Updated On 11-02-2025 By Lithanya

NCERT Solutions Class 10 Maths: Chapter 3 - Pair of Linear Equations in Two Variables

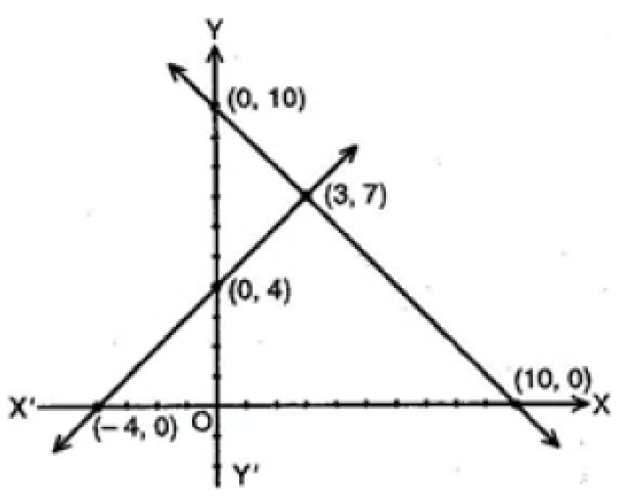
Ex 3.1 Question 1.

Form the pair of linear equations in the following problems, and find their solutions graphically.
(i) 10 students of class X took part in a mathematics quiz. If the number of girls is 4 more than the number of boys, find the number of boys and girls who took part in the quiz.
(ii) 5 pencils and 7 pens together cost Rs 50 , whereas 7 pencils and 5 pens together cost Rs. 46. Find the cost of one pencil and that of one pen.

Answer.

(i) Let number of boys who took part in the quiz $= x$
Let number of girls who took part in the quiz $= y$
According to given conditions, we have
$x + y = 10 \ldots$

And, $y = x + 4$
$\Rightarrow x - y = -4 \ldots$



For equation $\mathrm{x} + \mathrm{y} = 10$, we have following points which lie on the line

x	0	10
y	10	0

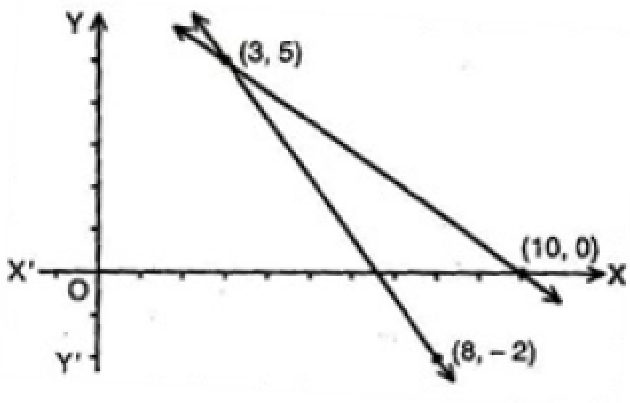
For equation $\mathrm{x} - \mathrm{y} = -4$, we have following points which lie on the line

x	0	– 4
y	4	0

We plot the points for both of the equations to find the solution.
We can clearly see that the intersection point of two lines is $(3, 7)$.
Therefore, number of boys who took park in the quiz $= 3$ and, number of girls who took part in the quiz $= 7$.

(ii) Let cost of one pencil = Rs x and Let cost of one pen = Rs y

According to given conditions, we have
$5x + 7y = 50 \ldots (1)$



$7x + 5y = 46 \ldots (2)$

For equation $5x + 7y = 50$, we have following points which lie on the line

x	10	3
y	0	5

For equation $7x + 5y = 46$, we have following points which lie on the line

x	8	3
y	-2	5

We can clearly see that the intersection point of two lines is $(3, 5)$.
Therefore, cost of pencil $=$ Rs 3 and, cost of pen $=$ Rs 5

Ex 3.1 Question 2.

On comparing the ratios $\frac{a_1}{a_2}, \frac{b_1}{b_2}$ and $\frac{c_1}{c_2}$, find out whether the lines representing the following pairs of linear equations intersect at a point, are parallel or coincide:
(i) $5x - 4y + 8 = 0; \quad 7x + 6y - 9 = 0$
(ii) $9x + 3y + 12 = 0; 18x + 6y + 24 = 0$
(iii) $6x - 3y + 10 = 0; 2x - y + 9 = 0$

Answer.

(i) $5x - 4y + 8 = 0, 7x + 6y - 9 = 0$
Comparing equation $5x - 4y + 8 = 0$ with $a_1x + b_1y + c_1 = 0$ and $7x + 6y - 9 = 0$ with $a_2x + b_2y + c_2 = 0$

We get, $a_1 = 5, b_1 = -4, c_1 = 8, a_2 = 7, b_2 = 6, c_2 = -9$
We have $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ because $\frac{5}{7} \neq \frac{-4}{6}$
Hence, lines have unique solution which means they intersect at one point.
(ii) $9x + 3y + 12 = 0, 18x + 6y + 24 = 0$

Comparing equation $9x + 3y + 12 = 0$ with $a_1x + b_1y + c_1 = 0$ and $18x + 6y + 24 = 0$ with $a_2x + b_2y + c_2 = 0$

We get, $a_1 = 9, b_1 = 3, c_1 = 12, a_2 = 18, b_2 = 6, c_2 = 24$

We have $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ because $\frac{9}{18} = \frac{3}{6} = \frac{12}{24} \Rightarrow \frac{1}{2} = \frac{1}{2} = \frac{1}{2}$
Hence, lines are coincide.
(iii) $6x - 3y + 10 = 0, 2x - y + 9 = 0$

Comparing equation $6x - 3y + 10 = 0$ with $a_1x + b_1y + c_1 = 0$ and $2x - y + 9 = 0$ with $a_2x + b_2y + c_2 = 0$

We get, $a_1 = 6, b_1 = -3, c_1 = 10, a_2 = 2, b_2 = -1, c_2 = 9$
We have $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ because $\frac{6}{2} = \frac{-3}{-1} \neq \frac{10}{9} \Rightarrow \frac{3}{1} = \frac{3}{1} \neq \frac{10}{9}$
Hence, lines are parallel to each other.

