

If  $a, b$  and  $r$  are real number (and if  $a$  and  $b$  are not both equal to 0) then  $ax+by=r$  is called a linear equation in two variables. (The two variables are the  $x$  and the  $y$ ) The numbers  $a$  and  $b$  are called the coefficient of the equation  $ax+by=r$ . The number  $r$  is called the constant of the equation  $ax+by=r$ .

## Exercise: 4.1

Q1 The cost of a notebook is twice the cost of a pen. Write a linear equation in two variables to represent this statement.

Sol:  $\rightarrow$  Cost of a notebook  $= x$

Cost of a pen  $= y$

Then according to given statement

$$x = 2y \text{ or } x - 2y = 0$$

Q2 Express the following linear equation in the form  $ax+bx+c=0$  and indicate the values of  $a, b$  and  $c$  in each case.

i)  $2x + 3y = 9.35$

Sol:  $\rightarrow$  ~~on~~  $2x + 3y - 9.35 = 0$

on comparing with linear equation  $ax+bx+c=0$  we get

So,  $a = 2, b = 3, c = -9.35$

ii)  $x - \frac{y}{5} - 10 = 0$

Sol:  $\rightarrow a = 1, b = -\frac{1}{5}, c = -10$

iii)  $-2x + 3y = 6$

Sol  $-2x + 3y - 6 = 0$

$\therefore a = -2, b = +3, c = -6$

$$\text{iv) } x = 3y$$

$$\text{Sol } x - 3y = 0$$

$$\therefore a = 1, b = -3, c = 0$$

$$\text{v) } 2x = -5y$$

$$\text{Sol } 2x + 5y = 0$$

$$\therefore a = 2, b = 5, c = 0$$

$$\text{vi) } 3x + 2 = 0$$

$$\text{Sol } 3x + 2 = 0$$

$$\Rightarrow 3x + 0y + 2 = 0$$

$$\text{So } a = 3, b = 0, c = 2$$

$$\text{vii) } y - 2 = 0$$

$$\text{Sol } y - 2 = 0$$

$$\Rightarrow 0x + 1y - 2 = 0$$

$$\text{So } a = 0, b = 1, c = -2$$

$$\text{viii) } 5 = 2x$$

$$\text{Sol } 5 - 2x = 0$$

$$\Rightarrow -2x + 0y + 5 = 0$$

$$\text{So, } a = -2, b = 0, c = 5$$

Q1. Which one of the following option is true, and why?  
 $y = 3x + 5$  has

- (i) a unique solution
- (ii) only two solutions
- (iii) infinitely many solutions

Sol. (iii) infinitely many solutions. It is because a linear equation in two variables has infinitely many solutions. We keep changing the value of  $x$  and solve the linear equation for the corresponding value of  $y$

$$\begin{aligned} \text{as for } x=1 \quad y &= 3(1) + 5 = 8 \\ x=2 \quad y &= 3(2) + 5 = 11 \\ x=3 \quad y &= 3(3) + 5 = 14 \end{aligned}$$

Q2 Write four solutions for each of the following equations

(i)  $2x + y = 7$

Sol As  $2x + y = 7$   
 $y = 7 - 2x$

Now Let  $x = 1$   
 then  $y = 7 - 2(1) = 5$   
 $\therefore (1, 5)$  is a solution.

ii) Let  $x = 2$

Then  $y = 7 - 2(2) = 7 - 4 = 3$   
 $\therefore (2, 3)$  is another solution

iii) Let  $x = 3$

Then  $y = 7 - 2(3) = 7 - 6 = 1$   
 $\Rightarrow (3, 1)$  is another solution

iv) Let  $x = 4$

Then  $y = 7 - 2(4) = 7 - 8 = -1$   
 $\Rightarrow (4, -1)$  is another solution.

