CHAPTER 4: Linear Equations iin two variables

Exercise 4.1

Question 1: The cost of a notebook is twice the cost of a pen. Write a linear equation in two variables to represent this statement. (Take the cost of a notebook to be ` *x* and that of a pen to be ` *y*).

Answer: Let the cost of a notebook = Rs. x and the cost of a pen = Rs. y
According to the condition, we have [Cost of a notebook] =2 x [Cost of a pen] i. e„
(x) = 2 x (y) or, x = 2y
or, x – 2y = 0
Thus, the required linear equation is x – 2y = 0.

Question 2: Express the following linear equations in the form *ax* + *by* + *c* = 0 and indicate the values of *a*, *b* and *c* in each case:

i) $2x+3y=9.3\overline{5}$ ii) $x-\frac{y}{5}-10=0$ iii) $-2x+3y=6$ iv) $x=3y$
v) $2x=-5y$ vi) $3x+2=0$ vii) $y-2=0$ viii) $5=2x$

Answer: (i) We have 2x + 3y = $9.\overline{35}$
or (2)x + (3)y + ($-9.\overline{35}$) = 0
Now, comparing it with ax + by +c= 0, we geta = 2,
b = 3 and c= – $9.\overline{35}$

(ii) We have x$-\frac{y}{5}-$10=0
or x + (- $\frac{1}{5}$) y + (10) = 0
Now comparing it with ax + by + c = 0, we get a =1, b =- 15 and c= -10

(iii) We have -2x + 3y = 6 or (-2)x + (3)y + (-6) = 0
Now comparing it with ax + by + c = 0,we get a = -2, b = 3 and c = -6.

(iv) We have x = 3y or (1)x + (-3)y + (0) = 0
Now comparing it with ax + by + c = 0, we get a = 1, b = -3 and c = 0.

(v) We have 2x = -5y or (2)x + (5)y + (0) = 0
Now comparing it with ax + by + c = 0, we get a = 2, b = 5 and c = 0.

(vi) We have 3x + 2 = 0 or (3)x + (0)y + (2) = 0
Now comparing it with ax + by + c = 0, we get a = 3, b = 0 and c = 2.

(vii) We have y – 2 = 0 or (0)x + (1)y + (-2) = 0 Comparing it with ax + by + c = 0, we get a = 0, b = 1 and c = -2.

(viii) We have 5 = 2x ⇒ 5 – 2x = 0
or -2x + 0y + 5 = 0
or (-2)x + (0)y + (5) = 0
Now comparing it with ax + by + c = 0, we get a = -2, b = 0 and c = 5.

Exercise 4.2

Question 1: Which one of the following options is true, and why?
$y + 3x$ has
i.) a unique solution ii) only two solutions iii) infinitely many solutions

Answer: The given option (iii) is true as,
for every value of x, we get a corresponding value of y and vice-versa in the given equation. Hence, the given linear equation has infinitely many solutions.

Question 2: Write four solutions for each of the following equations:
i) $2x + y = 7$ ii) $\pi x + y = 9$ iii) $x = 4y$

Answer: (i) 2x + y = 7
When x = 0,
2(0) + y = 7
⇒ y = 7
therefore, Solution is (0, 7)
When x =1,
2(1) + y = 7
⇒ y = 7 – 2
⇒ y = 5
therefore, Solution is (1, 5)
When x = 2,
2(2) + y =7y = 7 – 4
⇒ y = 3
therefore, Solution is (2, 3)
When x = 3,
2(3) + y = 7y = 7 – 6
⇒ y = 1
therefore., Solution is (3, 1).

(ii) πx + y = 9
When x = 0,
π(0) + y = 9
⇒ y = 9 – 0
⇒ y = 9
therefore, Solution is (0, 9)
When x = 1,
π(1) + y = 9
⇒ y = 9 – π
therefore, Solution is (1, (9 – π))
When x = 2,

π(2) + y = 9
⇒ y = 9 – 2π
therefore. Solution is (2, (9 – 2π))
When x = -1,
π(-1) + y = 9
⇒ y = 9 + π
therefore, Solution is (-1, (9 + π))

(iii) x = 4y
When x = 0,
4y = 1
⇒ y = 0
therefore, Solution is (0, 0)
When x = 1,
4y = 1
⇒ y = 14
therefore, Solution is (1,14)
When x = 4,
4y = 4
⇒ y = 1
therefore, Solution is (4, 1)
When x = 4,
4y = 4
⇒ y = -1
therefore, Solution is (-4, -1)

