

Introduction to Graphs

We'll cover the following key points:

- Coordinate Axes
- Coordinates of a Point
- Drawing Graphs



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Learning Outcomes

By the end of this chapter, students will be able to:

- Understand the concept and importance of graphs in representing data visually.
- Identify and interpret different types of graphs, such as bar graphs, histograms, line graphs, and pie charts.
- Plot points on a Cartesian plane using ordered pairs (x, y) .
- Understand the concept of the x-axis, y-axis, origin, and quadrants in the Cartesian plane.
- Draw and interpret line graphs for given data.
- Solve problems related to distance-time graphs and analyze trends.
- Understand the relationship between two quantities using graphs.
- Represent algebraic equations on a graph and interpret the solutions.
- Analyze and draw inferences from data using graphs.
- Apply graphical methods to real-life situations, such as tracking growth, trends, and changes over time.
- Differentiate between linear and non-linear graphs by observing their shapes.
- Use scales appropriately while plotting graphs for accurate representation.
- Solve simple real-life problems by interpreting graphs, such as temperature changes, rainfall patterns, or business trends.

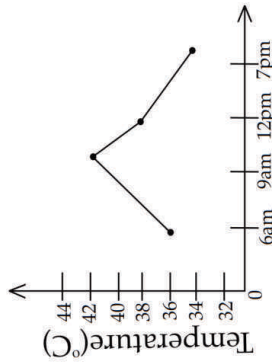


Mind Map

INTRODUCTION TO GRAPH

Line Graph

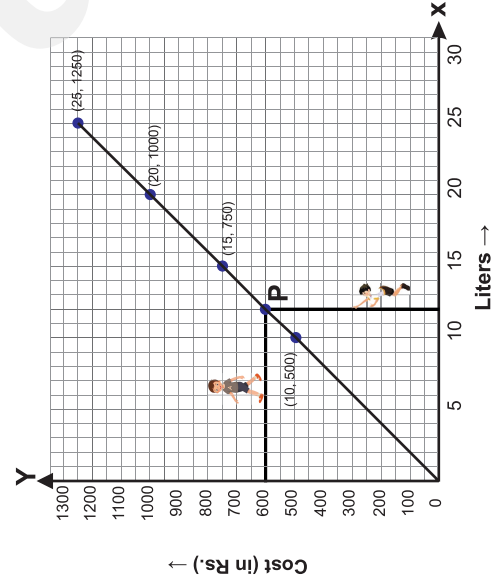
Displays that changes continuously over periods



Quantity and Cost

No. of Litres of petrol	10	15	20	25
Cost of petrol (in ₹)	500	750	1000	1250

- Mark number of litres along the horizontal axis.
- Mark cost of petrol along the vertical axis.
- Plot the points: (10,500), (15,750), (20,1000), (25,1250).
- Join the points