Therefore,  $(1, 5)$ ,  $(2, 3)$ ,  $(3, 1)$  and  $(4, -1)$  are all solutions of  $2x + y = 7$

$$(2) \pi x + y = 9$$

Solution :  $\rightarrow$  As  $\pi x + y = 9$

$$\therefore y = 9 - \pi x$$

i) Let  $x = \frac{1}{\pi}$

$$\text{Then } y = 9 - \pi\left(\frac{1}{\pi}\right) = 9 - 1 = 8$$

$\therefore \left(\frac{1}{\pi}, 8\right)$  is a solution

ii)  $x = \frac{2}{\pi}$

$$\text{Then } y = 9 - \pi\left(\frac{2}{\pi}\right) = 9 - 2 = 7$$

$\therefore \left(\frac{2}{\pi}, 7\right)$  is a solution

iii) Let  $x = \frac{3}{\pi}$

$$\text{Then } y = 9 - \pi\left(\frac{3}{\pi}\right) = 9 - 3 = 6$$

$\therefore \left(\frac{3}{\pi}, 6\right)$  is a solution

iv) Let  $x = \frac{4}{\pi}$

$$\text{Then } y = 9 - \pi\left(\frac{4}{\pi}\right)$$

$$= 9 - 4$$

$$= 5$$

$\therefore \left(\frac{4}{\pi}, 5\right)$  is a solution.

Therefore  $\left(\frac{1}{\pi}, 8\right), \left(\frac{2}{\pi}, 7\right),$

$\left(\frac{3}{\pi}, 6\right)$  and  $\left(\frac{4}{\pi}, 5\right)$  are

all solutions of the equations

$$\pi x + y = 9$$

$$3) x = 4y$$

Sol Let  $y = 2$

$$\text{Then } x = 4(2) = 8 \quad \therefore (8, 2) \text{ is a solution.}$$

$$\text{Let } y = 3$$

$$\therefore x = 4(3) = 12 \quad \therefore (12, 3) \text{ is a solution.}$$

$$\text{Let } y = 4$$

$$\therefore x = 4(4) = 16 \quad \therefore (16, 4) \text{ is a solution.}$$

$$\text{Let } y = 5$$

$$\therefore x = 4(5) = 20 \quad \therefore (20, 5) \text{ is a solution}$$

Therefore  $(8, 2), (12, 3), (16, 4)$  and  $(20, 5)$  are all solutions of  $x = 4y$



Q3 Check which of the following are solutions of the equation  $x-2y=4$  and which are not:

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- (i) 0, 2      (ii) (2, 0)      (iii) (4, 0)      (iv)  $(\sqrt{2}, 4\sqrt{2})$       (v) (1, 1)

Sol:  $\rightarrow x-2y=4$

i) When  $x=0$ ,  $y=2$ , then

$$0-2(2) \Rightarrow 0-4=4$$

$$\Rightarrow -4=4$$

$\Rightarrow$  R.H.S  $\neq$  L.H.S. Therefore, it is not a solution.

ii) When  $x=$  ,  $y=0$

$$-2 \times 0 = 4$$

$2-0=4 \Rightarrow$  RHS  $\neq$  L.H.S. Therefore, it is not a solution.

iii) When  $x=4$ ,  $y=0$

$$4-2 \times 0 = 4$$

$\Rightarrow 4-0=4 \Rightarrow 4=4 \Rightarrow$  R.H.S = L.H.S. Therefore, it is a solution

iv)  $x=\sqrt{2}$ ,  $y=4\sqrt{2}$

$$\text{then } \sqrt{2}-2(4\sqrt{2})$$

$\Rightarrow \sqrt{2}-8\sqrt{2}=4$ , L.H.S  $\neq$  R.H.S. Therefore, it is not a

solution

v) When  $x=1$ ,  $y=1$

$$\text{then } 1-2(1)=4$$

$$\Rightarrow 1-2=4 \Rightarrow -1=4, \text{ L.H.S } \neq \text{ R.H.S}$$

Therefore (1, 1) is not a solution.