Question 3: Check which of the following are solutions of the equation *x* – 2*y* = 4 and which are not:
i) (0, 2) **ii) (2, 0)** **iii) (4, 0)**
iv) $(\sqrt{2}, 4\sqrt{2})$ **v) (1, 1)**

Answer: (i) (0,2) means x = 0 and y = 2
Putting x = 0 and y = 2 in x – 2y = 4, we get
L.H.S. = 0 – 2(2) = -4.
But R.H.S. = 4
therefore, L.H.S. ≠ R.H.S.
therefore, x =0, y =2 is not a solution.

(ii) (2, 0) means x = 2 and y = 0
Putting x = 2 and y = 0 in x – 2y = 4, we get
L.H:S. 2 – 2(0) = 2 – 0 = 2.
But R.H.S. = 4
therefore, L.H.S. ≠ R.H.S.
thus, (2,0) is not a solution.

(iii) (4, 0) means x = 4 and y = 0
Putting x = 4 and y = o in x – 2y = 4, we get
L.H.S. = 4 – 2(0) = 4 – 0 = 4 =R.H.S.

therefore L.H.S. = R.H.S.
therefore (4, 0) is a solution.

(iv) (√2, 4√2) means x = √2 and y = 4√2
Putting x = √2 and y = 4√2 in x – 2y = 4, we get
L.H.S. = √2 – 2(4√2) = √2 – 8√2 = -7√2
But R.H.S. = 4
therefore L.H.S. ≠ R.H.S.
therefore (√2 , 4√2) is not a solution.

(v) (1, 1)means x =1 and y = 1
Putting x = 1 and y = 1 in x – 2y = 4, we get
LH.S. = 1 – 2(1) = 1 – 2 = -1. But R.H.S = 4
therefore LH.S. ≠ R.H.S.
therefore (1, 1) is not a solution.

Question 4: Find the value of *k*, if *x* = 2, *y* = 1 is a solution of the equation 2*x* + 3*y* = *k*.

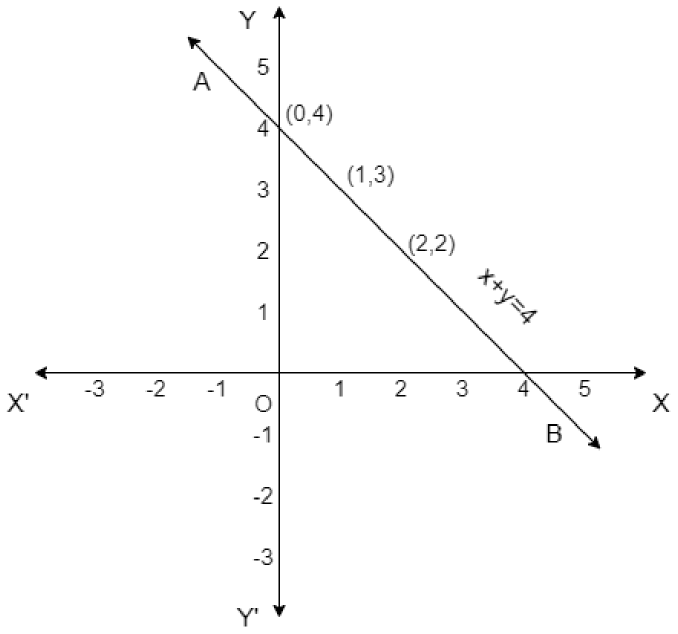
Answer: We have 2x + 3y = k
putting x = 2 and y = 1 in 2x+3y = k, we get
2(2) + 3(1) ⇒ k = 4 + 3 – k ⇒ 7 = k
Thus, the required value of k is 7.

