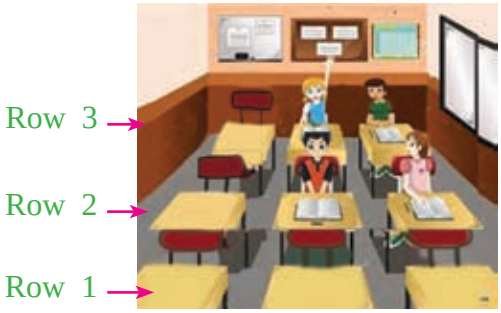
23 Cartesian Plane

By studying this lesson you will be able to

- identify what a Cartesian plane is,
- identify a point on a Cartesian plane by its coordinates, and
- plot a point on a Cartesian plane when its coordinates are given.

23.1 Identifying a location

The locations of several students seated in a classroom are shown in the figure. Let us describe the location of each of the students.



Location of several students

Location		Name of the student
Column	Row	
3	3	Nimal
2	2	Sesath
3	2	Mala
2	3	Mayuri

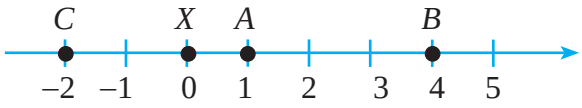
Mayuri's location is in the 3rd row of the 2nd column.
You may observe, as indicated in the table, that the location of each of the students in the classroom can be indicated exactly, in a similar manner.

Now let us see how the location of a point can be determined with respect to a fixed point.

• Location of a point with respect to a fixed point

A fixed point on a straight line is indicated as X.

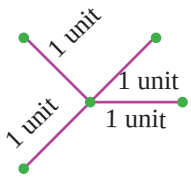
Considering point X as 0 (zero), number the straight line as a number line. Now, with respect to the point X, we can represent any point on the line by a number.



Accordingly, with respect to the point X, the positions of the points A, B and C can be represented by the numbers 1, 4 and – 2 r espectively.

Points A and B are located to the right of point X, at a distance of 1 unit and 4 units respectively from X. Point C is located to the left of point X, at a distance of 2 units from X.

There are many points on a plane which are at a distance of 1 unit from a fixed point on the plane. Therefore, it is not possible to exactly determine the location of a point at a distance of 1 unit from a particular point on a plane, using only one number line.

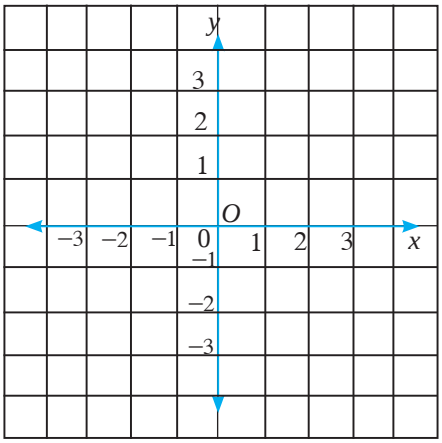


In 1637, Rene Descartes (1596 AD – 1650 AD) of French origin presented a method of representing the exact location of a point on a plane using a grid. Such a grid is called a **Cartesian plane.**


Rene Descartes

23.2 Cartesian plane

A Cartesian plane is shown in the figure.

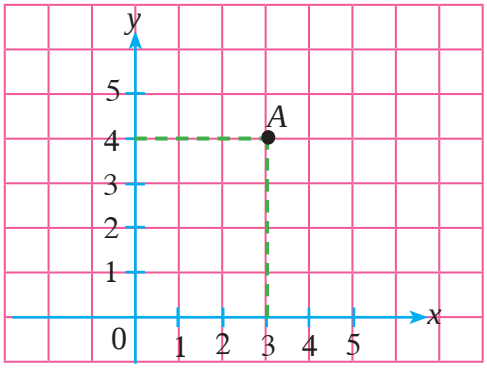


- O is a fixed point on this Cartesian plane.
- Here, two number lines intersect perpendicularly at point O.
- The number zero of each number line is positioned at point O. It is called the **origin**.
- As indicated in the figure, one number line is called the ***x*-axis** and the other number line is called the ***y*-axis**.
- Any point on the plane can be exactly identified by two numbers based on point O.
- These two numbers are called the **coordinates** of that point.

23.3 Identifying a point on a Cartesian plane by its coordinates

A is a point on the given Cartesian plane.

