph :



(i) What is the constant speed of the motion being represented by the graph ?
(ii) What is the speed of motion during the period from 3 sec to 5 sec ?
(iii) What is the speed of motion when it covers a distance of 30 m ?

Answers

1 **(i)** III quadrant **(ii)** II quadrant **(iii)** II quadrant

3. A((3,1) B(1,1) C(2,2) D(4,3) F(0,2)

Add your knowledge

1. The distance between any point 'P', whose coordinates are (x, y) and origin 'O' is PO = $\sqrt{x^2 + y^2}$.

Concept Map

Introduction to Graphs

Co-ordinate System

(1) Rectangular Co-ordinates
(2) Coordinates of a point
(3) Points on axis
(4) Plotting of points

Plotting of Graphs

(1) Perimeter v/s side of a square
(2) Area v/s side of a square

Reading of Graphs

Ex.
(1) Reading of distance v/s time graph
(2) Reading of temperature graph

Summary

1. To locate the position of an object or a point in a plane, we required two perpendicular lines. One of them is horizontal, and the other is vertical.

2. The plane is called the Cartesian, or coordinate plane and the lines are called the coordinate axes.

3. The horizontal line is called the x-axis, and the vertical line is called the y-axis.

4. The coordinate axes divided the plane into four parts called quadrants.

5. The point of intersection of the axes is called the origin.

6. The distance of a point from the y-axis is called its x-coordinate, or abscissa, and the distance of the point from the x-axis is called its y-coordinate, or ordinate.

7. If the abscissa of a point is x and the ordinate is y, then (x, y) are called the coordinates of the point.

8. The coordinates of a point on the x-axis are of the form (x, 0) and that of the point on the y-axis are (0, y).

9. The coordinates of the origin are (0, 0).

10. The coordinates of a point are of the form (+, +) in the first quadrant, (–, +) in the second quadrant, (–, –) in the third quadrant and (+, –) in the fourth quadrant, where + denotes a positive real number and – denotes a negative real number.

Exercise-1

SECTION -A (FIXED RESPONSE TYPE)

MULTIPLE CHOICE QUESTIONS

1. The point where the two axes intersect is called :
(A) x - coordinate (B) Origin (C) y - coordinate (D) Vertical point

2. The y - coordinate in (0, 2), (3, 0) are :
(A) (0, 0) (B) (2, 3) (C) (2, 0) (D) (0, 2)

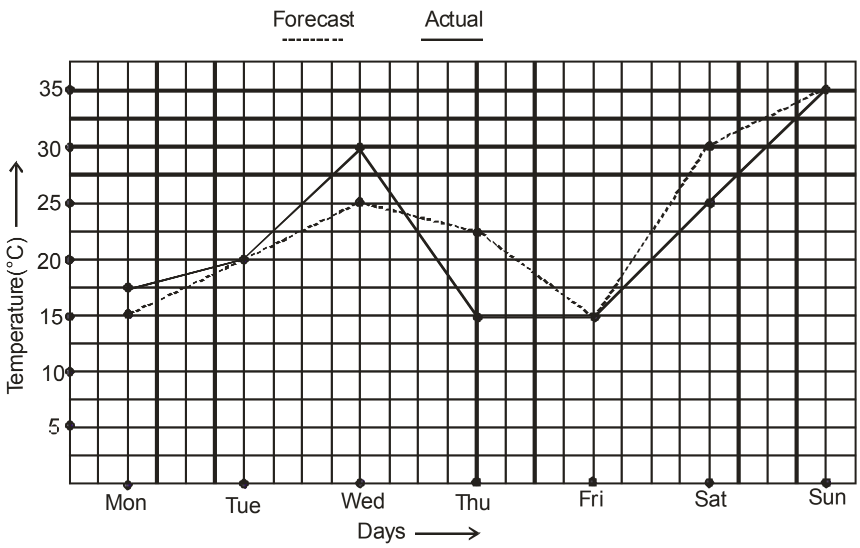
3. In which quadrant the sign of x coordinate and y coordinate of a point is same :
(A) I (B) III (C) (A) and (B) both (D) None of these

4. At origin, the x - coordinate & y - coordinate respectively are :
(A) (1, 1) (B) (0, 0) (C) (1, 0) (D) (0, 1)

5. In which of the following quadrants does the point (–3, –2) lie ?
(A) I (B) II (C) III (D) IV

Instructions (6 to 10) :

The following graph shows the temperature forecast and the actual temperature for each day of a week.