Exercise 4.3

Question 1: Draw the graph of each of the following linear equations in two variables:
i) $x + y = 4$ ii) $x - y = 2$ iii) $y = 3x$ iv) $3 = 2x + y$

Answer: (i) x + y = 4
or, y = 4 – x
If we have x = 0, then y = 4 – 0 = 4
x = 1, then y =4 – 1 = 3
x = 2, then y = 4 – 2 = 2
therefore,

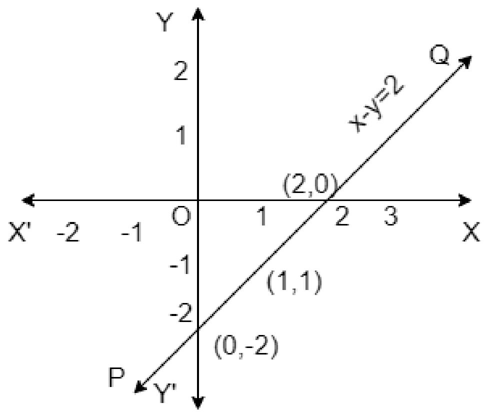
x	**0**	**1**	**2**
Y	**4**	**3**	**2**



Thus, the line AB is the required graph of x + y = 4

ii) x – y = 2
or, y = x – 2
If we have x = 0, then y = 0 – 2 = -2
x = 1, then y = 1 – 2 = -1
x = 2, then y = 2 – 2 = 0
therefore,

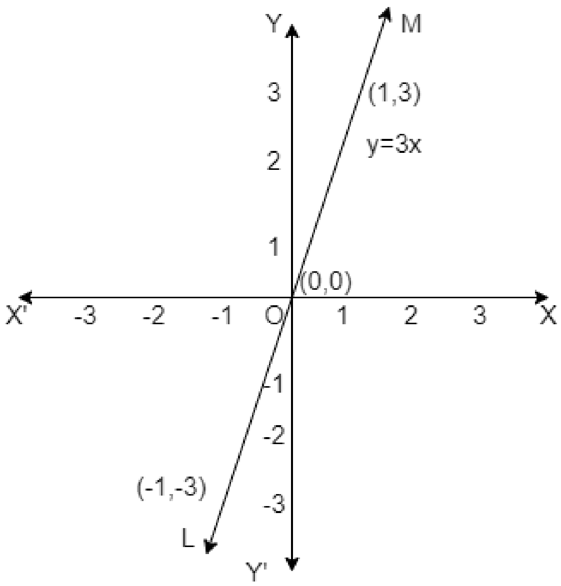
x	0	1	2
y	-2	-1	0



Thus, the line is the required graph of x – y = 2

iii) $y = 3x$
If we have $x = 0$,
then $y = 3(0) \Rightarrow y = 0$
$x = 1$, then $y = 3(1) = 3$
$x= -1$, then $y = 3(-1) = -3$
therefore,

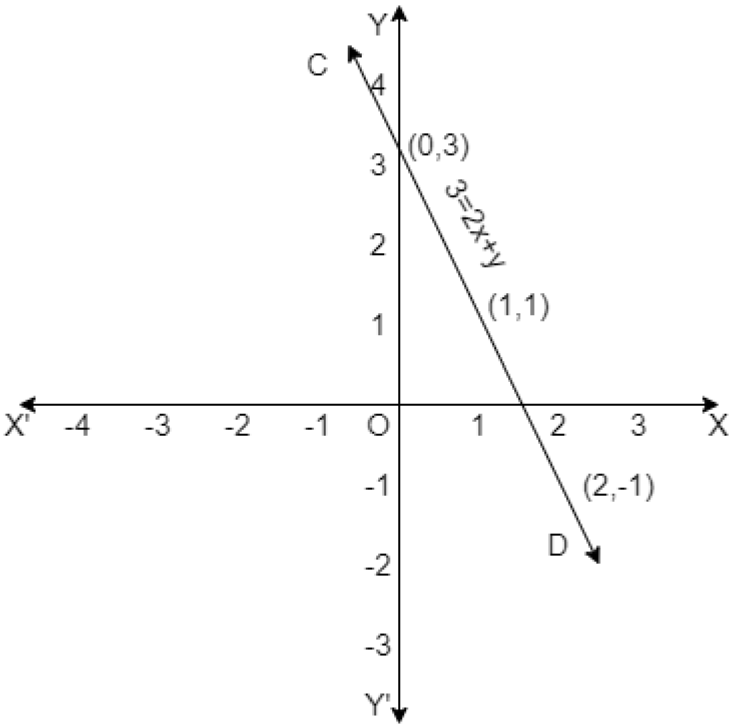
X	0	1	-1
y	0	3	-3



Thus, the line LM is the required graph of $y = 3x$

iv) $3 = 2x + y$
or, $y = 3 – 2x$
If we have $x = 0$, then $y = 3 – 2(0) = 3$
$x = 1$,then $y = 3 – 2(1) = 3 – 2 = 1$
$x = 2$,then $y = 3 – 2(2) = 3 – 4 = -1$
therefore,

x	0	1	2
y	3	1	-1



Thus, the line CD is the required graph of 3 = 2x + y

Question 2: Give the equations of two lines passing through (2, 14). How many more such lines are there, and why?