Q4 Find the value of  $k$ , if  $x=2$ ,  $y=1$  is a solution of equation  $2x+3y=k$

Sol:  $\rightarrow x=2$ ,  $y=1$  is a solution of  $2x+3y=k$

Thus,  $2 \times 2 + 3 \times 1 = k$

$\Rightarrow 4 + 3 = k$

$\Rightarrow \boxed{k=7}$

### Exercise 4.3

Q1 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)  $3=2x+y$

Sol i)  $\rightarrow x+y=4$

For  $x=0$ ,  $y=4$

For  $x=1$ ,  $y=3$

ii)  $x-y=2$

for  $\boxed{x=0}$

$0-y=2$

$\Rightarrow \boxed{y=-2}$

For  $\boxed{x=1}$

$1-y=2$

$\Rightarrow -y=+1$

$\Rightarrow \boxed{y=-1}$

So, we have the points  $(0,-2)$  and  $(1,-1)$

iii)  $y=3x$

When  $x=0$ , then  $y=0$

$x=1$  then  $y=3$

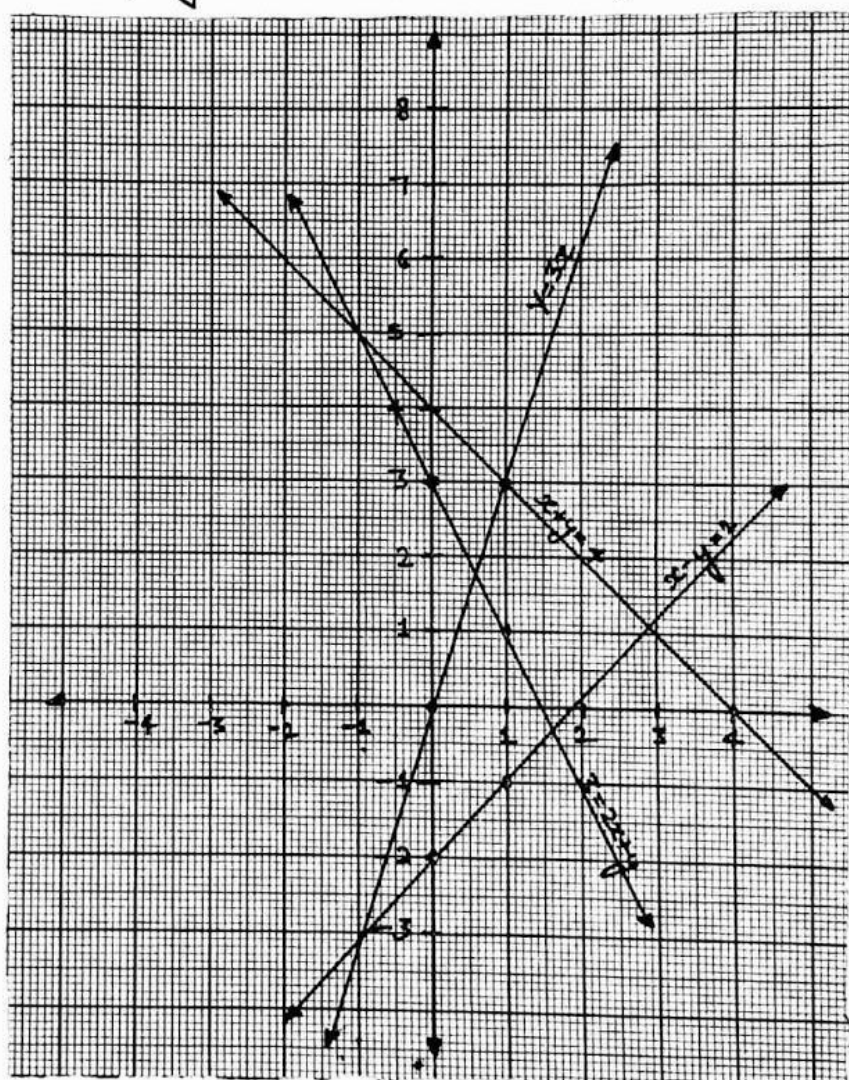
So, we have the points  $(0,0)$  and  $(1,3)$

iv)  $3=2x+y \Rightarrow \boxed{y=3-2x}$

When  $x=0 \Rightarrow y=3-2(0)=3-0 \Rightarrow \boxed{y=3}$

"  $x=1 \Rightarrow y=3-2(1)=3-2 \Rightarrow \boxed{y=1}$

So we have the points  $(0,3)$  and  $(1,1)$





Q2 Give the equations of two lines passing through (2,14). How many more such lines are there, and why?

