

### Exercise 5.1

Solve the following systems of simultaneous linear equations by the substitution method (1 to 4):

1. (i)  $x + y = 14$

$x - y = 4$

(ii)  $s - t = 3$

$s/3 + t/2 = 6$

(iii)  $2x + 3y = 9$

$3x + 4y = 5$

(iv)  $3x - 5y = 4$

$9x - 2y = 7$

**Solution:**

(i)  $x + y = 14$

$x - y = 4$

It can be written as

$x = 4 + y$

By substituting the value in the above equation

$4 + y + y = 14$

By further calculation

$2y = 14 - 4 = 10$

Dividing by 2

$y = 10/2 = 5$

So we get

$x = 4 + 5 = 9$

Hence,  $x = 9$  and  $y = 5$ .



(ii)  $s - t = 3$

$s/3 + t/2 = 6$

By taking LCM

$2s + 3t = 6 \times 6 = 36$

We know that

$s - t = 3 \dots (1)$

$2s + 3t = 36 \dots (2)$

So we get

$s = 3 + t \dots (3)$

By substituting the value of  $s$  in equation (2)

$2(3 + t) + 3t = 36$

By further calculation

$6 + 2t + 3t = 36$

So we get

$5t = 36 - 6 = 30$

By division

$t = 30/5 = 6$

Substituting  $t$  in equation (3)

$s = 3 + 6 = 9$

Hence,  $s = 9$  and  $t = 6$ .

(iii)  $2x + 3y = 9 \dots (1)$

$$3x + 4y = 5 \dots (2)$$

Equation (1) can be written as

$$2x = 9 - 3y$$

$$x = (9 - 3y)/2 \dots (3)$$

By substituting the value of x in equation (2)

$$3 \times (9 - 3y)/2 + 4y = 5$$

By further calculation

$$(27 - 9y)/2 + 4y = 5$$

By taking LCM

$$27 - 9y + 8y = 10$$

So we get

$$-y = -17$$

$$y = 17$$

Substituting y in equation (3)

$$x = [9 - (3 \times 17)]/2$$

By further calculation

$$x = (9 - 51)/2$$

$$x = -21$$

Hence,  $x = -21$  and  $y = 17$ .

$$(iv) 3x - 5y = 4 \dots (1)$$

$$9x - 2y = 7 \dots (2)$$

Multiply equation (1) by 3

$$9x - 15y = 12$$

$$9x - 2y = 7$$

By subtracting both the equations

$$-13y = 5$$

$$y = -5/13$$

Equation (1) can be written as

$$3x - 5y = 4$$

$$x = (4 + 5y)/3 \dots (3)$$

By substituting the value of x in equation (2)

$$9 [(4 + 5y)/3] - 2y = 7$$

By further calculation

$$12 + 15y - 2y = 7$$

$$13y = -5$$

So we get

$$y = -5/13$$

Substituting y in equation (3)



$$x = \frac{4 + 5 \times \frac{-5}{13}}{3}$$

By further calculation

$$= \frac{4 - \frac{25}{13}}{3}$$

Taking LCM

$$= \frac{\frac{52-25}{13}}{3}$$

So we get

$$= \frac{27}{13 \times 3}$$
$$= \frac{9}{13}$$

Hence,  $x = 9/13$  and  $y = -5/13$ .

**2. (i)  $a + 3b = 5$**

**$7a - 8b = 6$**

**(ii)  $5x + 4y - 4 = 0$**

**$x - 20 = 12y$**

**Solution:**

(i)  $a + 3b = 5$  .... (1)

$7a - 8b = 6$  ..... (2)

Now multiply equation (1) by 7

$7a + 21b = 35$  .... (3)

$7a - 8b = 6$  ..... (4)

By subtracting both the equations

$29b = 29$

So we get

$b = 29/29 = 1$

Now substituting  $b = 1$  in equation (1)

$a + 3(1) = 5$

By further calculation

$a + 3 = 5$

So we get

$a = 5 - 3 = 2$

Therefore,  $a = 2$  and  $b = 1$ .