Ex 3.1 Question 3.

On comparing the ratios $\frac{a_1}{a_2}, \frac{b_1}{b_2}$ and $\frac{c_1}{c_2}$, find out whether the following pair of linear equations are consistent, or inconsistent.
(i) $3x + 2y = 5, 2x - 3y = 7$
(ii) $2x - 3y = 8, 4x - 6y = 9$
(iii) $\frac{3}{2}x + \frac{5}{3}y = 7, 9x - 10y = 14$
(iv) $5x - 3y = 11, -10x + 6y = -22$
(v) $\frac{4}{3}x + 2y = 8; 2x + 3y = 12$

Answer.

(i) $3x + 2y = 5, 2x - 3y = 7$
Comparing equation $3x + 2y = 5$ with $a_1x + b_1y + c_1 = 0$ and $2x - 3y = 7$ with $a_2x + b_2y + c_2 = 0$

We get, $a_1 = 3, b_1 = 2, c_1 = -5, a_2 = 2, b_2 = -3, c_2 = -7$

$\frac{a_1}{a_2} = \frac{3}{2}$ and $\frac{b_1}{b_2} = \frac{2}{-3}$

Here $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ which means equations have unique solution.

Hence they are consistent.

(ii) $2x - 3y = 8, 4x - 6y = 9$

Comparing equation $2x - 3y = 8$ with $a_1x + b_1y + c_1 = 0$ and $4x - 6y = 9$ with $a_2x + b_2y + c_2 = 0$

We get, $a_1 = 2, b_1 = -3, c_1 = -8, a_2 = 4, b_2 = -6, c_2 = -9$

Here $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ because $\frac{2}{4} = \frac{-3}{-6} \neq \frac{-8}{-9} \Rightarrow \frac{1}{2} = \frac{1}{2} \neq \frac{-8}{-9}$

Therefore, equations have no solution because they are parallel.

Hence, they are inconsistent.

(iii) $\frac{3}{2}x + \frac{5}{3}y = 7, 9x - 10y = 14$

Comparing equation $\frac{3}{2}x + \frac{5}{3}y = 7$ with $a_1x + b_1y + c_1 = 0$ and $9x - 10y = 14$ with $a_2x + b_2y + c_2 = 0$

We get, $a_1 = \frac{3}{2}, b_1 = \frac{5}{3}, c_1 = -7, a_2 = 9, b_2 = -10, c_2 = -14$

$$\frac{a_1}{a_2} = \frac{\frac{3}{2}}{9} = \frac{1}{6} \text{ and } \frac{b_1}{b_2} = \frac{\frac{5}{3}}{-10} = \frac{-1}{6}$$

$$\text{Here } \frac{a_1}{a_2} \neq \frac{b_1}{b_2}$$

Therefore, equations have unique solution.

Hence, they are consistent.

(iv) $5x - 3y = 11, -10x + 6y = -22$

Comparing equation $5x - 3y = 11$ with $a_1x + b_1y + c_1 = 0$ and $-10x + 6y = -22$ with $a_2x + b_2y + c_2 = 0$

We get, $a_1 = 5, b_1 = -3, c_1 = -11, a_2 = -10, b_2 = 6, c_2 = 22$

$\frac{a_1}{a_2} = \frac{5}{-10} = \frac{-1}{2}, \frac{b_1}{b_2} = \frac{-3}{6} = \frac{-1}{2}$ and $\frac{c_1}{c_2} = \frac{-11}{22} = \frac{-1}{2}$

Here $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Therefore, the lines have infinite many solutions.

Hence, they are consistent.

(v) $\frac{4}{3}x + 2y = 8; 2x + 3y = 12$

Comparing equation $\frac{4}{3}x + 2y = 8$ with $a_1x + b_1y + c_1 = 0$ and $2x + 3y = 12$ with $a_2x + b_2y + c_2 = 0$

We get, $a_1 = \frac{4}{3}, b_1 = 2, c_1 = -8, a_2 = 2, b_2 = 3, c_2 = -12$

$\frac{a_1}{a_2} = \frac{\frac{4}{3}}{2} = \frac{2}{3}, \frac{b_1}{b_2} = \frac{2}{3}$ and $\frac{c_1}{c_2} = \frac{8}{12} = \frac{2}{3}$

Here $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Therefore, the lines have infinite many solutions.

Hence, they are consistent.

Ex 3.1 Question 4.

Which of the following pairs of linear equations are consistent/inconsistent? If

consistent, obtain the solution graphically:

(i) $x + y = 5, 2x + 2y = 10$

(ii) $x - y = 8, 3x - 3y = 16$

(iii) $2x + y - 6 = 0, 4x - 2y - 4 = 0$

(iv) $2x - 2y - 2 = 0, 4x - 4y - 5 = 0$

Answer.