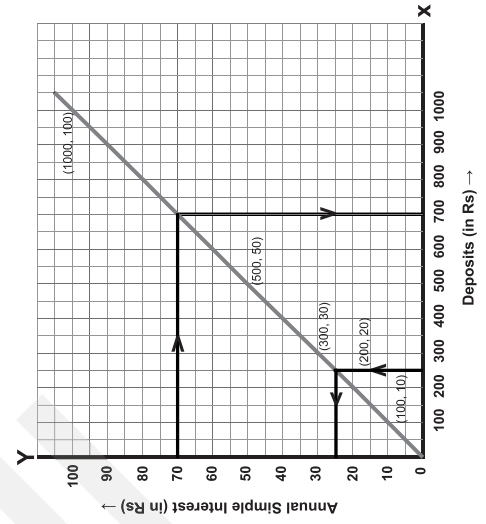
Some Applications

- Quantity and cost
- Principal and simple interest
- Time and distance

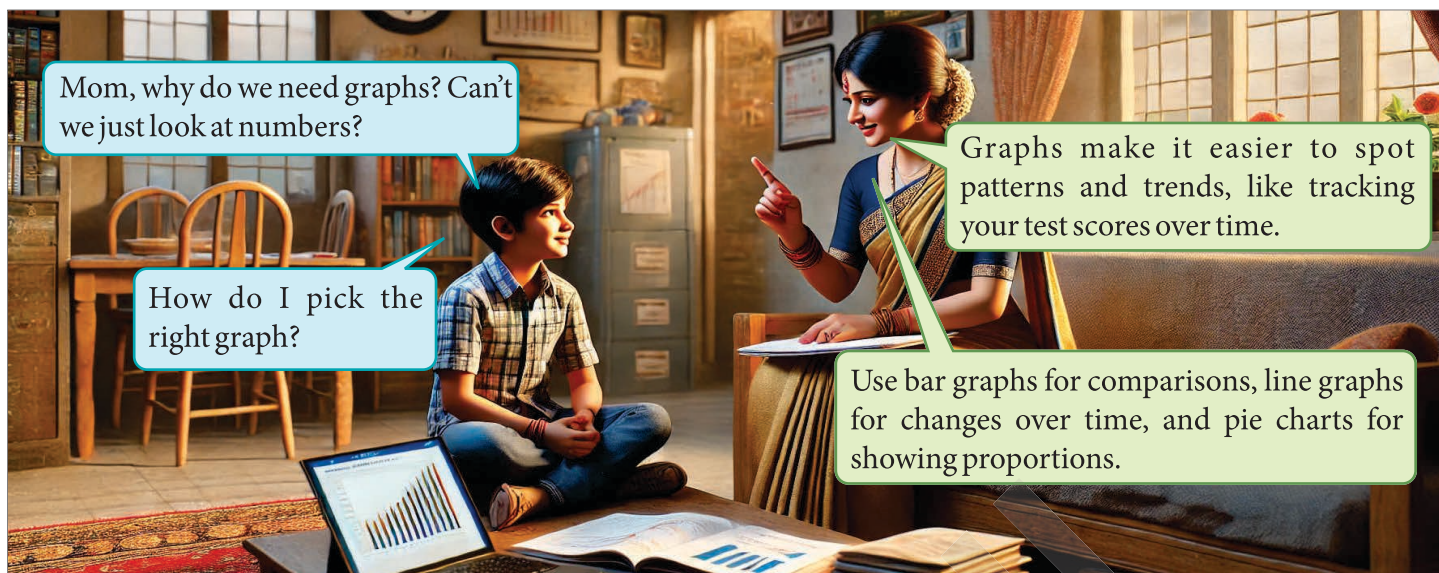
Principal and simple interest

Deposit (in ₹)	100	200	300	500	1000
Annual S.I. (in ₹)	10	20	30	50	100

- Mark Deposits along horizontal axis.
- Mark Simple Interest along vertical axis.
- Plot the points : (100,10), (200, 20), (300, 30), (500,50) etc.
- Join the points.



Introduction

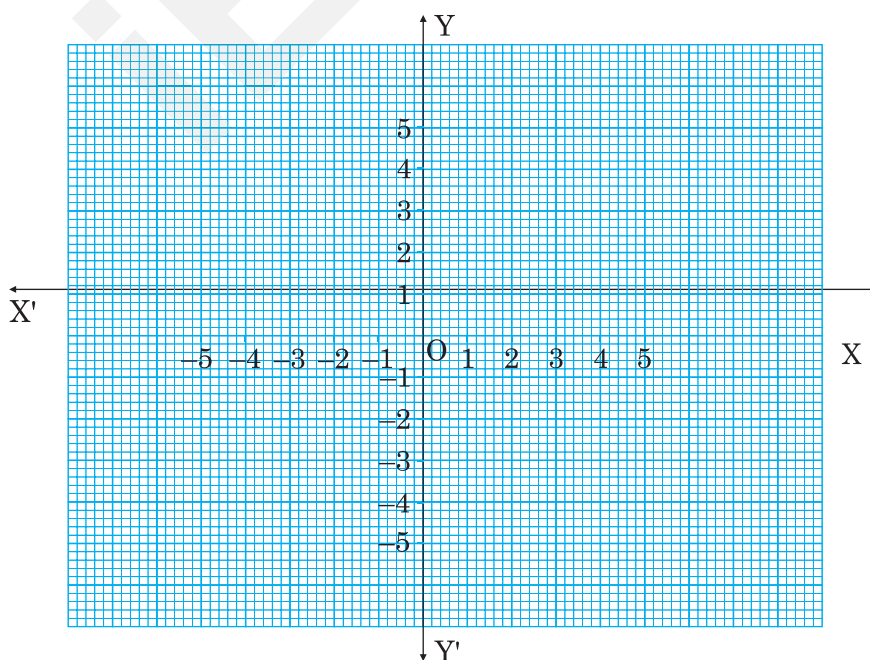


Coordinate Axes

Coordinates are used in mathematics to describe the position of a point. In a graph-paper draw two mutually perpendicular straight lines $X'OX$ and YOY' , intersecting each other at the point O . These lines are known as *coordinate axes*.

The line $X'OX$ is called the X-axis or the axis of x and the line YOY' is called the Y-axis or the axis of Y , while the point where the two axes meet is called the *origin*.