(ii)  $5x + 4y - 4 = 0$

$x - 20 = 12y$

We can write it as

$5x + 4y = 4 \dots (1)$

$x - 12y = 20 \dots (2)$

Now multiply equation (2) by 5

$5x + 4y = 4 \dots (3)$

$5x - 60y = 100$

By subtracting both the equations

$64y = -96$

So we get

$y = -96/64 = -3/2$

Now substitute the value of y in equation (1)

$5x + 4(-3/2) = 4$

By further calculation

$5x + 2(-3) = 4$

So we get

$5x - 6 = 4$

$5x = 4 + 6 = 10$

By division

$x = 10/5 = 2$

Therefore,  $x = 2$  and  $y = -3/2$ .

3. (i)  $2x - 3y/4 = 3$

$5x - 2y - 7 = 0$

(ii)  $2x + 3y = 23$

$5x - 20 = 8y$

**Solution:**

(i)  $2x - 3y/4 = 3$

$5x - 2y - 7 = 0$

We can write it as

$2x/1 - 3y/4 = 3$

By taking LCM

$(8x - 3y)/4 = 3$

By cross multiplication

$8x - 3y = 12 \dots (1)$

$5x - 2y = 7 \dots (2)$

Now multiply equation (1) by 2 and (2) by 3

$16x - 6y = 24$

$15x - 6y = 21$

By subtracting both the equations

$x = 3$

Now substituting the value of x in equation (1)

$8 \times 3 - 3y = 12$

By further calculation

$24 - 3y = 12$

$-3y = 12 - 24$



So we get

$$-3y = -12$$

$$y = -12/-3 = 4$$

Therefore,  $x = 3$  and  $y = 4$ .

$$(ii) 2x + 3y = 23$$

$$5x - 20 = 8y$$

We can write it as

$$2x + 3y = 23 \dots (1)$$

$$5x - 8y = 20 \dots (2)$$

By multiplying equation (1) by 5 and equation (2) by 2

$$10x + 15y = 115$$

$$10x - 16y = 40$$

By subtracting both the equations

$$31y = 75$$

So we get

$$y = 75/31 = 2 \frac{13}{31}$$

By substituting the value of  $y$  in equation (1)

$$2x + 3 \left(\frac{75}{31}\right) = 23$$

By further calculation

$$2x + \frac{225}{31} = 23$$

We can write it as

$$2x = \frac{23}{1} - \frac{225}{31}$$

Taking LCM

$$2x = \frac{(713 - 225)}{31} = \frac{488}{31}$$

So we get

$$x = \frac{488}{(31 \times 2)} = \frac{244}{31} = 7 \frac{27}{31}$$

Therefore,  $x = 7 \frac{27}{31}$  and  $y = 2 \frac{13}{31}$ .

$$4. (i) mx - ny = m^2 + n^2$$

$$x + y = 2m$$

$$(ii) \frac{2x}{a} + \frac{y}{b} = 2$$

$$\frac{x}{a} - \frac{y}{b} = 4$$

**Solution:**

$$(i) mx - ny = m^2 + n^2 \dots (1)$$

$$x + y = 2m \dots (2)$$

We can write it as

$$x = 2m - y \dots (3)$$

Now substitute the value of  $x$  in (1)

$$m(2m - y) - ny = m^2 + n^2$$

By further calculation

$$2m^2 - my - ny = m^2 + n^2$$

Taking out  $y$  as common

$$m^2 - y(m + n) = n^2$$

It can be written as

$$m^2 - n^2 - y(m + n) = 0$$



Expanding using formula

$$(m - n)(m + n) - y(m + n) = 0$$

Taking  $(m + n)$  as common

$$(m + n)[(m - n) - y] = 0$$

So we get

$$m - n - y = 0$$

$$y = m - n$$

From equation (3)

$$x = 2m - (m - n)$$

By further calculation

$$x = 2m - m + n = m + n$$

Hence,  $x = m + n$  and  $y = m - n$ .

$$(ii) \quad 2x/a + y/b = 2 \dots (1)$$

$$x/a - y/b = 4 \dots (2)$$

Adding both the equations

$$3x/a = 6$$

So we get

$$x = 6a/3 = 2a$$

Substituting  $x$  in equation (1)

$$2(2a)/a + y/b = 2$$

By further calculation

$$4a/a + y/b = 2$$

So we get

$$4 + y/b = 2$$

$$y/b = 2 - 4 = -2$$

Here

$$y = -2b$$

Therefore,  $x = 2a$  and  $y = -2b$ .