(i) $x + y = 5, 2x + 2y = 10$

For equation $\mathrm{x + y = 5}$ we have following points which lie on the line

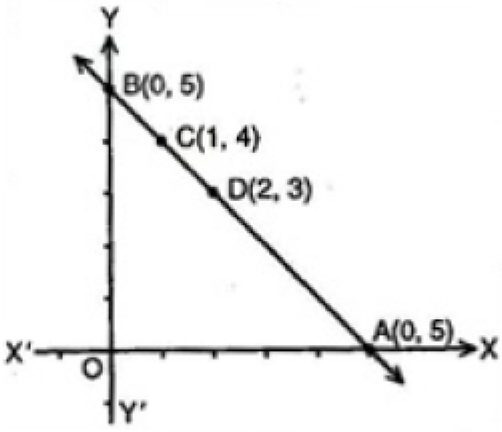
x	0	5
y	5	0

For equation $2x + 2y - 10 = 0$, we have following points which lie on the line

x	1	2
y	4	3

We can see that both of the lines coincide. Hence, there are infinite many solutions. Any point which lies on one line also lies on the other. Hence, by using equation $(x + y - 5 = 0)$, we can say that $x = 5 - y$

We can assume any random values for y and can find the corresponding value of x using the above equation. All such points will lie on both lines and there will be infinite number of such points.



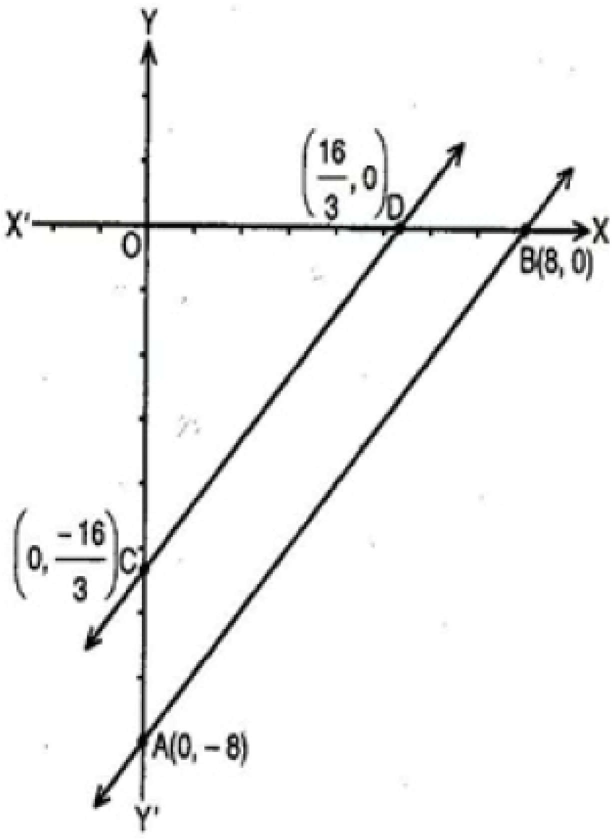
(ii) $x-y=8, 3x-3y=16$

For $x-y=8$, the coordinates are:

x	0	8
y	– 8	0

And for $3x-3y=16$, the coordinates

x	0	$\frac{16}{3}$
y	$\frac{-16}{3}$	0



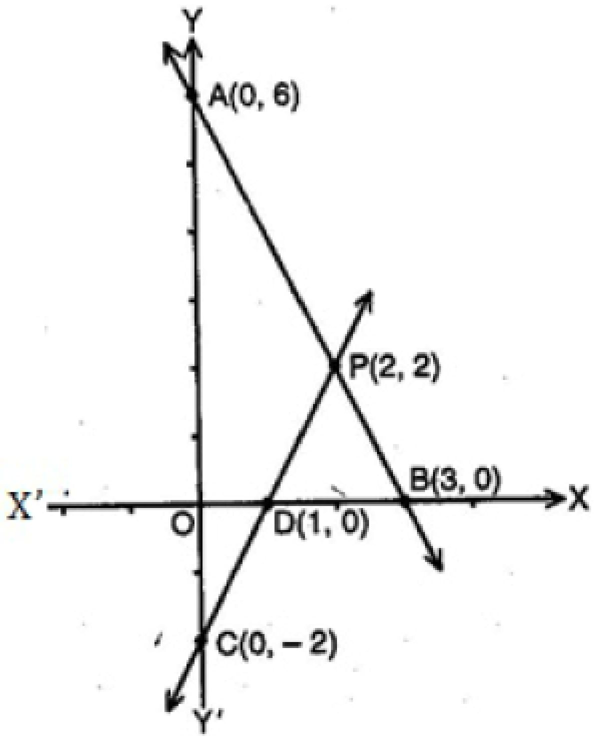
Plotting these points on the graph, it is clear that both lines are parallel. So the two lines have no common point. Hence the given equations have no solution and lines are inconsistent.
(iii) $2x+y-6=0, 4x-2y-4=0$