The plane of the paper containing both the coordinate axes is called the *Cartesian plane*. The left and right-hand side of the Y-axis, *i.e.*, every endpoint of a square on the X-axis, represents negative and a positive integer respectively, as shown in the figure:

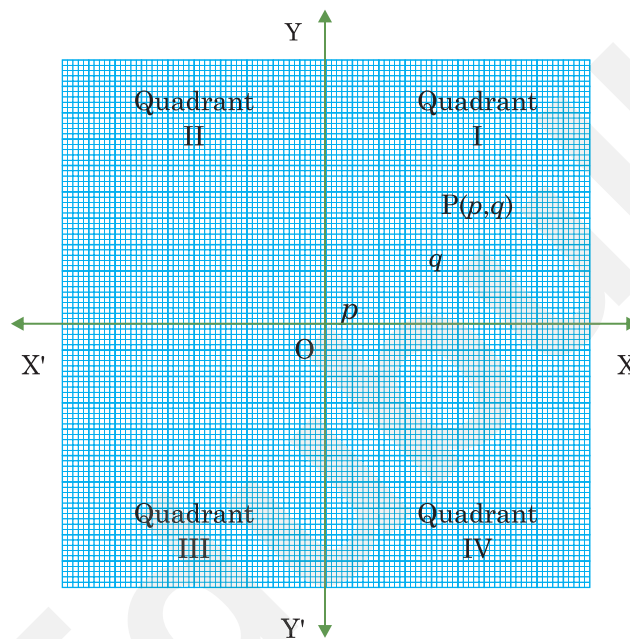


Above and below the X-axis, (*i.e.*) every endpoint of a square on the Y-axis, represents a positive and negative integer, as shown in the figure above.

Ordered pair: A pair of two numbers say p and q , listed in a specific order, is called an *ordered pair* (p, q) with p at the first place and q at the second place.

• Coordinates of a Point •

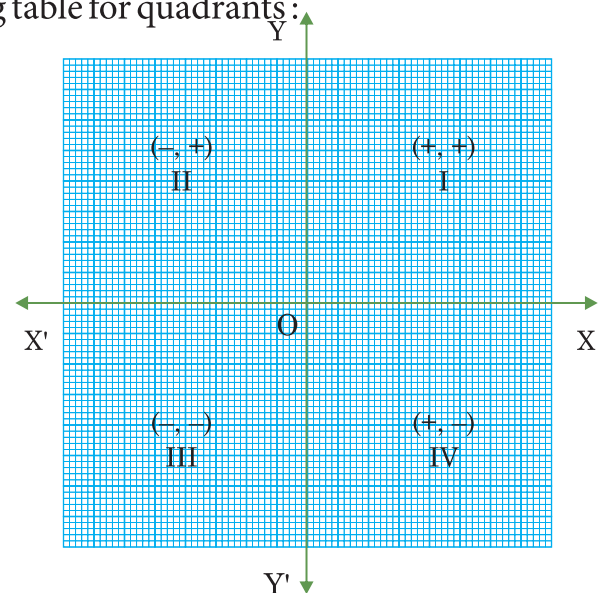
Let $X'OX$ and YOY' be the coordinate axes and let P be a point on the graph paper such that P is at a distance of p units from the Y-axis and q units from the X-axis. Thus, we say that the coordinates of point P are $P(p, q)$.



Here, p is called the X-coordinate or abscissa of P , while q is called the Y-coordinate or ordinate of P .

Quadrants: Observe that the coordinate axes divide the plane of the graph paper into four regions. These regions are called the quadrants. Study the following table for quadrants:

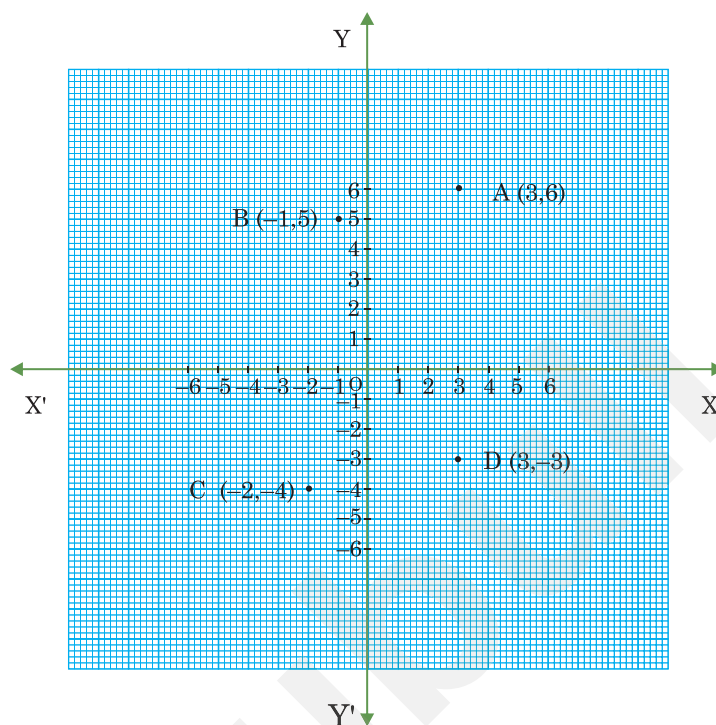
Region	Quadrant	Sign of coordinates
XOY	I	$(+, +)$
YOX'	II	$(-, +)$
X'OY'	III	$(-, -)$
Y'OX	IV	$(+, -)$