Answer: (2, 14) means x = 2 and y = 14
Equations which have (2,14) as the solution are (i) x + y = 16, (ii) 7x – y = 0
There are infinite number of lines which passes through the point (2, 14), because infinite number of lines can be drawn through a point.

Question 3: If the point (3, 4) lies on the graph of the equation 3*y* = *ax* + 7, find the value of *a*.
Answer: The equation of the given line is 3y = ax + 7
since, (3, 4) lies on the given line.
therefore, It must satisfy the equation 3y = ax + 7
We have, (3, 4) i.e., x = 3 and y = 4.
Putting these values in given equation, we get
3 × 4 = 3a + 7
or, 12 = 3a + 7
or, 3a = 12 – 7 = 5
or, a = $\frac{5}{3}$
Thus, the required value of a is $\frac{5}{3}$.

Question 4: The taxi fare in a city is as follows: For the first kilometre, the fare is Rs.8 and for the subsequent distance it is Rs. 5 per km. Taking the distance covered as *x* km and total fare as Rs. *y*, write a linear equation for this information, and draw its graph.

Answer: Here, given the total distance covered = x km and total taxi fare = Rs. y

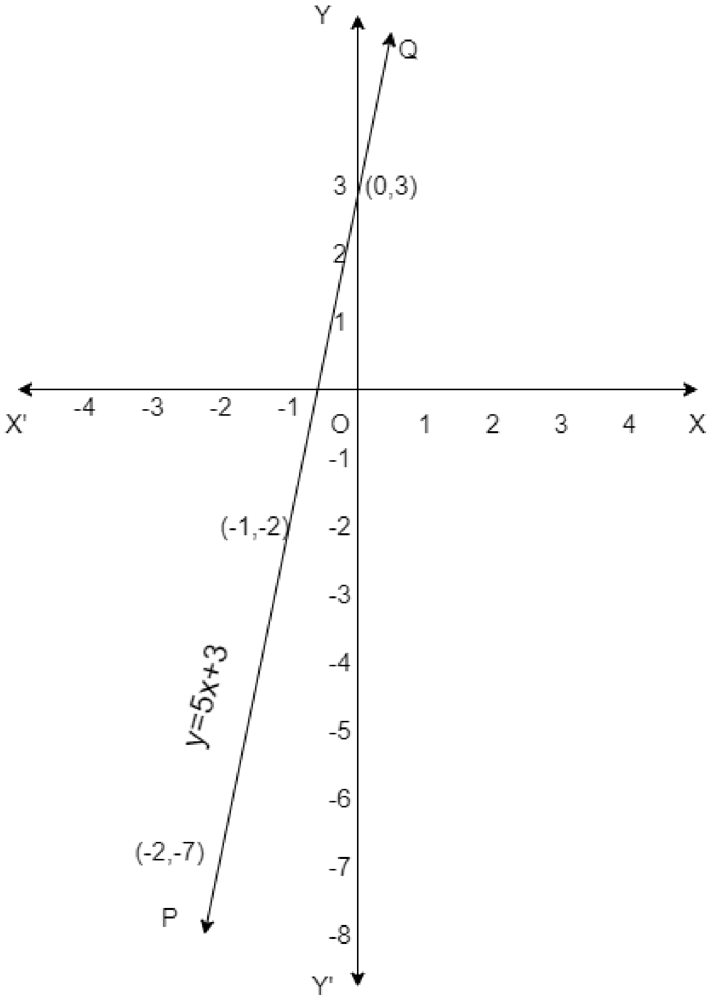
Then fare for 1km = Rs. 8
Hence the remaining distance = (x – 1) km

Therefore, fare for (x – 1)km = Rs.5 x(x – 1)
Total taxi fare = Rs. 8 + Rs. 5(x – 1)

According to the given question,
$y = 8 + 5(x - 1)$
or, $y = 8 + 5x - 5$
or, $y = 5x + 3$, which is the required linear equation representing the given information.