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Sol:  $\rightarrow$  Let  $x+y=k$  be such a line

$$\text{then } 2+14=k$$

$$\Rightarrow \boxed{k=16}$$

$\therefore x+y=16$  passes through (2,14)

Let  $2x+3y=k'$  be another line through (2,14)

$$2 \times 2 + 3 \times 14 = k'$$

$$\Rightarrow k' = 4 + 42$$

$$\Rightarrow \boxed{k' = 46}$$

$\Rightarrow 2x+3y=46$  passes through (2,14)

There are infinitely many such lines, as through a point infinite number of straight line can be drawn.

Q3 If the point (3,4) lies on the graph of the equation  $3y = ax+7$ , find the value of  $a$ .

Sol:  $\rightarrow$  (3,4) lies on  $3y = ax+7$

Therefore, substituting 3 for  $x$  and 4 for  $y$  in the above equation, we have

$$3 \times 4 = a \times 3 + 7$$

$$\Rightarrow 12 = 3a + 7$$

$$\Rightarrow 3a = 12 - 7$$

$$\Rightarrow \boxed{a = \frac{5}{3}}$$

Q4 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.

Sol:  $\rightarrow$  Total fare

$$y = 1 \times 8 + (x-1)5$$

= Where  $x$  is in km

and  $y$  in Rs. So, the required equation is  $y = 5(x-1) + 8$

Now, for  $x = 1$

$$y = 5(1-1) + 8$$

$$y = 0 + 8$$

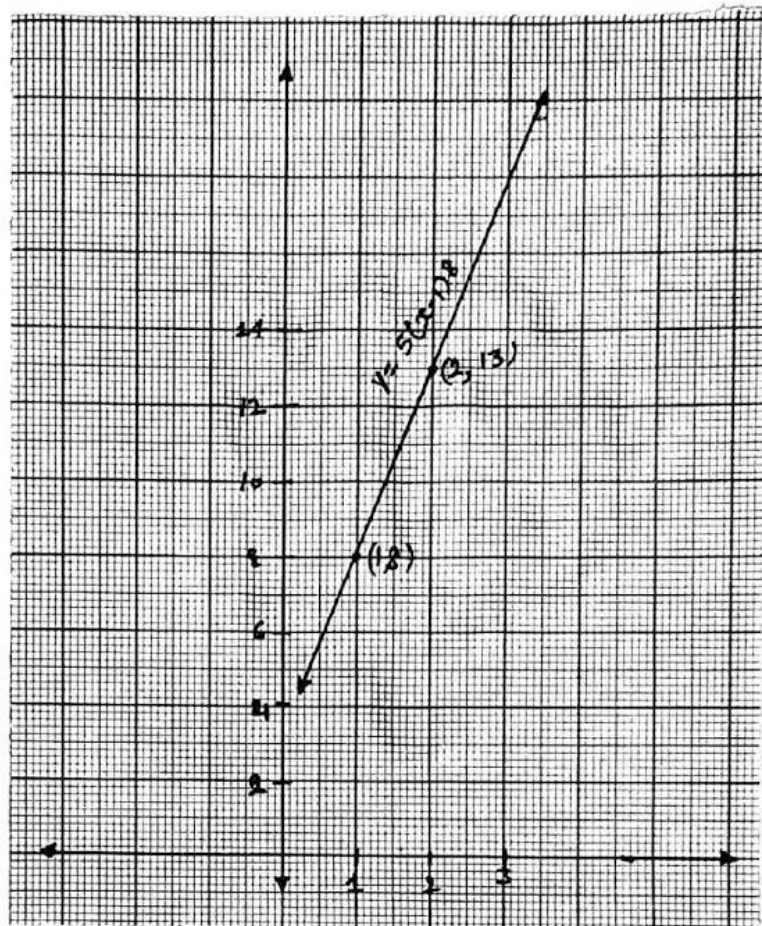
$$\Rightarrow \boxed{y = 8}$$

for  $x = 2$

$$y = 5(2-1) + 8$$

$$y = 5 + 8$$

$$\Rightarrow \boxed{y = 13}$$



So, the points are  $(1, 8)$  and  $(2, 13)$

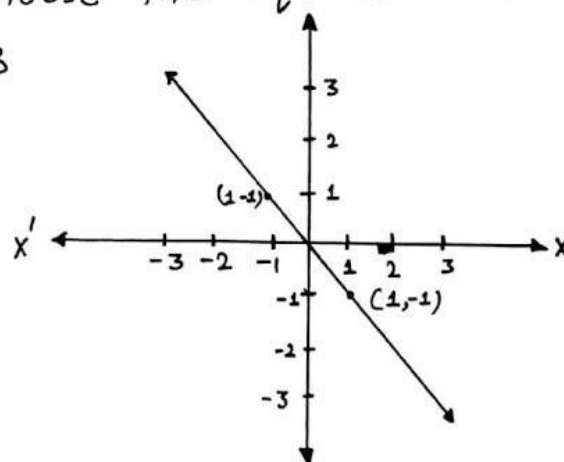
Q5 From the choices given below, choose the equation whose graph are given in Fig A and Fig B

i)  $y = x$

ii)  $x + y = 0$

iii)  $y = 2x$

iv)  $2 + 3y = 7x$



From figure A

$x + y = 0$ . This can be verified by putting

$$x = 1, y = -1$$

$$\text{in } x + y = 0$$



For Fig B

i)  $y = x + 2$

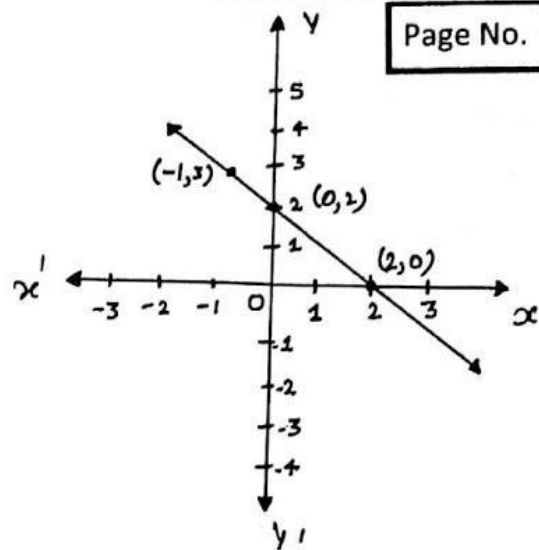
ii)  $y = x - 2$

iii)  $y = -x + 2$

iv)  $x + 2y = 6$

From fig B

iii)  $y = -x + 2$  is the right equation. This can be verified by putting  $x = -1$ ,  $y = 3$  in  $y = -x + 2$



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Q6 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 units.

Sol:  $\rightarrow$  Let  $y =$  work done.