Let us see how the point A on the Cartesian plane can be exactly identified by two numbers.



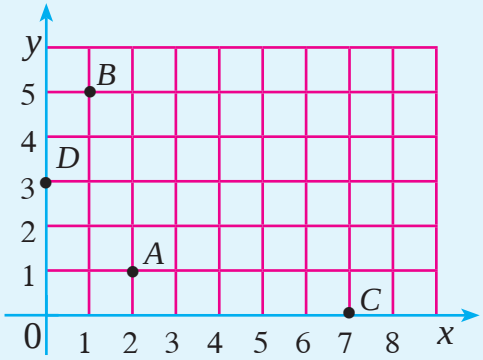
The line drawn from point A which is perpendicular to the x - axis, meets the x - axis at 3. The line drawn from point A which is perpendicular to the y - axis, meets the y-axis at 4.

Accordingly, the x - coordinate of the point A is defined as 3 and the y - coordinate of A is defined as 4. The coordinates of A are written as (3, 4) by writing the x - coordinate first and the y-coordinate second, within brackets. This is written in short as $A(3,4)$.

Accordingly, the coordinates of the origin O are (0, 0).

Example 1

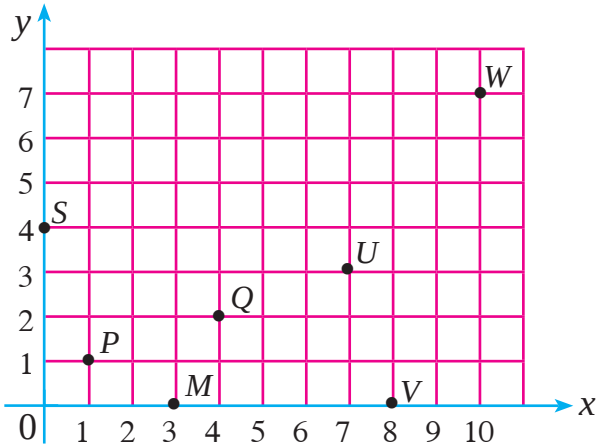
Write down the coordinates of the points on the given cartesian plane as ordered pairs.



Point	x - coordinate	y - coordinate	Coordinates
A	2	1	(2,1)
B	1	5	(1,5)
C	7	0	(7,0)
D	0	3	(0,3)

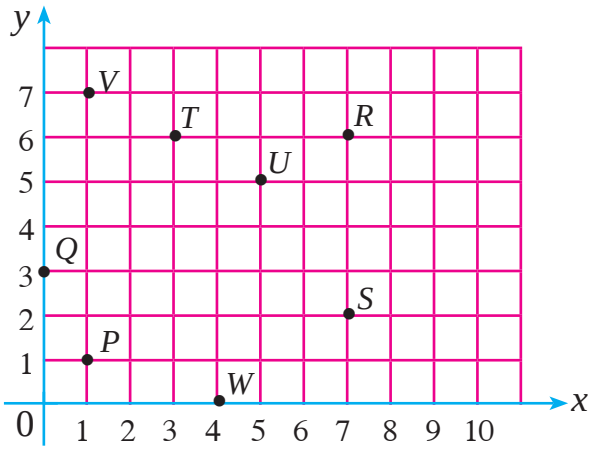
Exercise 23.1

(1) Copy the given table in your book and complete it based on the coordinates of the points represented on the Cartesian plane.

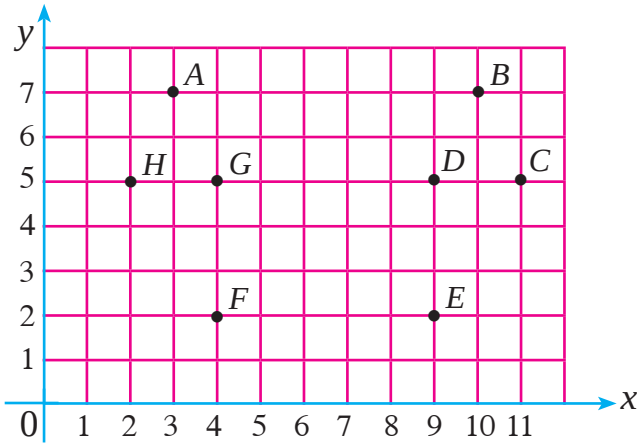


Point	x - coordinate	y - coordinate	Coordinates	Name of the point with its coordinates
P	1	1	(1,1)	P (1,1)
Q				
S				
V				
U				
W				
M				

(2) Write down the coordinates of the points on the given Cartesian plane.