For equation $2x+y-6=0$, we have following points which lie on the line

x	0	3
y	6	0

For equation $4x-2y-4=0$, we have following points which lie on the line

x	0	1
y	-2	0



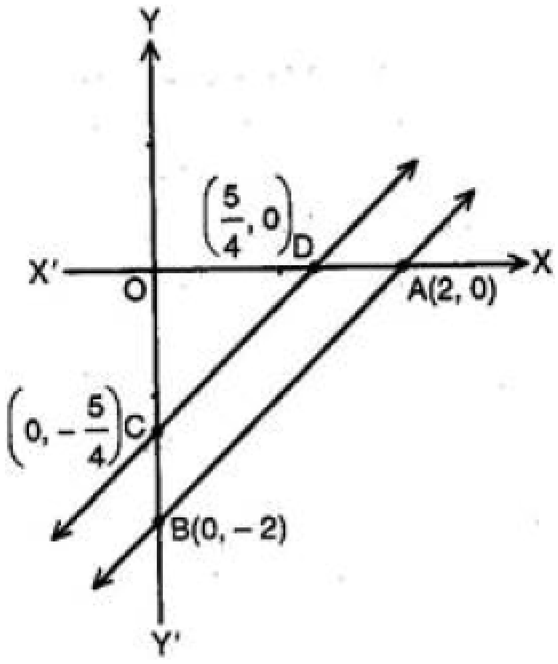
We can clearly see that lines are intersecting at $(2,2)$ which is the solution.
Hence $\mathrm{x}=2$ and $\mathrm{y}=2$ and lines are consistent.
(iv) $2x-2y-2=0, 4x-4y-5=0$

For $2x-2y-2=0$, the coordinates are:

x	2	0
y	0	-2

And for $4x-4y-5=0$, the coordinates

x	0	$\frac{5}{4}$
y	$\frac{-5}{4}$	0



Plotting these points on the graph, it is clear that both lines are parallel. So the two lines have no common point. Hence the given equations have no solution and lines are inconsistent.
5. Half the perimeter of a rectangle garden, whose length is $4 \mathrm{~m}$ more than its width, is $36 \mathrm{~m}$. Find the dimensions of the garden.

Answer.

Let length of rectangular garden $=\mathrm{x}$ metres
Let width of rectangular garden $=y$ metres
According to given conditions, perimeter $=36 \mathrm{~m}$

$\Rightarrow \frac{1}{2}[2(x+y)]=36$

$\Rightarrow x+y=36 \ldots .$ (i)

And $x=y+4$

$\Rightarrow x-y=4$

Adding eq. (i) and (ii),

$2x = 40$

$\Rightarrow x = 20\text{ m}$

Subtracting eq. (ii) from eq. (i),

$2y = 32$

$\Rightarrow y = 16\text{ m}$

Hence, length $= 20\text{ m}$ and width $= 16\text{ m}$

Ex 3.1 Question 6.

Given the linear equation $(2x + 3y - 8 = 0)$, write another linear equation in two variables such that the geometrical representation of the pair so formed is:
(i) Intersecting lines
(ii) Parallel lines
(iii) Coincident lines

Answer.

(i) Let the second line be equal to $a_2x + b_2y + c_2 = 0$
Comparing given line $\mathbf{2x + 3 - 8 = 0}$ with $a_1x + b_1y + c_1 = 0$,
We get $a_1 = 2, b_1 = 3$ and $c_1 = -8$
Two lines intersect with each other if $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$
So, second equation can be $\mathbf{x + 2y = 3}$ because $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

(ii) Let the second line be equal to $a_2x + b_2y + c_2 = 0$

Comparing given line $\mathbf{2x + 3y - 8 = 0}$ with $a_1x + b_1y + c_1 = 0$,
We get $a_1 = 2, b_1 = 3$ and $c_1 = -8$
Two lines are parallel to each other if $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$
So, second equation can be $\mathbf{2x + 3y - 2 = 0}$ because $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$
(iii) Let the second line be equal to $a_2x + b_2y + c_2 = 0$

Comparing given line $\mathbf{2x + 3y - 8 = 0}$ with $a_1x + b_1y + c_1 = 0$,
We get $a_1 = 2, b_1 = 3$ and $c_1 = -8$
Two lines are coincident if $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$
So, second equation can be $\mathbf{4x + 6y - 16 = 0}$ because $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Ex 3.1 Question 7.

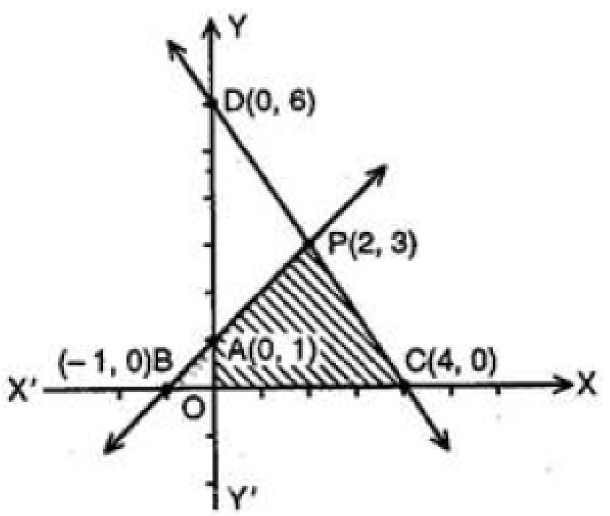
Draw the graphs of the equations $x - y + 1 = 0$ and $3x + 2y - 12 = 0$. Determine the coordinates of the vertices of the triangle formed by these lines and the x-axis, and shade the triangular region.

Ans. For equation $x - y + 1 = 0$, we have following points which lie on the line

x	0	-1
y	1	0

For equation $3x + 2y - 12 = 0$, we have following points which lie on the line

x	4	0
y	0	6



We can see from the graphs that points of intersection of the lines with the x-axis are $(-1, 0)$, $(2, 3)$ and $(4, 0)$.

NCERT Solutions Class 10 Maths: Chapter 3 - Pair of Linear Equations in Two Variables

Ex 3.2 Question 1.

Solve the following pair of linear equations by the substitution method.