$F =$  constant force  $= 5$

$x =$  distance travelled.

then  $y = 5x$

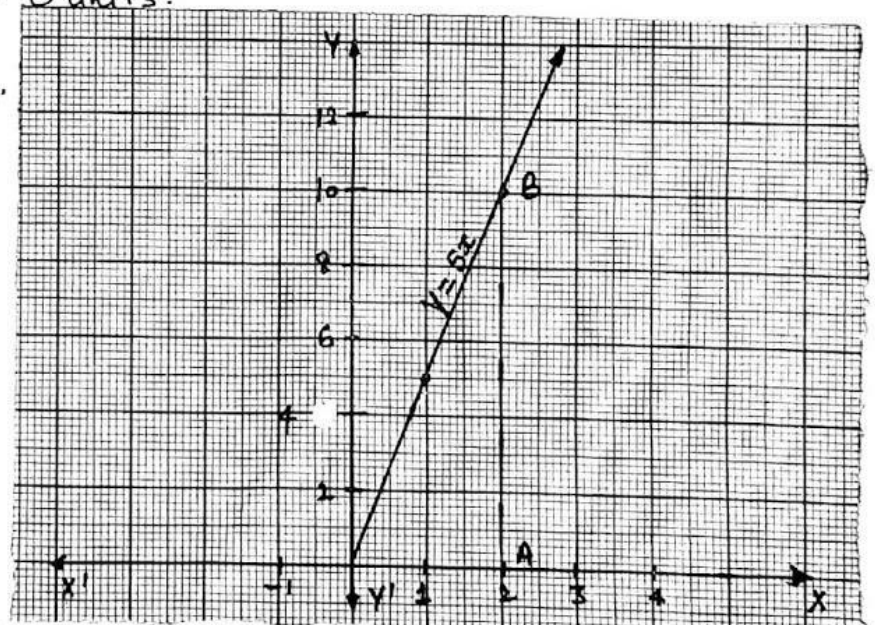
For  $x = 0$ ,  $y = 0$

$x = 1$ ,  $y = 5$

$x = 2$ ,  $y = 10$

$x = 3$ ,  $y = 15$

$x = 4$ ,  $y = 20$



i) Let A represent  $x = 2$ . The  $x$ -axis. From A, draw  $AB \perp x$ -axis, meeting the graph at B. From B, draw  $BC \perp y$ -axis, meeting  $y$ -axis at C. The ordinate of C is 10

So, when the distance travelled is 24 units. The work done.

ii) For  $x = 0$ ,  $y = 0$ . From the graph.

Q7 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

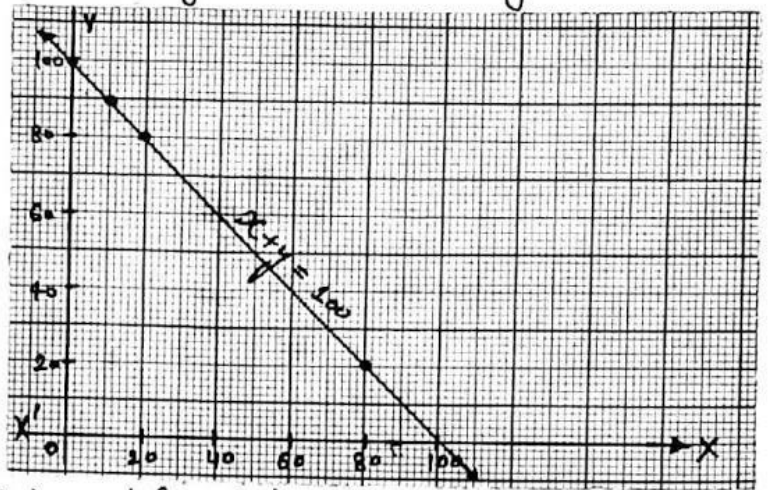
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Sol  $x + y = 100$  is the linear equation satisfying the given data as  $y = 100 - x$

$$\text{For } x = 0, y = 100$$

$$x = 10, y = 90$$

$$x = 20, y = 80$$



So the points are  $(0, 100)$ ,  $(10, 90)$  and  $(20, 80)$

Q8: → 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:

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

i) Draw the graph of the linear equation above using Celsius for  $x$ -axis and Fahrenheit for  $y$ -axis [www.ndtutition.com](http://www.ndtutition.com)