Example 1 : Plot the following points on a graph paper :

- (i) $A(3, 6)$ (ii) $B(-1, 5)$ (iii) $C(-2, -4)$ (iv) $D(3, -3)$

Solution: Let $X'OX$ and YOY' be the coordinate axes. Then the given four points may be plotted as given on the next page:



Explanation: (i) On X-axis, take 3 units to the right of Y-axis and then on the Y-axis, take 6 units above the X-axis.

Thus, we get the point $A(3, 6)$.

(ii) On the X-axis, take 1 unit to the left of the Y-axis and then on the Y-axis, take 5 units above the x-axis.

Thus, we get the point $B(-1, 5)$.

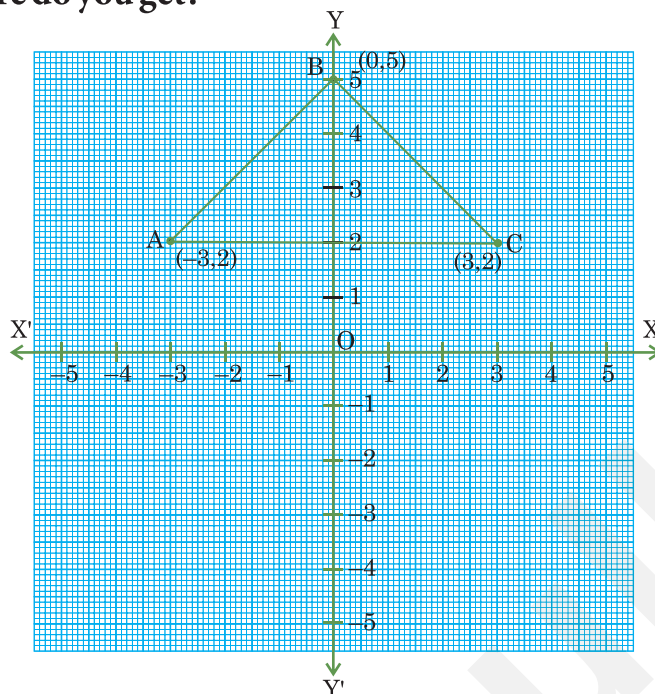
(iii) On the X-axis, take 2 units to the left of the Y-axis and then on the Y-axis, take 4 units below the X-axis.

Thus, we get the point $C(-2, -4)$.

(iv) On the X-axis, take 3 units to the right of the Y-axis and then on the Y-axis, take 3 units below the X-axis.

Thus, we get the point $D(3, -3)$.

Example 2: On a Cartesian plane, plot the points A $(-3, 2)$, B $(0, 5)$ and C $(3, 2)$. Join them, which figure do you get?



Solution : On joining the points A, B and C, we get the triangle ABC.

Exercise 13.1

1. On a graph paper draw the coordinate axes $X'OX$ and YOY' , and plot each of the following points:

(i) $(5, 3)$ (ii) $(3, -2)$ (iii) $(-2, -7)$ (iv) $(6, -4)$

(v) $(-3, 4)$ (vi) $(5, 0)$ (vii) $(0, -4)$ (viii) $(0, 0)$

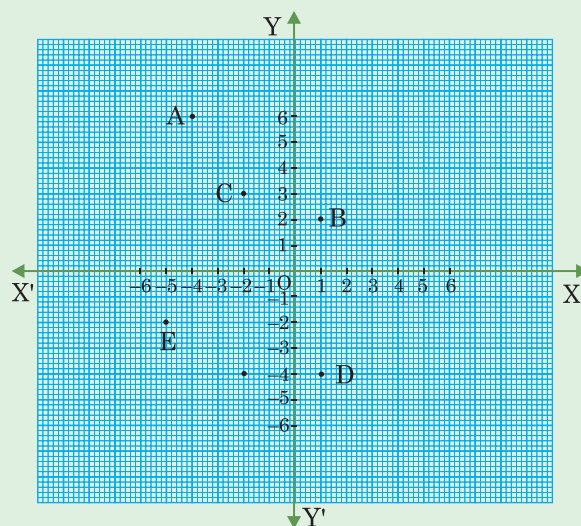
2. Write the ordered pair whose:

(i) ordinate = 0, abscissa = 2

(ii) ordinate = -5, abscissa = -3

(iii) ordinate = -6, abscissa = 4

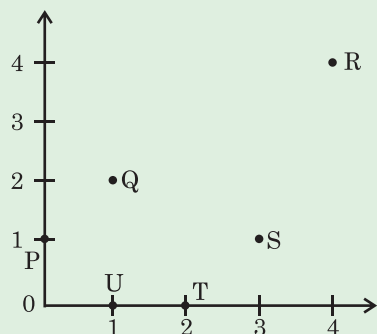
3. Write the coordinate of points A, B, C, D and E in the given figure :



4. Without plotting the points on a graph paper, state in which quadrants do the following points lie:

- (i) A (3, 3) (ii) B (7, 3) (iii) C (-4, 1) (iv) D (-1, -5)
 (v) E (-2, 4) (vi) F (6, -4)

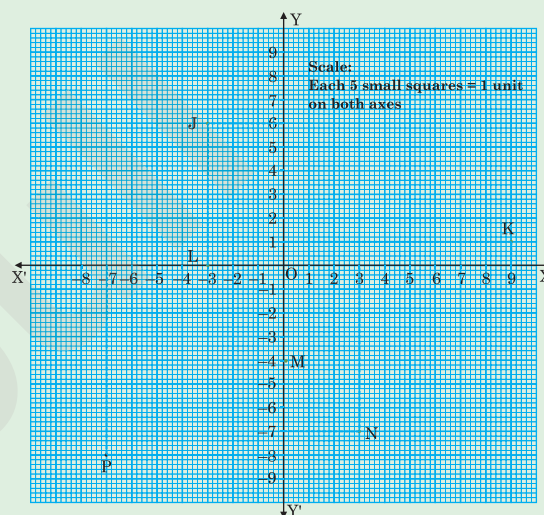
5. Write down the coordinates of points shown in the given figure :



6. Plot the following points on a graph sheet. Verify if they lie on a line:

- (i) P (5, 0), Q (5, 2), R (5, 4), S (5, 6)
 (ii) L (1, 1), M (2, 2), N (3, 3), O (4, 4)

7. Find out coordinates of the points J, K, L, M, N and P from the following graph :



Skills covered: Evaluation skills, analytical skills, problem solving skills, numeracy skills

• Drawing Graphs •

Example 3: Draw the graph of the function $A = 3x$ and from the graph, find the value of A, when $x = 3.5$.

Solution: The given function is $A = 3x$.

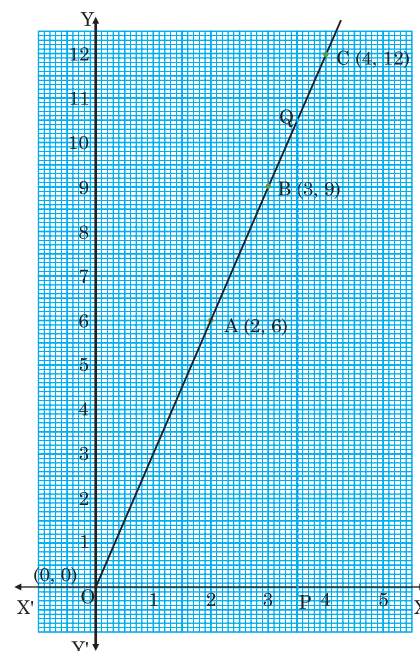
For different values of x , the corresponding values of y will be as given below:

x	0	2	3	4
$A = 3x$	0	6	9	12

On a graph paper plot the points O (0, 0), A (2, 6), B (3, 9) and C (4, 12). Join them successively to obtain the required graph.

Reading off from the graph:

On the X-axis, take the point P at $x = 3.5$.



Draw $PQ \perp X\text{-axis}$, meeting the graph at Q.