(i) $x+y=14$

$x-y=4$

(ii) $s-t=3$

$\frac{s}{3}+\frac{t}{2}=6$

(iii) $3x-y=3$

$9x-3y=9$

(iv) $0.2x+0.3y=1.3$

$0.4x+0.5y=2.3$

(v) $\sqrt{2}x+\sqrt{3}y=0$

$\sqrt{3}x-\sqrt{8}y=0$

(vi) $\frac{3x}{2}-\frac{5y}{3}=-2$

$\frac{x}{3}+\frac{y}{2}=\frac{13}{6}$

Answer.

(i) $x+y=14$

$x-y=4\ldots(2)$

$x=4+y$ from equation (2)

Putting this in equation (1), we get

$4+y+y=14$

$\Rightarrow 2y=10 \Rightarrow y=5$

Putting value of y in equation (1), we get

$x+5=14$

$\Rightarrow x=14-5=9$

Therefore, $x=9$ and $y=5$

(ii) $s-t=3$

$\frac{s}{3}+\frac{t}{2}=6$

Using equation (1), we can say that $s=3+t$

Putting this in equation (2), we get

$$\frac{3+t}{3}+\frac{t}{2}=6$$

$$\Rightarrow \frac{6+2t+3t}{6}=6$$

$\Rightarrow 5t+6=36$

$\Rightarrow 5t=30 \Rightarrow t=6$

Putting value of t in equation (1), we get
$s-6=3 \Rightarrow s=3+6=9$

Therefore, $t=6$ and $s=9$

(iii) $3x-y=3\ldots$
$9x-3y=9\ldots(2)$

Comparing equation $3x-y=3$ with $a_1x+b_1y+c_1=0$ and equation $9x-3y=9$ with $a_2x+b_2y+c_2=0$

We get $a_1=3, b_1=-1, c_1=-3, a_2=9, b_2=-3$ and $c_2=-9$
Here $\frac{a_1}{a_2}=\frac{b_1}{b_2}=\frac{c_1}{c_2}$
Therefore, we have infinite many solutions for x and y
(iv) $0.2x+0.3y=1.3.$
$0.4x+0.5y=2.3$

Using equation (1), we can say that
$$0.2x=1.3-0.3y$$
$$\Rightarrow x=\frac{1.3-0.3y}{0.2}$$

Putting this in equation (2), we get
$$0.4\left(\frac{1.3-0.3y}{0.2}\right)+0.5y=2.3$$
$$\Rightarrow 2.6-0.6y+0.5y=2.3$$
$$\Rightarrow -0.1y=-0.3 \Rightarrow y=3$$

Putting value of y in (1), we get
$$0.2x+0.3(3)=1.3$$
$$\Rightarrow 0.2x+0.9=1.3$$
$$\Rightarrow 0.2x=0.4 \Rightarrow x=2$$

Therefore, $x=2$ and $y=3$

(v) $\sqrt{2}x+\sqrt{3}y=0$
$\sqrt{3}x-\sqrt{8}y=0$

Using equation (1), we can say that
$x=\frac{-\sqrt{3}y}{\sqrt{2}}$

Putting this in equation (2), we get
$$\sqrt{3}\left(\frac{-\sqrt{3}y}{\sqrt{2}}\right)-\sqrt{8}y=0 \Rightarrow \frac{-3y}{\sqrt{2}}-\sqrt{8}y=0$$
$$\Rightarrow y\left(\frac{-3}{\sqrt{2}}-\sqrt{8}\right)=0 \Rightarrow y=0$$

Putting value of y in (1), we get $x=0$
Therefore, $x=0$ and $y=0$
(vi) $\frac{3x}{2}-\frac{5y}{3}=-2$
$\frac{x}{3}+\frac{y}{2}=\frac{13}{6}\ldots$

Using equation (2), we can say that
$$x=\left(\frac{13}{6}-\frac{y}{2}\right)\times 3$$
$$\Rightarrow x=\frac{13}{2}-\frac{3y}{2}$$

Putting this in equation (1), we get
$$\frac{3}{2}\left(\frac{13}{2}-\frac{3y}{2}\right)-\frac{5y}{3}=\frac{-2}{1}$$
$$\Rightarrow \frac{39}{4}-\frac{9y}{4}-\frac{5y}{3}=-2$$
$$\Rightarrow \frac{-27y-20y}{12}=-2-\frac{39}{4}$$
$$\Rightarrow \frac{-47y}{12}=\frac{-8-39}{4}$$
$$\Rightarrow \frac{-47y}{12}=\frac{-47}{4} \Rightarrow y=3$$

Putting value of y in equation (2), we get

$\frac{x}{3}+\frac{3}{2}=\frac{13}{6}$

$\Rightarrow \frac{x}{3}=\frac{13}{6}-\frac{3}{2}=\frac{13-9}{6}=\frac{4}{6}=\frac{2}{3}$

$\Rightarrow \frac{x}{3}=\frac{2}{3}$

$\Rightarrow \mathrm{x}=2$

Therefore, $x=2$ and $y=3$

Ex 3.2 Question 2.

Solve $2x+3y=11$ and $2x-4y=-24$ and hence find the value of ' m ' for which $y=mx+3$.

Answer.

$2x+3y=11\ldots$
$2x-4y=-24\ldots$

Using equation (2), we can say that

$2x=-24+4y$

$\Rightarrow x=-12+2y$

Putting this in equation (1), we get

$2(-12+2y)+3y=11$

$\Rightarrow -24+4y+3y=11$

$\Rightarrow 7y=35 \Rightarrow y=5$

Putting value of y in equation (1), we get

$2x+3(5)=11$

$\Rightarrow 2x+15=11$

$\Rightarrow 2x=11-15=-4 \Rightarrow x=-2$

Therefore, $x=-2$ and $y=5$

Putting values of x and y in $y=mx+3$, we get

$5=m(-2)+3$

$\Rightarrow 5=-2m+3$

$\Rightarrow -2m=2 \Rightarrow m=-1$

Ex 3.2 Question 3.