Sol: →  $F = \left(\frac{9}{5}\right)C + 32$

i) For  $C = 0$ ,  $F = 32$  i.e.  $F = \left(\frac{9}{5}\right)0 + 32 \Rightarrow \boxed{F = 32}$

For  $C = 5$ ,  $F = \left(\frac{9}{5}\right)5 + 32 \Rightarrow F = 9 + 32 \Rightarrow \boxed{F = 41}$

For  $C = 10$ ,  $F = \left(\frac{9}{5}\right)10 + 32 \Rightarrow F = 18 + 32 \Rightarrow \boxed{F = 50}$

ii) For  $30^\circ\text{C}$  corresponding Fahrenheit temperature is  $86^\circ\text{F}$

$$F = \left(\frac{9}{5}\right)30 + 32 \Rightarrow F = 54 + 32 \Rightarrow \boxed{F = 86^\circ\text{F}}$$



iii) If the temperature is  $95^{\circ}\text{F}$ . What is the temp in celcius

Sol For  $F = 95$

$$95 = \left(\frac{9}{5}\right)C + 32$$

$$\Rightarrow 95 - 32 = \left(\frac{9}{5}\right)C$$

$$\Rightarrow \left(\frac{9}{5}\right)C = 63$$

$$\Rightarrow C = \frac{63 \times 5}{9} \Rightarrow \boxed{C = 35^{\circ}\text{C}}$$

iv) If the temperature is  $0^{\circ}\text{C}$ , what is the temperature in Fahrenheit and if the temperature is  $0^{\circ}\text{F}$  what is the temperature in Celcius.