So for the Graph: We have $y = 5x + 3$
When $x = 0$, then $y = 5(0) + 3$ or, $y = 3$
$x = -1$, then $y = 5(-1) + 3$ or, $y = -2$
$x = -2$, then $y = 5(-2) + 3$ or, $y = -7$

x	0	-1	-2
y	3	-2	-7



Thus, the line PQ is the required graph of the linear equation y = 5x + 3.

Question 5: From the choices given below, choose the equation whose graphs are given in Fig. 4.6 and Fig. 4.7.

For figure 4.6

i) $y = x$

ii) $x + y = 0$

iii) $y = 2x$

iv) $2 + 3y = 7x$

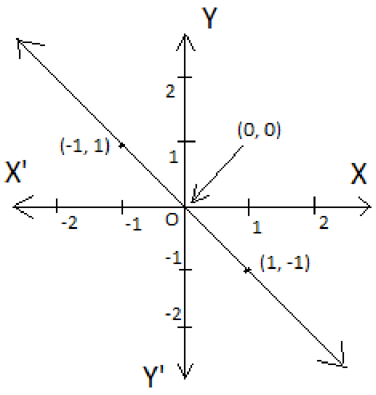
For figure 4.7

i) $y = x + 2$

ii) $y = x - 2$

iii) $y = -x + 2$

iv) $x + 2y = 6$



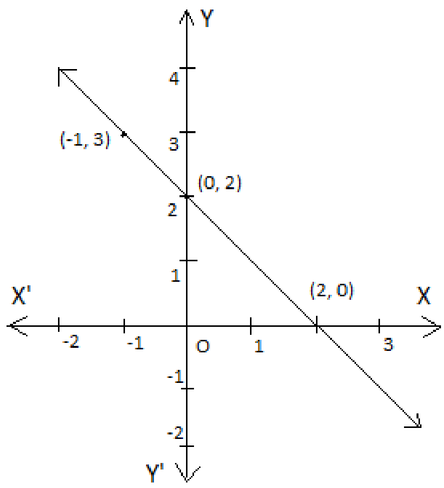


Fig. 4.6 **Fig. 4.7**

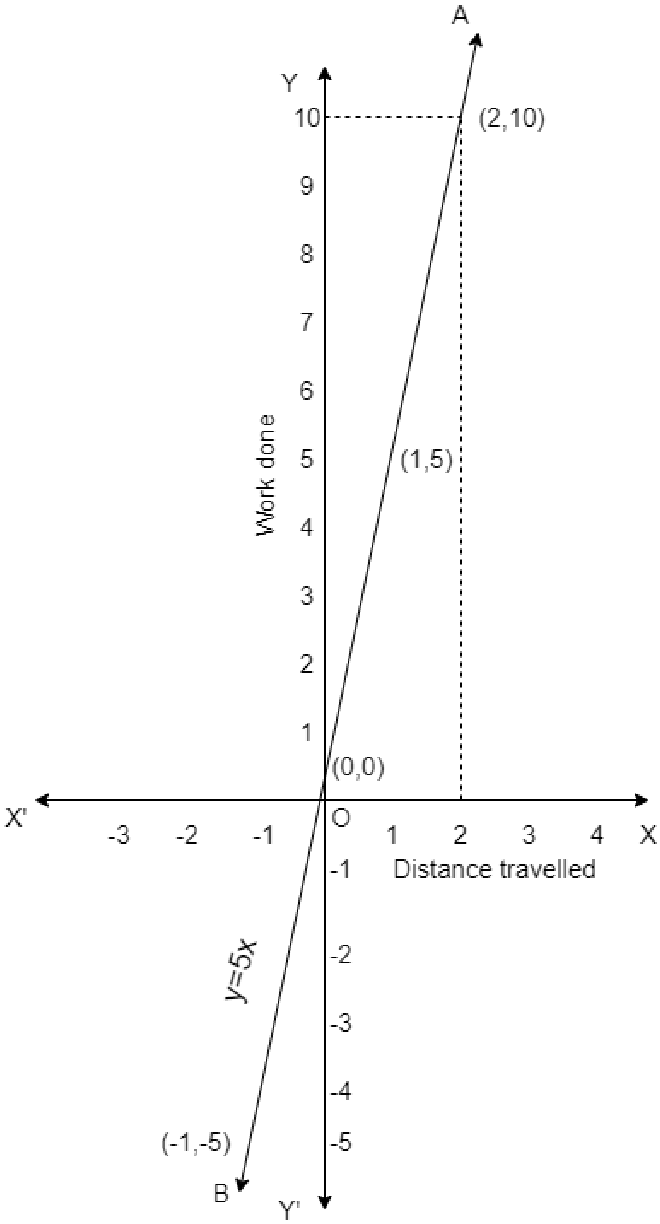
Answer: For Fig. (4.6),
the correct linear equation is x + y = 0 [As (-1, 1) = -1 + 1 = 0 and (1,-1) = 1 + (-1) = 0]