Form a pair of linear equations for the following problems and find their solution by substitution method.
(i) The difference between two numbers is 26 and one number is three times the other. Find them.
(ii) The larger of two supplementary angles exceeds the smaller by 18 degrees. Find them.
(iii)The coach of a cricket team buys 7 bats and 6 balls for Rs 3800. Later, she buys 3 bats

and 5 balls for Rs 1750. Find the cost of each bat and each ball.
(iv) The taxi charges in a city consist of a fixed charge together with the charge for the distance covered. For a distance of $10 \mathrm{~km}$, the charge paid is Rs 105 and for a journey of $15 \mathrm{~km}$, the charge paid is Rs 155 . What are the fixed charges and the charge per $\mathbf{km}$? How much does a person have to pay for travelling a distance of $25\mathbf{km}$?
(v) A fraction becomes $\frac{9}{11}$, if 2 is added to both the numerator and the denominator. If, 3 is added to both the numerator and denominator it becomes $\frac{5}{6}$. Find the fraction.
(vi) Five years hence, the age of Jacob will be three times that of his son. Five years ago, Jacob's age was seven times that of his son. What are their present ages?

Answer.

(i) Let first number be x and second number be y.
According to given conditions, we have
$x-y=26$ (assuming $x>y$) ..
$x=3y(x>y)\ldots$

Putting equation (2) in (1), we get
$3y-y=26$
$\Rightarrow 2y=26$
$\Rightarrow y=13$
Putting value of y in equation (2), we get
$x=3y=3\times 13=39$

Therefore, two numbers are 13 and 39.

(ii) Let smaller angle $=x$ and let larger angle $=y$

According to given conditions, we have

$y = x + 18 \ldots (1)$

Also, $x + y = 180^\circ$ (Sum of supplementary angles) ...
Putting (1) in equation (2), we get

$x + x + 18 = 180$

$\Rightarrow 2x = 180 - 18 = 162$

$\Rightarrow x = 81^\circ$

Putting value of x in equation (1), we get
$y = x + 18 = 81 + 18 = 99^\circ$

Therefore, two angles are 81° and 99°.
(iii) Let cost of each bat = Rs x and let cost of each ball = Rs y

According to given conditions, we have
$7x + 6y = 3800$

$\text{And, } 3x + 5y = 1750$

Using equation (1), we can say that
$7x = 3800 - 6y \Rightarrow x = \frac{3800-6y}{7}$

Putting this in equation (2), we get
$3\left(\frac{3800-6y}{7}\right) + 5y = 1750$

$\Rightarrow \left(\frac{11400-18y}{7}\right) + 5y = 1750$

$\Rightarrow \frac{5y}{1} - \frac{18y}{7} = \frac{1750}{1} - \frac{11400}{7}$

$\Rightarrow \frac{35y - 18y}{7} = \frac{12250 - 11400}{7}$

$\Rightarrow 17y = 850 \Rightarrow y = 50$

Putting value of y in (2), we get
$3x + 250 = 1750$

$\Rightarrow 3x = 1500 \Rightarrow x = 500$

Therefore, cost of each bat = Rs 500 and cost of each ball = Rs 50
(iv) Let fixed charge = Rs x and let charge for every $\mathrm{km} = \mathrm{Rsy}$

According to given conditions, we have
$x + 10y = 105 \ldots$

$x + 15y = 155 \ldots$

Using equation (1), we can say that
$x = 105 - 10y$

Putting this in equation (2), we get
$105 - 10y + 15y = 155$

$\Rightarrow 5y = 50 \Rightarrow y = 10$

Putting value of y in equation (1), we get
$x + 10(10) = 105$

$\Rightarrow x = 105 - 100 = 5$

Therefore, fixed charge $=$ Rs 5 and charge per km $=$ Rs 10

To travel distance of $25\mathrm{Km}$, person will have to pay $= \mathrm{Rs}(\mathrm{x} + 25\mathrm{y})$