**5. Solve  $2x + y = 35$ ,  $3x + 4y = 65$ . Hence, find the value of  $x/y$ .**

**Solution:**

It is given that

$$2x + y = 35 \dots (1)$$

$$3x + 4y = 65 \dots (2)$$

Now multiply equation (1) by 4

$$8x + 4y = 140 \dots (3)$$

$$3x + 4y = 65 \dots (4)$$

By subtracting both the equations

$$5x = 75$$

$$x = 75/5 = 15$$

Now substituting the value of  $x$  in equation (1)

$$8 \times 15 + 4y = 140$$

By further calculation



$$120 + 4y = 140$$

$$4y = 140 - 120$$

So we get

$$4y = 20$$

$$y = 20/4 = 5$$

Here

$$x/y = 15/5 = 3$$

Therefore,  $x/y = 3$ .

**6. Solve the simultaneous equations  $3x - y = 5$ ,  $4x - 3y = -1$ . Hence, find  $p$ , if  $y = px - 3$ .**

**Solution:**

It is given that

$$3x - y = 5 \dots\dots (1)$$

$$4x - 3y = -1 \dots\dots (2)$$

Now multiply equation (1) by 3

$$9x - 3y = 15 \dots\dots (3)$$

$$4x - 3y = -1 \dots\dots (4)$$

Subtracting equation (3) and (4)

$$5x = 16$$

$$x = 16/5$$

Substitute the value of  $x$  in equation (3)

$$3 \times 16/5 - y = 5$$

By further calculation

$$48/5 - y = 5$$

$$48/5 - 5 = y$$

Taking LCM

$$(48 - 25)/5 = y$$

So we get

$$y = 23/5$$

We know that

$$y = px - 3$$

$$23/5 = p \times 16/5 - 3$$

Substitute the value of  $x$  and  $y$

$$23/5 + 3 = 16p/5$$

Taking LCM

$$(23 + 15)/5 = 16p/5$$

By further calculation

$$38/5 = 16p/5$$

So we get

$$16p = 38$$

$$p = 19/8$$

Therefore,  $x = 16/5$ ,  $y = 23/5$  and  $p = 19/8$ .



### Exercise 5.2

Solve the following systems of simultaneous linear equations by the elimination method (1 to 9):

1. (i)  $3x + 4y = 10$

$$2x - 2y = 2$$

(ii)  $2x = 5y + 4$

$$3x - 2y + 16 = 0$$

**Solution:**

(i)  $3x + 4y = 10$  ..... (1)

$$2x - 2y = 2$$
 ..... (2)

Multiplying equation (1) by 1 and (2) by 2

$$3x + 4y = 10$$

$$4x - 4y = 4$$

By adding both the equations

$$7x = 14$$

By division

$$x = 14/7 = 2$$

Substituting the value of x in equation (2)

$$2 \times 2 - 2y = 2$$

By further calculation

$$4 - 2y = 2$$

So we get

$$2y = 4 - 2 = 2$$

$$y = 2/2 = 1$$

Therefore,  $x = 2$  and  $y = 1$ .

(ii)  $2x = 5y + 4$

$$3x - 2y + 16 = 0$$

We can write it as

$$2x - 5y = 4$$
 ..... (1)

$$3x - 2y = -16$$
 ..... (2)

Now multiply equation (1) by 3 and (2) by 2

$$6x - 15y = 12$$
 ..... (3)

$$6x - 4y = -32$$
 ..... (4)

By subtracting both the equations

$$-11y = 44$$

$$y = -44/11 = -4$$

Substitute the value of y in equation (1)

$$2x - 5(-4) = 4$$

By further calculation

$$2x + 20 = 4$$

So we get

$$2x = 4 - 20 = -16$$

$$x = -16/2 = -8$$

Therefore,  $x = -8$  and  $y = -4$ .