For Fig.(4.7), the correct linear equation is y = -x + 2
[As(-1,3) 3 = -1(-1) + 2 = 3 = 3 and (0,2) or, 2 = -(0) + 2 or, 2 = 2]

Question 6: If the work done by a body on application of a constant force is directly proportional to the distance travelled by the body, express this in the form of an equation in two variables and draw the graph of the same by taking the constant force as 5 units. Also read from the graph the work done when the distance travelled by the body is
i) 2 units ii) 0 unit

Answer: The given constant force is 5 units.
Let the distance travelled = x units and work done = y units.
Work done = Force x Distance
or, y = 5 x x
or, y = 5x
For the graph, we have y = 5x
When x = 0, then y = 5(0) = 0
x = 1, then y = 5(1) = 5
x = -1, then y = 5(-1) = -5

x	0	1	-1
y	0	5	-5



From the above graph, we get
(i) Distance travelled = 2 units i.e., x = 2
therefore, If x = 2, then y = 5(2) = 10
hence, Work done = 10 units.

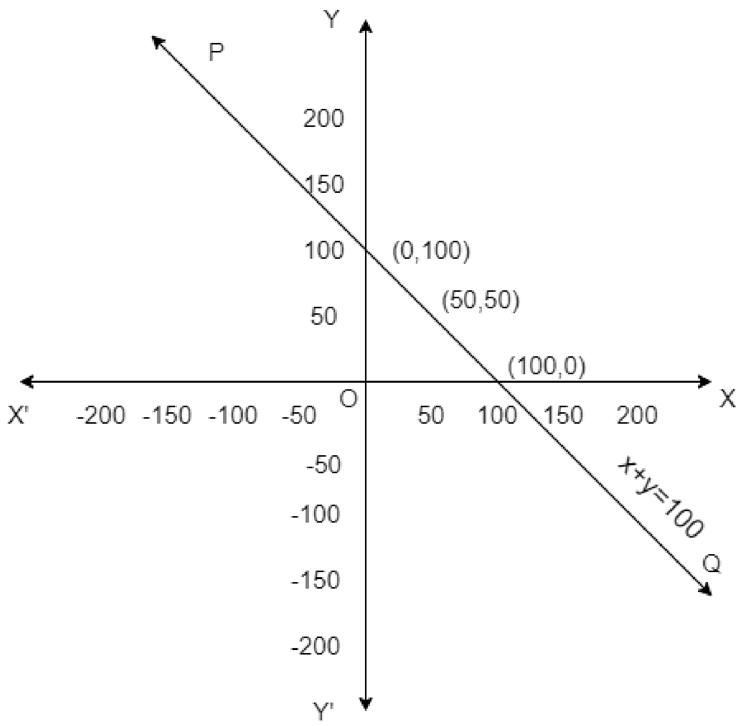
(ii) Distance travelled = 0 unit i.e., x = 0
therefore, If x = 0 ⇒ y = 5(0) – 0
hence, Work done = 0 unit.

Question 7: Yamini and Fatima, two students of Class IX of a school, together contributed Rs. 100 towards the Prime Minister's Relief Fund to help the

earthquake victims. Write a linear equation which satisfies this data. (You may take their contributions as Rs. *x* and Rs. *y*.) Draw the graph of the same.

Answer: Let the contribution of Yamini = Rs. x and Fatima's is Rs. y
therefore, We have x + y = 100
or, y = 100 – x
Now, when x = 0, y = 100 – 0 = 100
x = 50, y = 100 – 50 = 50
x = 100, y = 100 – 100 = 0

x	0	50	100
y	100	50	0



Thus, the line PQ is the required graph of the linear equation x + y = 100.