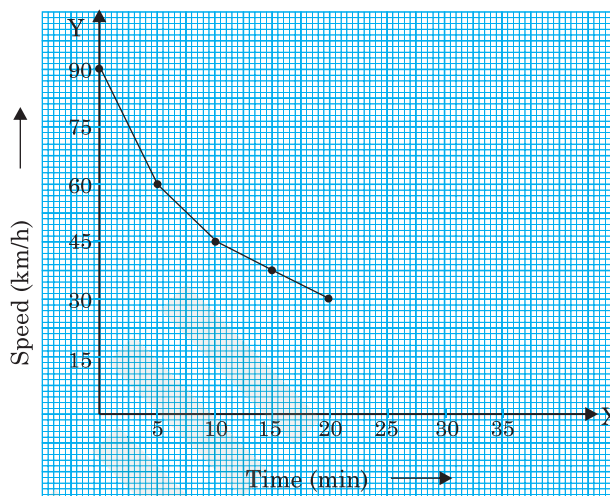
Clearly, $PQ = 10.5$ units.

$$\therefore x = 3.5 \Rightarrow A = 10.5.$$

Sometimes, you may get a curve instead of a straight line. Let us plot the data showing speed (in km/h) at five minutes interval of time:

Time (in minutes)	0	5	10	15	20
Speed (in km/h)	90	60	45	37.5	30

The given graph represents decreasing curve which shows that as time increases speed decreases correspondingly.



Example 4: We know that, the perimeter of a square is given by the formula $P = 4s$. Here P = perimeter and s = length of side.

(i) Draw a graph of this function.

(ii) From the graph, find the value of P , when $s = 4$.

Solution:

(i) The given function is $P = 4s$. For different values of s , the corresponding values of P are given below:

s	0	1	2	3
$P = 4s$	0	4	8	12

On a graph paper, plot the points $O(0, 0)$, $P(1, 4)$, $Q(2, 8)$ and $R(3, 12)$. Join these points to get required graph line as shown on the right side.

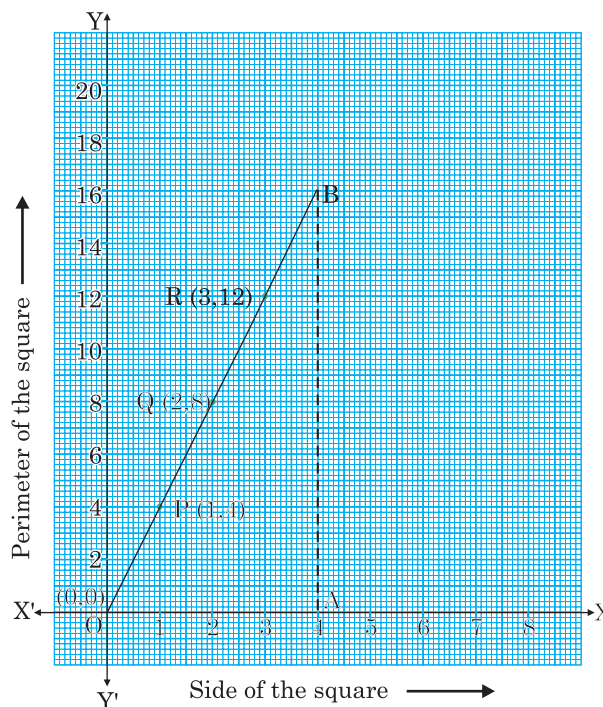
(ii) **Reading off from the graph :**

On the x -axis, take the point A at $s = 4$. Draw $AB \perp x\text{-Axis}$, meeting the graph at B .

Clearly, $AB = 16$ units.

$$\therefore s = 4 \Rightarrow P = 16.$$

Thus, when $s = 4$, then $P = 16$.



Example 5 : Suppose simple interest on a certain sum is ₹ 50 per year.

Then simple interest, $I = 50 \times t$, where t is the number of years.

- Write the ordered pairs (t, I) for drawing the graph.
- Draw a graph of this function with t along X-axis and I along Y-axis.
- From the graph, find the value of I , when $t = 4$.
- Making use of the graph find t when $I = ₹ 250$.

Solution: (i) The given function is $I = 50 \times t$.

Putting $t = 0, 1, 2, 3$ successively in the function, we find the corresponding value of I as given in the table.

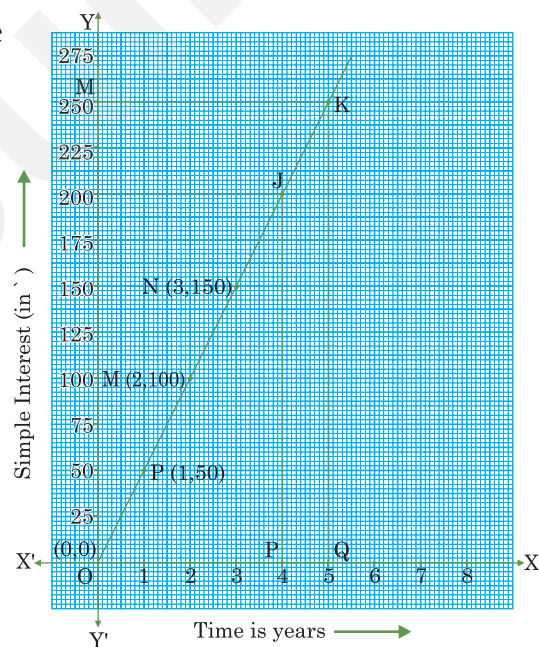
t	0	1	2	3
$I = 50t$	0	50	100	150

- (ii) Let us choose scale as under. Along the X-axis: 1 small square = 1 unit.