6. On which days was the forecast temperature the same as the actual temperature ?
(A) Tuesday (B) Friday (C) Sunday (D) All of these

7. What was the maximum forecast temperature during the week ?
(A) 30°C (B) 35°C (C) 40°C (D) 45°C

8. What was the minimum actual temperature during the week ?
(A)10°C (B) 15°C (C) 20°C (D) 25°C

9. On which day did the actual temperature differ the most from the forecast temperature ?
(A) Monday (B) Wednesday (C) Thursday (D) Friday

10. What was the average actual temperature during the week.
(A) 20°C (B) 22.5°C (C) 25°C (D) 27.5°C

FILL IN THE BLANKS

1. The horizontal axis is called ______ axis.

2. The coordinates of a point on ______ axis are (0, y).

3. The coordinate of the origin are ______.

4. The abscissa of the point (– 4, 1) is ______.

5. The ordinate of a point on the x axis is ______.

6. If both abscissa and ordinate of a point are negative, it lies in the ______ quadrant.

TRUE / FALSE

1. The abscissa of a point on x axis may be a negative integer .

2. Coordinate axes are also called rectangular axes.

3. The coordinates of origin are (0,0) ,

4. There are 5 quadrants .

5. In 4th quadrant x and y both co-ordinates are negative.

MATCH THE COLUMN

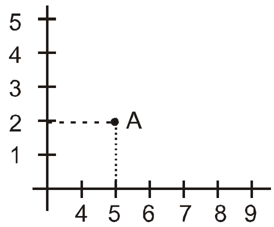
	Column– I		**Column– II**
(A)	(3,-2)	(p)	on x axis
(B)	(-9,8)	(q)	origin
(C)	(0,0)	(r)	in 2nd quadrant
(D)	(-6,-8)	(s)	on y axis
(E)	(0,4)	(t)	in 3rd quadrant
(F)	(-5,0)	(u)	in 4th quadrant

SECTION -B (FREE RESPONSE TYPE)

VERY SHORT ANSWER TYPE

1. In which quadrants will the following points lie ?
(i) A (3,–5) **(ii)** B (– 2, – 5)

2. Find the coordinates of A ?



3. Plot (100, 150) on a graph.

4. plot the points on graph :
(i) (3,4) **(ii)** (2,-7) **(iii)** (-5,2) **(iv)** (-4,-4)

5. **(i)** Plot the point (1, 1), (1, 4), (4, 4), (4, 1) on a graph paper.
(ii) Join the points plotted in (a) and write the figure you get.

SHORT ANSWER TYPE

6. Plot the graph between Simple interest Vs Number of Years by taking Principal = Rs. 5000 and rate of interest = 10% p.a.

7. Plot the graph of Perimeter Vs. Length of Rectangle by taking breadth= 5 cm.

8. The following table gives the sum of the angles of a polygon in right angles and the number of sides of the polygon. Plot the points on the graph, answer the questions that follow :

Number of sides (n)	**3**	**4**	**6**	**10**
Sum of the angles in right angles (r)	**2**	**4**	**8**	**16**

(i) What is the sum of the angles of a polygon of 5 sides?
(ii) What is the sum of the angles of a polygon of 12 sides?
(iii) How many sides has a polygon whose angles add up to 12 right angles ?
(iv) How many sides has a polygon whose angles add up to 1260° ?

LONG ANSWER TYPE

9. Different packets are weighed by a spring balance. The length of spring changes proportionally with the weight of the packet. The following table gives the length of the spring corresponding to the weight.