Question 8: In countries like USA and Canada, temperature is measured in Fahrenheit, whereas in countries like India, it is measured in Celsius. Here is a linear equation that converts Fahrenheit to Celsius:

$$F = \frac{9}{5}C + 32$$

i) Draw the graph of the linear equation above using Celsius for *x*-axis and Fahrenheit for *y*-axis.
ii) If the temperature is 30°C, what is the temperature in Fahrenheit?
iii) If the temperature is 95°F, what is the temperature in Celsius?
iv) If the temperature is 0°C, what is the temperature in Fahrenheit and if the temperature is 0°F, what is the temperature in Celsius?
v) Is there a temperature which is numerically the same in both Fahrenheit and Celsius? If yes, find it.

Answer: i) We have

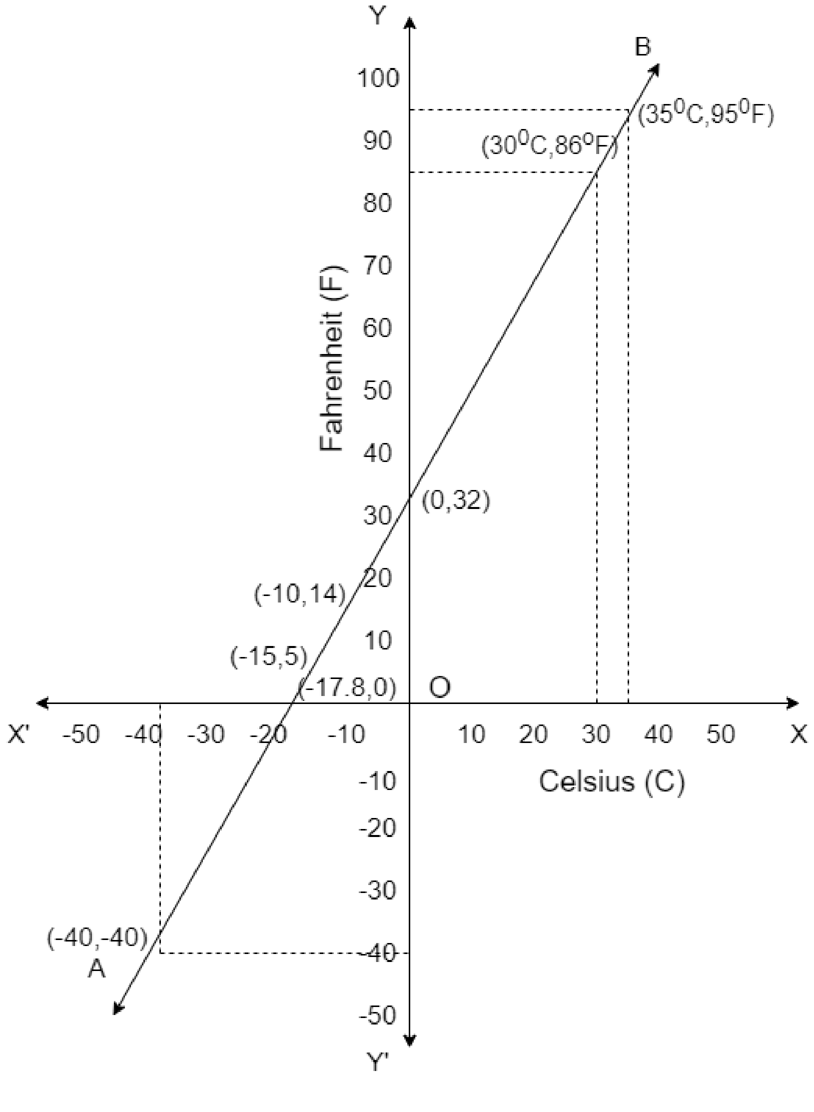
F = ($\frac{9}{5}$)C + 32

When C = 0, F = ($\frac{9}{5}$) x 0 + 32 = 32 ………………………………………….(1)

When C = 15, F = ($\frac{9}{5}$)(-15) + 32= -27 + 32 = 5

When C = -10, F = $\frac{9}{5}$ (-10)+32 = -18 + 32 = 14

C	0	-15	-10
F	32	5	14



(ii) From the graph, we have 86°F corresponds to 30°C.

(iii) From the graph, we have 95°F corresponds 35°C.