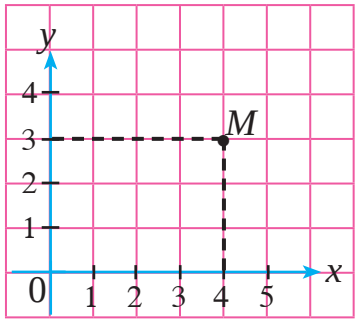
(3) Write down the coordinates of the points on the given Cartesian plane.



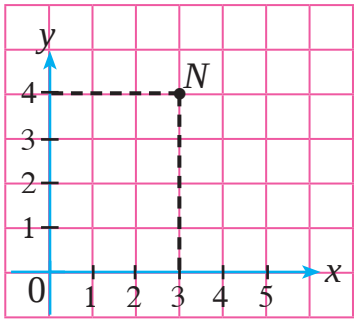
23.4 Plotting points on a Cartesian plane

Let us see how the point M (4, 3) is plotted on a cartesian plane. From the origin O, move 4 units to the right along the x - axis, and from there, move 3 units upwards parallel to the y - axis and then mark M.

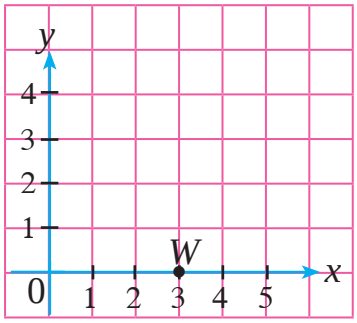
(i) Plotting the point M (4,3)



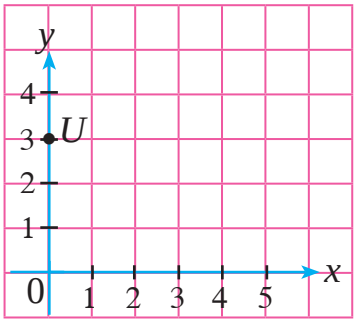
(ii) Plotting the point N (3,4)



(iii) Plotting the point W (3,0)



(iv) Plotting the point U (0,3)



- The coordinates of a point with y - coordinate zero, i.e., a point on the x - axis, is of the form $(x, 0)$.
- The coordinates of a point with x - coordinate zero, i.e., a point on the y - axis, is of the form $(0, y)$.
- The coordinates of the point with the x and y - coordinates both equal to zero is (0, 0). This point is the origin.

Exercise 23.2

(1) Draw a suitable Cartesian plane and plot the following points.
A (2, 5), B (4, 3), C (2, 1), D (0, 6), E (3, 6), F (7, 0)

(2) Plot the following points on a Cartesian plane and join them with straight line segments in the order of the letters and return to the starting point.

(i) A (1, 7), B (2, 1), C (5, 5), D (8, 1), E (9, 7)

(ii) A (5, 1), B (5, 3), C (0, 5), D (0, 6), E (5, 4), F (5, 5), G (10, 5), H (10, 1)

(iii) A (1, 4), B (0, 4), C (0, 7), D (1, 7), E (1, 6), F (7, 6), G (7, 7), H (10, 7), I (10, 4), J (7, 4), K (7, 5), L (1, 5)

(3) Shanuka says that "the vertices of a square are positioned at P (2, 2), Q (2, 7), R (7, 7), S (7, 2)". Plot these points on a cartesian plane and verify the validity of the above statement.

(4) Draw a Cartesian plane and plot four points such that the x - coordinate and y - coordinate values of each point are equal to each other. Write down the coordinates of the four points.

(5) (i) Plot the points given below on a Cartesian plane and join them in the order of the letters with straight line segments.
A (4, 1), B (4, 2), C (4, 3), D (4, 4)

(ii) Extend the line that is obtained.

(iii) Write the coordinates of two other points on this line.

(6) (i) Plot the points given below on a Cartesian plane and join them in the order of the letters with straight line segments.
P (2, 3), Q (4, 3), R (6, 3), S (7, 3)

(ii) Extend the line that is obtained.

(iii) Write the coordinates of two other points on this line.

Summary

- Any point on a Cartesian plane can be denoted by an ordered pair (x, y).
- The number denoted by x is called the x - coordinate and the number denoted by y is called the y - coordinate of the point (x, y).