Weight (in kg)	**0**	**5**	**10**	**15**
Length of spring (in mm)	**30**	**35**	**40**	**45**

Draw the graph for the above table and from the graph, answer the following questions :
(i) What will be the length of the spring when a weight of 20 kg is hung ?
(ii) What will be the length of the spring when a weight of 35 kg is hung ?
(iii) If the length of the spring is 62 mm, what weight is hung ?

10. A scooterist calculated his average cost of running his scooter, which is given in the following table :

Distance travelled (in km)	**10**	**20**	**30**	**50**
Cost (in Rs)	**15**	**25**	**35**	**55**

Draw the graph (distance, cost) and from the graph answer the following questions :
(i) What will be the cost if he drives 40 km ?
(ii) What will be the cost if he drives 53 km ?
(iii) If he spends Rs 44, how far has he travelled ?

Exercise-2

SECTION -A (COMPETITIVE EXAMINATION QUESTION)

MULTIPLE CHOICE QUESTIONS

1. The distance of the point (3, 5) from X-axis is :
(A) $\sqrt{34}$ (B) 3 (C) 5 (D) None of these

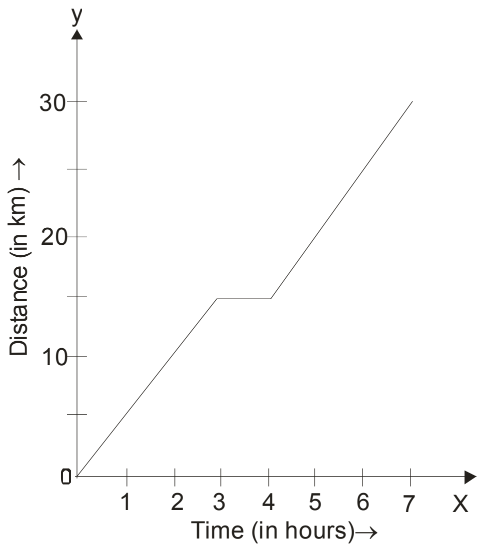
2. Ordinate of a point is negative in :
(A) III and IV quadrant (B) III quadrant only
(C) II and III quadrant (D) IV quadrant only

3. If (2a–4,3a–9) lie on Y axis then find the value of a
(A)1 (B) 2 (C) 3 (D) 4

4. If (a–3,5b–20) lie on origin then find the value of a+b
(A)3 (B) 4 (C) 7 (D) 10

5. If (a+b,7a–2b–18) lie on origin then find the value of a
(A)2 (B) –2 (C) 3 (D) –3

Direction:(For Q.No. 6 to 8)
. The graph in figure respresents the path of a walker. From the graph answer the following questions.



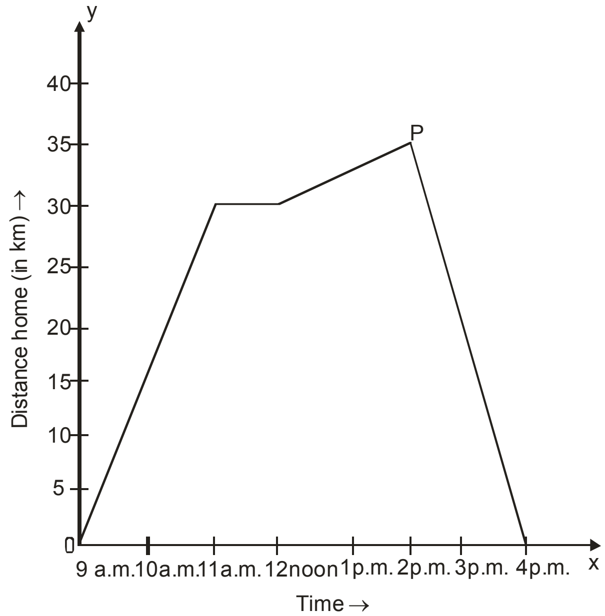
6. What was the average speed during the first part of the journey?
(A) 3 km/hr (B) 4km/hr (C) 5 km/hr (D) 6 km/hr

7. What was the speed oduring 3 hr to 4 hr?
(A) 0 km/hr (B) 1km/hr (C) 5 km/hr (D) 3 km/hr

8. Find the ratio of his average speed during 0 hr to 3 hr and 4 hr to 7 hr?
(A) 1 : 1 (B) 6 : 7 (C) 5 : 6 (D) 6 : 5

Direction:(For Q.No. 9 to 10)

The journey of a cyclist is shown in figure . Read this graph and answer the following questions.