Along the Y-axis: 1 small square = 25 units.

Now, on a graph paper, plot the points $O (0, 0)$, $L (1, 50)$, $M (2, 100)$ and $N (3, 150)$ and join them successively.

We get the required graph as shown along side.



- (iii) On the X-axis, take the point J at $t = 4$.
Draw $PJ \perp$ X-axis, meeting the graph at J . Clearly, $PJ = 200$ units.

$$\therefore t = 4 \text{ years} \Rightarrow I = ₹ 200.$$

Thus, when $t = 4$ years, then $I = ₹ 200$

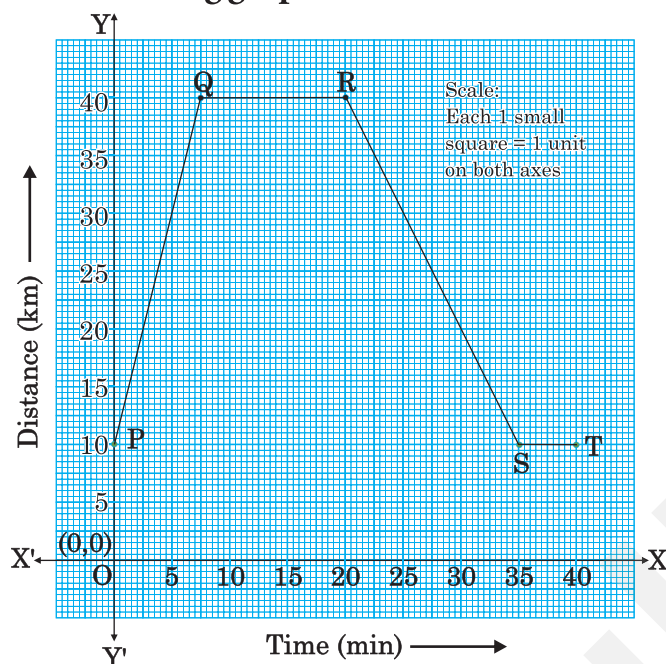
- (iv) On the Y-axis, take the point M at $I = ₹ 250$.

Draw $QK \perp$ X-axis, meeting the graph at K . Clearly, $QK = 5$ years.

$$\therefore I = ₹ 250 \Rightarrow t = 5 \text{ years}.$$

Thus, when $I = ₹ 250$, time period = 5 years.

Example 6: Observe the following graph:



- (i) What is the speed of the object in 10th minute?
- (ii) When is the speed of the object zero?
- (iii) Calculate speed of the object during 0–5 min.

Solution:

$$(i) \text{ Speed} = \frac{\text{Change in distance in 10th minute}}{\text{One minute}} = \frac{0}{1} = 0$$

Thus, speed is zero.

- (ii) Speed of the object is zero between 10th and 20th minutes, and between 35th and 40th minutes. Therefore, distance covered is zero in these time periods.

$$(iii) \text{ Speed} = \frac{\text{Total distance}}{\text{Total time}} \\ = \frac{40 - 10}{10} = \frac{30}{10}$$

\therefore Speed = 3 km/min.

Exercise 13.2

1. (i) Draw the graph of the function $A = s^2$.
- (ii) From the graph, find the value of A, when :
 - (a) $s = 2$
 - (b) $s = 3$
 - (c) $s = 4$

2. Copy and complete the table of values of each equation. Hence draw the respective graphs:

(i) $x = y + 8$

x				
y	0	3	5	-2

(ii) $y = x - 4$

x	2	5	-6	-4
y				

3. (i) Draw the graph of the function $y = 4x$.

(ii) From the graph, find the value of y , when :

(a) $x = 2$

(b) $x = -2$

(c) $x = 3$

4. The graph given below shows the number of books sold by a shopkeeper between the month February to June.

(i) In which month was the sale of books highest?

(ii) In which month was the sale of books minimum?

(iii) How many books were sold in the different months?