2. (i)  $\frac{3}{4}x - \frac{2}{3}y = 1$

$\frac{3}{8}x - \frac{1}{6}y = 1$

(ii)  $2x - 3y - 3 = 0$

$\frac{2x}{3} + 4y + \frac{1}{2} = 0$ .

**Solution:**

(i)  $\frac{3}{4}x - \frac{2}{3}y = 1$

$\frac{3}{8}x - \frac{1}{6}y = 1$

We can write it as

$\frac{3}{4}x - \frac{2}{3}y = 1$

$(9x - 8y)/12 = 1$

By cross multiplication

$9x - 8y = 12 \dots\dots (1)$

$\frac{3}{8}x - \frac{1}{6}y = 1$

$(9x - 4y)/24 = 1$

By cross multiplication

$9x - 4y = 24 \dots\dots (2)$

Subtracting equations (1) and (2)

$-4y = -12$

By division

$y = -12/-4 = 3$

Substitute the value of y in (1)

$9x - 8 \times 3 = 12$

By further calculation

$9x - 24 = 12$

$9x = 12 + 24 = 36$

By division

$x = 36/9 = 4$

Therefore,  $x = 4$  and  $y = 3$ .

(ii)  $2x - 3y - 3 = 0$

$\frac{2x}{3} + 4y + \frac{1}{2} = 0$

We can write it as

$2x - 3y - 3 = 0$

$2x - 3y = 3 \dots\dots (1)$

$\frac{2x}{3} + 4y + \frac{1}{2} = 0$

$\frac{2x}{3} + 4y = -\frac{1}{2}$

Taking LCM

$(2x + 12y)/3 = -\frac{1}{2}$

By cross multiplication

$2(2x + 12y) = -1 \times 3$

So we get

$4x + 24y = -3 \dots\dots (2)$

Multiply equation (1) by 2

$4x - 6y = 6$



$$4x + 24y = -3$$

By subtracting both the equations

$$-30y = 9$$

So we get

$$y = -9/30 = -3/10$$

Substitute the value of y in equation (1)

$$2x - 3(-3/10) = 3$$

By further calculation

$$2x + 9/10 = 3$$

We can write it as

$$2x = 3 - 9/10$$

By taking LCM

$$2x = (30 - 9)/10$$

So we get

$$2x = 21/10$$

$$x = 21/20$$

Therefore,  $x = 21/20$  and  $y = -3/10$ .

**3. (i)  $15x - 14y = 117$**

**$14x - 15y = 115$**

**(ii)  $41x + 53y = 135$**

**$53x + 41y = 147$ .**

**Solution:**

(i)  $15x - 14y = 117$  ..... (1)

$14x - 15y = 115$  ..... (2)

Now multiply equation (1) by 14 and (2) by 15

$210x - 196y = 1638$  .... (3)

$210x - 225y = 1725$  ..... (4)

By subtracting both the equations

$$29y = -87$$

So we get

$$y = -87/29 = -3$$

Substitute the value of y in equation (1)

$$15x - 14(-3) = 117$$

By further calculation

$$15x + 42 = 117$$

So we get

$$15x = 117 - 42 = 75$$

By division

$$x = 75/15 = 5$$

Therefore,  $x = 5$  and  $y = -3$ .

(ii)  $41x + 53y = 135$  ..... (1)

$53x + 41y = 147$  ..... (2)

Now multiply equation (1) by 53 and (2) by 41



$$2173x + 2809y = 7155 \dots (3)$$

$$2173x + 1681y = 6027 \dots (4)$$

By subtracting both the equations

$$1128y = 1128$$

So we get

$$y = 1128/1128 = 1$$

Substitute the value of y in equation (1)

$$41x + 53 \times 1 = 135$$

By further calculation

$$41x + 53 = 135$$

So we get

$$41x = 135 - 53 = 82$$

By division

$$x = 82/41 = 2$$

Therefore,  $x = 2$  and  $y = 1$ .