9. During which hours the cyclist did take rest?

(A) 9 am to 11 am (B) 11 am to 12 noon
(C) 12 noon to 3 pm (D) 3 pm to 4 pm

10. What is his average speed on return journey?

(A) $17\frac{1}{2}$ km/hr (B) 15km/hr (C) 0 km/hr (D) 12 km/hr

SECTION -B (TECHIE STUFF)

11. The distance of a P(–3, 4) from origin is

(A) 4 (B) 3 (C) 5 (D) 6

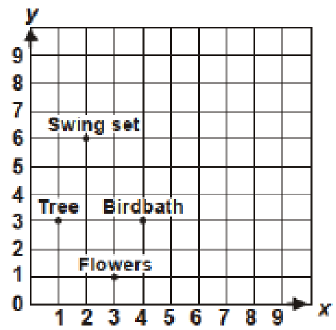
12. There are 2 points P(3, 4) and Q(– 3, – 4). Find the distance between P and Q ?

(A) 5 (B) 6 (C) 10 (D) 11

Exercise-3

(PREVIOUS YEAR EXAMINATION QUESTIONS)

1. John made the given grid to show the location of some things in his garden.
Which ordered pair best represents the point on the grid labeled "Tree"? **[IMO - 2010]**



(A) (2,6) (B) (3,1) (C) (1,3) (D) None of these

Direction (Q.No. 2 - 3)

Study the following Table carefully to answer the following questions. **[IMO - 2011]**

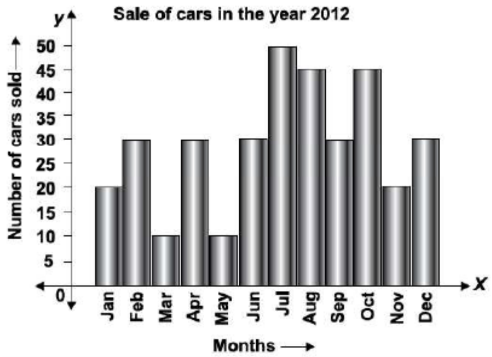
2. What are the average marks obtained by all the students in Math?

Marks Obtained by Five Students in Three Subjects out of 100			
Student	Subjects		
	Math	Science	English
Mohit	94	83	74
Sameer	72	88	68
Rachna	86	75	66
Purab	90	61	82
Mansi	68	67	71

(A) 137 (B) 82 (C) 75 (D) 98

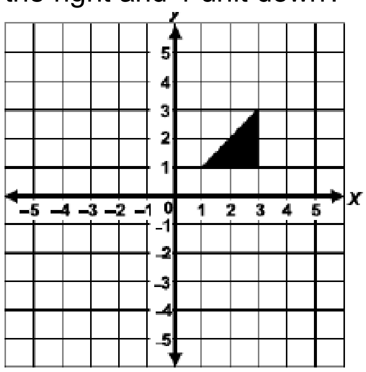
3. What is the respective ratio of marks obtained by Mansi in Science and English together to the marks obtained by Rachna in the same subjects?
(A) 17:18 (B) 11:13 (C) 46 : 47 (D) 21: 23

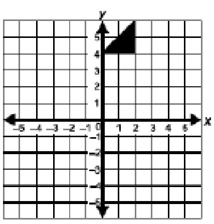
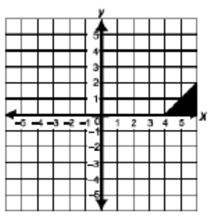
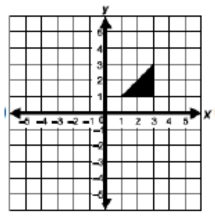
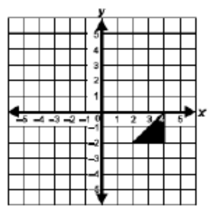
4. How many cars were sold in the first quarter of the year? **[IMO - 2012]**