(iv) We have, C = 0

From (1), we get

F = ($\frac{9}{5}$)0 + 32 = 32

Also, F = 0

From (1), we get

$0 = (\frac{9}{5})C + 32$

Or, $\frac{-32\times5}{9} = C$

or, $C = -17.8$

(v) When F = C (numerically)

From (1), we get

$F = \frac{9}{5}F + 32$

or, $F - \frac{9}{5}F = 32$

or, $-\frac{4}{5}F = 32$

or, $F = -40$

therefore, Temperature is – 40° both in F and C.

Exercise 4.4

Question 1: Give the geometric representations of *y* = 3 as an equation
i) in one variable
ii) in two variables

Answer: (i) y = 3

As, y = 3 is an equation in one variable, i.e., y only.

therefore, y = 3 is a unique solution on the number line.

(ii) y = 3

We can write y = 3 in two variables as $0 \times x + y = 3$

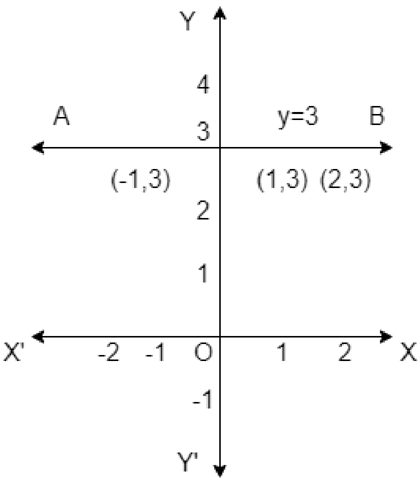
Now, when x = 1, y = 3

x = 2, y = 3

x = -1, y = 3

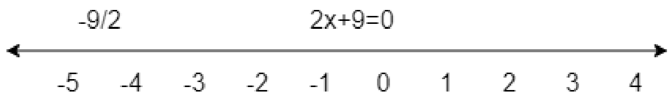
x	1	2	-1
y	3	3	3

So, whatever the value of x be, y will always be 3.



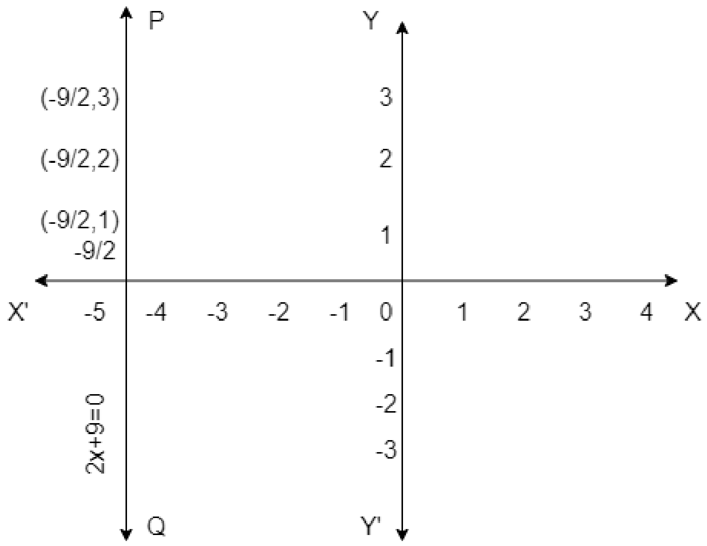
Question 2: Give the geometric representations of 2*x* + 9 = 0 as an equation
i) in one variable
ii in two variables

Answer: (i) $2x + 9 = 0$
We have, $2x + 9 = 0$
or, $2x = -9$
or, $x = -\frac{9}{2}$ which is a linear equation in one variable i.e., x only.
Therefore, $x = -\frac{9}{2}$ is a unique solution on the number line.



(ii) $2x + 9 = 0$
We can write $2x + 9 = 0$ in two variables as $2x + 0, y + 9 = 0$
or $x = \frac{-9-0\times y}{2}$
therefore, when $y = 1$, $x = \frac{-9-0(1)}{2} = -\frac{9}{2}$
when, $y = 2$, $x = \frac{-9-0(2)}{2} = -\frac{9}{2}$
when, $y = 3$, $x = \frac{-9-0(3)}{2} = -\frac{9}{2}$

x	$-\frac{9}{2}$	$-\frac{9}{2}$	$-\frac{9}{2}$
y	1	2	3


P
Y
(-9/2,3)
3
(-9/2,2)
2
(-9/2,1)
1
-9/2
X'
-5
-4
-3
-2
-1
0
1
2
3
4
X
-1
-2
-3
2x+9=0
Q
Y'