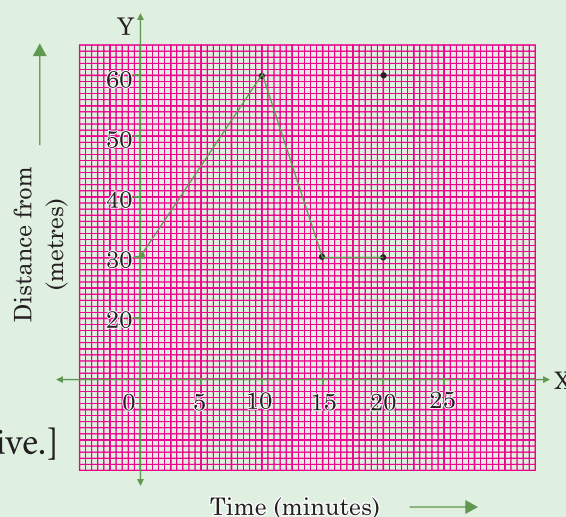
5. In the following distance-time graph of a body, find:

(i) Speed between 0 to 5 minutes.

(ii) At what time interval speed is zero?

(iii) At what time, the speed is highest?

(iv) Total distance travelled by the body in 20 minutes.

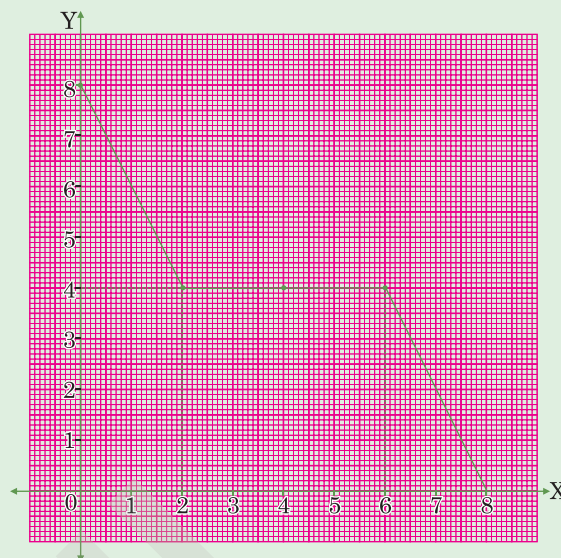


[Hint: Consider all distances whether positive or negative.]

6. Study the following graph carefully and answer the following questions :

Find:

- Change in y when x changes from 0 to 2.
- Change in y when x changes from 2 to 6.
- Change in y when x changes from 6 to 8.



7. Interest on deposits for a year is given in the following table:

Deposit (in ₹)	1,000	2,000	3,000	4,000	5,000
Simple Interest (in ₹)	90	180	270	360	450

Draw the graph for the above table. Now, answer the following questions:

- Does the graph pass through the origin ?
 - Use the graph to find the interest on ₹ 3,500 for a year.
8. Draw the graph between simple interest versus time on amount of ₹10,000 at rate of interest 10% per annum.
9. The area A of a triangle of base b units, height h units is $\frac{1}{2} \times b \times h$ square units. If the base is held constant at 15 cm, graph the relationship between A and h .

Skills covered: Evaluation skills, analytical skills, problem solving skills, numeracy skills

Revision Exercise

A. Tick (✓) the correct option:

- The ordinate of the point $(6, 2)$ is _____
 (a) 0 (b) 6 (c) 2 (d) none
- The abscissa of the point $(-3, 5)$ is _____
 (a) -3 (b) 5 (c) -15 (d) none
- The point $(3, 0)$ lies on the _____
 (a) I quadrant (b) II quadrant (c) x -axis (d) y -axis

Conceptual Learning



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- (iv) The point (0, 5) lies on the _____
 (a) x -axis (b) y -axis (c) both axes (d) none
- (v) Do the points (2, 3) and (3, 2) have same location on the graph?
 (a) Sometimes (b) No (c) Yes (d) none
- (vi) (0, y) are the co-ordinates of a point lying on which of the following?
 (a) origin (b) x -axis (c) y -axis (d) none of these.

B. Fill in the blanks:

- (i) The coordinate of the origin are _____
- (ii) (0, 3) lies on the _____
- (iii) (3, 0) lies on the _____
- (iv) (-1, 2) lies in the _____ quadrant.
- (v) x -coordinate is called _____
- (vi) y -coordinate is called _____
- (vii) A cartesian plane is divided into _____ quadrants.

C. Consider the formula $D = 5t$, where D is variable for the distance that a shuttle travelled in ' t ' seconds of time:

- (i) Use the formula to complete the table of values given below:

t (in sec.)	0	1	2	3	4			10
D (in metre)	0	5				25	35	

- (ii) Draw graph of the formula $D = 5t$, choosing the horizontal axis as the t -axis.
- (iii) From the above graph, find the distance covered by the shuttle in 5 seconds and 7 seconds.
- (iv) Using the graph find the time taken by the shuttle in covering a distance of 15 metres and 45 metres.