Sol  $\rightarrow$  For  $C = 0^{\circ}$

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

$$\therefore \boxed{F = 32^{\circ}\text{F}}$$

For  $F = 0$

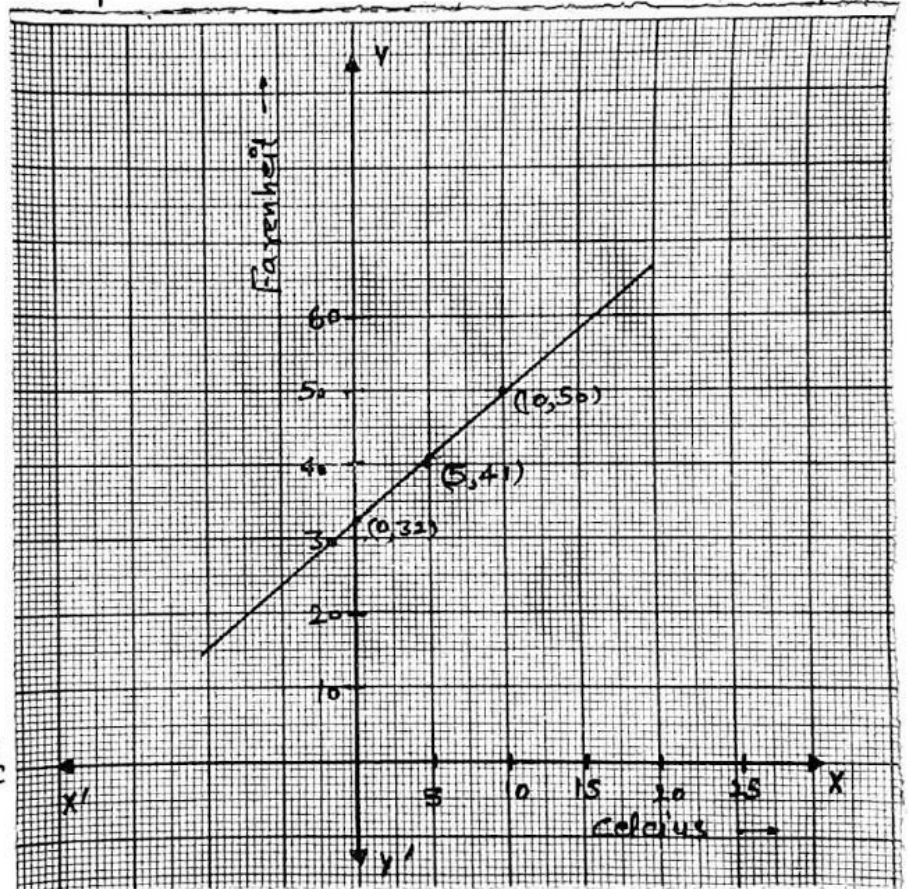
$$0 = \left(\frac{9}{5}\right)C + 32$$

$$\Rightarrow \frac{9}{5}C = -32$$

$$C = \frac{-32 \times 5}{9}$$

$$\Rightarrow C = \frac{-160}{9} = -17.8^{\circ}\text{C}$$

$$\Rightarrow \boxed{C = -17.8^{\circ}\text{C}}$$



v) Is there a temperature which is numerically the same in both Fahrenheit and Celsius? If yes find it

Sol  $\rightarrow$  Let  $F = x$ ,  $C = x$

$$\text{Then, } x = \left(\frac{9}{5}\right)x + 32$$



$$\Rightarrow x - \frac{9}{5}x = 32$$

$$\Rightarrow x \left(1 - \frac{9}{5}\right) = 32$$

$$\Rightarrow x \left(-\frac{4}{5}\right) = 32$$

$$\Rightarrow x = \frac{-32 \times 5}{4}$$

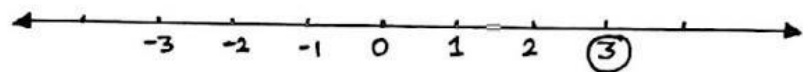
$$\Rightarrow \boxed{x = -40^\circ\text{C}}$$
 Thus  $-40^\circ\text{C}$  and  $-40^\circ\text{F}$  are equal temperature

### Exercise 4.4

Q1 Give the geometrical representation of  $y=3$  as an equation  
i) in one variable ii) two variables

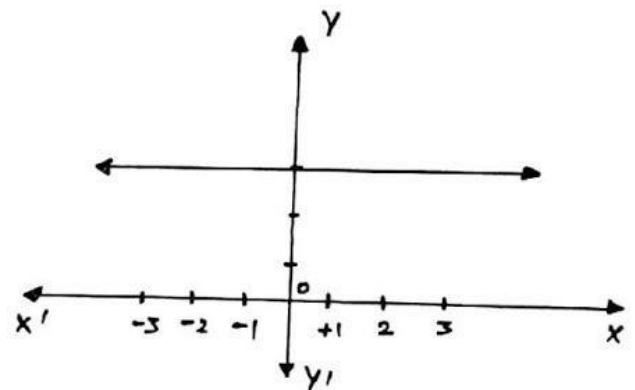
Sol:  $\rightarrow y=3$

i) As an equation in one variable, it is the number 3 on the number line.



ii) As an equation in two variables, it can be written as  
 $0x + y = 3$

Value of  $x$  can be any number but of  $y$  will continue to be 3. It is a line parallel to  $x$ -axis and 3 unit above it.



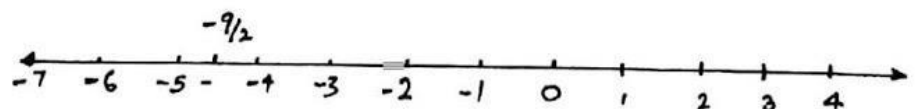
Q2 Give the geometric representation of  $2x+9=0$  as an equation  
-ion i) in one variable ii) in two variables.

i) Sol:  $\rightarrow$  As an equation in one variable

$$2x + 9 = 0$$

$$\Rightarrow 2x = -9$$

$$\Rightarrow x = -\frac{9}{2}$$



ii)  $2x + 0 \cdot y + 9 = 0$  is an equation in two variables.  
Value of  $y$  can be any number but  $x$  remains  $-\frac{9}{2}$

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It is a line parallel to  $y$ -axis and  $\frac{9}{2}$   
units to the left of 0