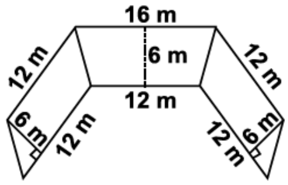
(A) 60 (B) 90 (C) 50 (D)100

5. The figure shows a triangle on a coordinate plane. Which of the following shows the triangle translated 3 units to the right and 1 unit down? **[IMO - 2012]**



(A)  (B)  (C)  (D) 

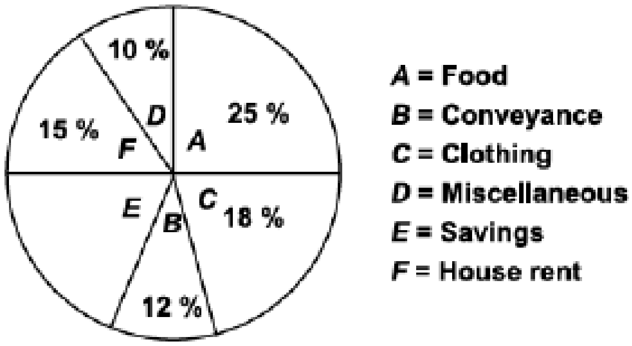
6. Find the area of the given figure. **[IMO - 2012]**



(A) 128 m^2 (B) 228 m^2 (C) 328 m^2 (D) 628 m^2

Direction (Q.No. 7 & 8):

The Pie graph depicts the budget of a family 'X'. The total monthly income of the family is Rs.3080, **[IMO - 2012]**



7. How many degrees should be there in the central angle of the sector for miscellaneous expenses?
(A) 60 degrees (B) 55 degrees (C) 46 degrees (D) 36 degrees

8. How much total expenses are incurred on food, clothing and conveyance every month?
(A) Rs.1794 (B) Rs.1684 (C) Rs.1664 (D) Rs.1694

9. Nita walks from her house 160 metres north and from there 630 metres west to visit her friend. While coming back, she walked diagonally from her friend's house, back to her home. What distance did she walk while returning? **[IMO - 2012]**
(A) 730 m (B) 800 m (C) 1250 m (D) 650 m

Answer Key

Exercise-1

SECTION -A (FIXED RESPONSE TYPE)

MULTIPLE CHOICE QUESTIONS

Ques.	1	2	3	4	5	6	7	8	9	10
Ans.	B	C	C	B	C	D	B	B	C	B

FILL IN THE BLANKS

1. x **2.** y **3.** (0,0) **4.** – 4 **5.** 0

6. 3

TRUE / FALSE

1. True **2.** True **3.** True **4.** False **5.** False

MATCH THE COLUMN

1. (A) – u, (B) – r, (C) –q , (D) – t, (E) – s, (F) – p

SECTION -B (FREE RESPONSE TYPE)

VERY SHORT ANSWER TYPE

1. **(i)** 4^{th} **(ii)** 3^{rd} **2.** (5, 2)

SHORT ANSWER TYPE

8. **(i)** 6 right angles **(ii)** 20 right angles
(iii) 8 sides polygon **(iv)** 9 sides polygon

LONG ANSWER TYPE

9. **(i)** 50 mm **(ii)** 65 mm **(iii)** 32 Kg.

10. **(i)** Rs. 45 **(ii)** 58 km **(iii)** 39 km

Exercise-2

SECTION -A (COMPETITIVE EXAMINATION QUESTION)

MULTIPLE CHOICE QUESTIONS

Ques.	1	2	3	4	5	6	7	8	9	10	11	12
Ans.	C	A	B	C	A	C	A	A	B	A	C	C

Exercise-3

SECTION -A (PREVIOUS YEAR EXAMINATION QUESTIONS)

Ques.	1	2	3	4	5	6	7	8	9
Ans.	C	B	C	A	B	B	D	D	D