$= \mathrm{Rs}(5 + 25 \times 10)$

$= \mathrm{Rs}(5 + 250) = \mathrm{Rs}\,255$

(v) Let numerator $= \mathrm{x}$ and let denominator $= \mathrm{y}$

According to given conditions, we have

$\frac{x+2}{y+2} = \frac{9}{11} \ldots (1)$

$\frac{x+3}{y+3} = \frac{5}{6} \ldots (2)$

Using equation (1), we can say that

$11(x + 2) = 9y + 18$

$\Rightarrow 11x + 22 = 9y + 18$

$\Rightarrow 11x = 9y - 4$

$\Rightarrow x = \frac{9y - 4}{11}$

Putting value of x in equation (2), we get

$$6\left(\frac{9y-4}{11}+3\right)=5(y+3)$$

$$\Rightarrow \frac{54y}{11}-\frac{24}{11}+18=5y+15$$

$$\Rightarrow -\frac{24}{11}+\frac{3}{1}=\frac{5y}{1}-\frac{54y}{11}$$

$$\Rightarrow \frac{-24+33}{11}=\frac{55y-54y}{11}$$

$$\Rightarrow y=9$$

Putting value of y in (1), we get

$$\frac{x+2}{9+2}=\frac{9}{11}$$

$$\Rightarrow x+2=9 \Rightarrow x=7$$

Therefore, fraction $=\frac{x}{y}=\frac{7}{9}$

(vi) Let present age of Jacob $=$ x years

Let present age of Jacob's son = y years

According to given conditions, we have

$$(x+5)=3(y+5)$$

$$\text{And, } (x-5)=7$$

From equation

$$x+5=3y+15$$

$$\Rightarrow x=10+3y$$

Putting value of x in equation (2) we get

$$10+3y-5=7y-35$$

$$\Rightarrow -4y=-40$$

$$\Rightarrow y=10 \text{ years}$$

Putting value of y in equation (1), we get

$$x+5=3(10+5)=3\times 15=45$$

$$\Rightarrow x=45-5=40 \text{ years}$$

Therefore, present age of Jacob $=40$ years and, present age of Jacob's son $=10$ years

NCERT Solutions Class 10 Maths: Chapter 3 - Pair of Linear Equations in Two Variables

Ex 3.3 Question 1.

Solve the following pair of linear equations by the elimination method and the substitution method:
(i) $x+y=5, 2x-3y=4$
(ii) $3x+4y=10, 2x-2y=2$
(iii) $3x-5y-4=0, 9x=2y+7$
(iv) $\frac{x}{2}+\frac{2y}{3}=-1, x-\frac{y}{3}=3$

Answer.

(i) $x+y=5$
$2x-3y=4\ldots$

Elimination method:
Multiplying equation (1) by 2, we get equation (3)
$2x+2y=10$
$2x-3y=4$

Subtracting equation (2) from (3), we get
$5y=6 \Rightarrow y=\frac{6}{5}$

Putting value of y in (1), we get
$x+\frac{6}{5}=5$

$\Rightarrow x=5-\frac{6}{5}=\frac{19}{5}$

Therefore, $x=\frac{19}{5}$ and $y=\frac{6}{5}$
Substitution method:
$x+y=5\ldots$
$2x-3y=4$

From equation (1), we get,
$x=5-y$

Putting this in equation (2), we get
$2(5-y)-3y=4$
$\Rightarrow 10-2y-3y=4$
$\Rightarrow 5y=6 \Rightarrow y=\frac{6}{5}$

Putting value of y in (1), we get
$x=5-\frac{6}{5}=\frac{19}{5}$

Therefore, $x=\frac{19}{5}$ and $y=\frac{6}{5}$
(ii) $3x+4y=10\ldots$
$2x-2y=2\ldots$ (2)

Elimination method:

Multiplying equation (2) by 2 , we get (3)

$4x - 4y = 4 \ldots$
$3x + 4y = 10.$

Adding (3) and (1), we get
$7x = 14 \Rightarrow x = 2$

Putting value of x in (1), we get
$3(2) + 4y = 10$
$\Rightarrow 4y = 10 - 6 = 4$
$\Rightarrow y = 1$

Therefore, $x = 2$ and $y = 1$
Substitution method:
$3x + 4y = 10 \ldots$
$2x - 2y = 2 \ldots$

From equation (2), we get
$2x = 2 + 2y$
$\Rightarrow x = 1 + y \ldots$

Putting this in equation (1), we get
$3(1 + y) + 4y = 10$
$\Rightarrow 3 + 3y + 4y = 10$
$\Rightarrow 7y = 7 \Rightarrow y = 1$

Putting value of y in (3), we get $x = 1 + 1 = 2$
Therefore, $x = 2$ and $y = 1$

(iii) $3x - 5y - 4 = 0..$
$9x = 2y + 7 \ldots$

Elimination method:
Multiplying (1) by 3 , we get (3)
$9x - 15y - 12 = 0$
$9x - 2y - 7 = 0 \ldots$

Subtracting (2) from (3), we get
$-13y - 5 = 0$
$\Rightarrow -13y = 5$
$\Rightarrow y = \frac{-5}{13}$

Putting value of y in (1), we get
$3x - 5\left(\frac{-5}{13}\right) - 4 = 0$
$\Rightarrow 3x = 4 - \frac{25}{13} = \frac{52 - 25}{13} = \frac{27}{13}$
$\Rightarrow x = \frac{27}{13 \times 3} = \frac{9}{13}$
Therefore, $x = \frac{9}{13}$ and $y = \frac{-5}{13}$

Substitution Method:
$3x - 5y - 4 = 0 \ldots$
$9x = 2y + 7 \ldots (2)$

From equation (1), we can say that
$3x = 4 + 5y \Rightarrow x = \frac{4+5y}{3}$

Putting this in equation (2), we get
$9\left(\frac{4 + 5y}{3}\right) - 2y = 7$
$\Rightarrow 12 + 15y - 2y = 7$
$\Rightarrow 13y = -5 \Rightarrow y = \frac{-5}{13}$

Putting value of y in (1), we get
$3x - 5\left(\frac{-5}{13}\right) = 4$
$\Rightarrow 3x = 4 - \frac{25}{13} = \frac{52 - 25}{13} = \frac{27}{13}$
$\Rightarrow x = \frac{27}{13 \times 3} = \frac{9}{13}$

Therefore, $x=\frac{9}{13}$ and $y=\frac{-5}{13}$
(iv) $\frac{x}{2}+\frac{2y}{3}=-1 \ldots$
$x-\frac{y}{3}=3 \ldots$

Elimination method:

Multiplying equation (2) by 2, we get (3)

$$2x-\frac{2}{3}y=6 \ldots$$
$$\frac{x}{2}+\frac{2y}{3}=-1 \ldots$$

Adding (3) and (1), we get
$\frac{5}{2}x=5 \Rightarrow x=2$

Putting value of x in (2), we get
$$2-\frac{y}{3}=3$$
$$\Rightarrow y=-3$$

Therefore, $x=2$ and $y=-3$
Substitution method:
$$\frac{x}{2}+\frac{2y}{3}=-1 \ldots$$
$$x-\frac{y}{3}=3 \ldots (2)$$

From equation (2), we can say that $x=3+\frac{y}{3}=\frac{9+y}{3}$
Putting this in equation (1), we get
$\frac{9+y}{6}+\frac{2}{3}y=-1$
$$\Rightarrow \frac{9+y+4y}{6}=-1$$
$$\Rightarrow 5y+9=-6$$
$$\Rightarrow 5y=-15 \Rightarrow y=-3$$

Putting value of y in (1), we get
$\frac{x}{2}+\frac{2}{3}(-3)=-1 \Rightarrow x=2$

Therefore, $x=2$ and $y=-3$
Ex 3.3 Question 2.

Form the pair of linear equations in the following problems, and find their solutions (if they exist) by the elimination method:
(i) If we add 1 to the numerator and subtract 1 from the denominator, a fraction reduces to 1 . It becomes $1/2$ if we only add 1 to the denominator. What is the fraction?
(ii) Five years ago, Nuri was thrice as old as sonu. Ten years later, Nuri will be twice as old as sonu. How old are Nuri and Sonu?
(iii) The sum of the digits of a two-digit number is 9 . Also, nine times this number is twice the number obtained by reversing the order of the digits. Find the number.
(iv) Meena went to a bank to withdraw Rs 2000 . She asked the cashier to give her Rs 50 and Rs 100 notes only. Meena got 25 notes in all. Find how many notes of Rs 50 and Rs 100 she received.
(v) A lending library has a fixed charge for the first three days and an additional charge for each day thereafter. Saritha paid Rs 27 for a book kept for seven days, while Susy paid Rs 21 for the book she kept for five days. Find the fixed charge and the charge for each extra day.

Answer.

(i) Let numerator $=x$ and let denominator $=y$
According to given condition, we have
$$\frac{x+1}{y-1}=1 \text{ and } \frac{x}{y+1}=\frac{1}{2}$$
$$\Rightarrow x+1=y-1 \text{ and } 2x=y+1$$
$\Rightarrow x-y=-2$ (1) and $2x-y=1$
So, we have equations (1) and (2), multiplying equation (1) by 2 we get (3)
$$2x-2y=-4 \ldots (3)$$
$$2x-y=1 \ldots (2)$$

Subtracting equation (2) from (3), we get
$-y=-5 \Rightarrow y=5$

Putting value of y in (1), we get
$x-5=-2 \Rightarrow x=-2+5=3$

Therefore, fraction $=\frac{x}{y}=\frac{3}{5}$
(ii) Let present age of Nuri = x years and let present age of Sonu = y years
5 years ago, age of Nuri $=(x-5)$ years

5 years ago, age of Sonu $= (y-5)$ years
According to given condition, we have
$(x-5) = 3(y-5)$
$\Rightarrow x-5 = 3y-15$
$\Rightarrow x-3y = -10\ldots$
10 years later from present, age of Nuri $= (x+10)$ years
10 years later from present, age of Sonu $= (y+10)$ years
According to given condition, we have

$(x+10) = 2(y+10)$
$\Rightarrow x+10 = 2y+20$

$\Rightarrow x-2y = 10\ldots$

Subtracting equation (1) from (2), we get
$y = 10-(-10) = 20$ years

Putting value of y in (1), we get
$x-3(20) = -10$
$\Rightarrow x-60 = -10$
$\Rightarrow x = 50$ years

Therefore, present age of Nuri $= 50$ years and present age of Sonu $= 20$ years
(iii) Let digit at ten's place $= x$ and Let digit at one's place $= y$

According to given condition, we have
$x+y = 9$

And $9(10x+y) = 2(10y+x)$
$\Rightarrow 90x+9y = 20y+2x$
$\Rightarrow 88x = 11y$
$\Rightarrow 8x = y$
$\Rightarrow 8x-y = 0\ldots (2)$

Adding (1) and (2), we get
$9x = 9 \Rightarrow x = 1$

Putting value of x in (1), we get
$1+y = 9$

$\Rightarrow y = 9-1 = 8$

Therefore, number $= 10x+y = 10(1)+8 = 10+8 = 18$
(iv) Let number of Rs 100 notes = x and let number of Rs 50 notes $= y$

According to given conditions, we have
$x+y = 25$
and $100x+50y = 2000$
$\Rightarrow 2x+y = 40\ldots(2)$

Subtracting (2) from (1), we get
$-x = -15 \Rightarrow x = 15$

Putting value of $\mathbf{x}$ in (1), we get
$15+y = 25$
$\Rightarrow y = 25-15 = 10$

Therefore, number of Rs 100 notes $= 15$ and number of Rs 50 notes $= 10$
(v) Let fixed charge for 3 days $=$ Rs x

Let additional charge for each day thereafter $=$ Rs y
According to given condition, we have
$x+4y = 27\ldots (1)$
$x+2y = 21\ldots (2)$

Subtracting (2) from (1), we get
$2y = 6 \Rightarrow y = 3$

Putting value of y in (1), we get
$x+4(3) = 27$
$\Rightarrow x = 27-12 = 15$

Therefore, fixed charge for 3 days $=$ Rs 15 and additional charge for each day after 3 days Rs 3