**4. (i)  $x/6 = y - 6$**

**$3x/4 = 1 + y$**

**(ii)  $x - 2/3 y = 8/3$**

**$2x/5 - y = 7/5$ .**

**Solution:**

(i)  $x/6 = y - 6$

$3x/4 = 1 + y$

We can write it as

$x = 6(y - 6)$

$x = 6y - 36$

$x - 6y = -36 \dots (1)$

$3x/4 = 1 + y$

By cross multiplication

$3x = 4(1 + y)$

So we get

$3x = 4 + 4y$

$3x - 4y = 4 \dots (2)$

Multiply equation (1) by 3

$3x - 18y = -108$

$3x - 4y = 4$

Subtracting both the equations

$-14y = -112$

So we get

$y = -112/-14 = 8$

Substitute the value of y in equation (1)

$x - 6 \times 8 = -36$

By further calculation

$x - 48 = -36$



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Simultaneous Linear Equations

$$x = -36 + 48$$
$$x = 12$$

Therefore,  $x = 12$  and  $y = 8$ .

(ii)  $x - \frac{2}{3}y = \frac{8}{3}$   
 $\frac{2x}{5} - y = \frac{7}{5}$

We can write it as

$$x - \frac{2}{3}y = \frac{8}{3}$$

Taking LCM

$$(3x - 2y)/3 = 8/3$$

By cross multiplication

$$3x - 2y = \frac{8}{3} \times 3 = 8$$

$$3x - 2y = 8 \dots\dots (1)$$

$$\frac{2x}{5} - y = \frac{7}{5}$$

Taking LCM

$$(2x - 5y)/5 = 7/5$$

By cross multiplication

$$2x - 5y = \frac{7}{5} \times 5 = 7$$

$$2x - 5y = 7 \dots\dots (2)$$

Multiply equation (1) by 2 and (2) by 3

$$6x - 4y = 16 \dots\dots (3)$$

$$6x - 15y = 21 \dots\dots (4)$$

Subtracting both the equations

$$11y = -5$$

$$y = -5/11$$

Substitute the value of  $y$  in equation (1)

$$3x - 2(-5/11) = 8$$

By further calculation

$$3x + 10/11 = 8$$

We can write it as

$$3x = 8 - 10/11$$

Taking LCM

$$3x = (88 - 10)/11 = 78/11$$

By cross multiplication

$$x = 78/(11 \times 3) = 26/11$$

Therefore,  $x = 26/11$  and  $y = -5/11$ .

**5. (i)  $9 - (x - 4) = y + 7$**

**$2(x + y) = 4 - 3y$**

**(ii)  $2x + (x - y)/6 = 2$**

**$x - (2x + y)/3 = 1$ .**

**Solution:**

(i)  $9 - (x - 4) = y + 7$

$2(x + y) = 4 - 3y$

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Simultaneous Linear Equations**

We can write it as

$$9 - (x - 4) = y + 7$$

$$9 - x + 4 = y + 7$$

By further calculation

$$13 - x = y + 7$$

$$-x - y = 7 - 13 = -6$$

$$x + y = 6 \dots\dots (1)$$

$$2(x + y) = 4 - 3y$$

$$2x + 2y = 4 - 3y$$

By further calculation

$$2x + 2y + 3y = 4$$

So we get

$$2x + 5y = 4 \dots\dots (2)$$

Now multiply equation (1) by 5 and (2) by 1

$$5x + 5y = 30$$

$$2x + 5y = 4$$

By subtracting both the equations

$$3x = 26$$

So we get

$$x = 26/3$$

Substitute the value of x in (1)

$$26/3 + y = 6$$

We can write it as

$$y = 6 - 26/3$$

Taking LCM

$$y = (18 - 26)/3$$

So we get

$$y = -8/3$$

Therefore,  $x = 26/3$  and  $y = -8/3$ .

$$(ii) 2x + (x - y)/6 = 2$$

$$x - (2x + y)/3 = 1$$

$$2x + (x - y)/6 = 2$$

Multiply by 6

$$12x + x - y = 12$$

By further calculation

$$13x - y = 12 \dots\dots (2)$$

$$x - (2x + y)/3 = 1$$

Multiply by 3

$$3x - 2x - y = 3$$

By further calculation

$$x - y = 3 \dots\dots (2)$$

So we get

$$x = 3 + y \dots\dots (3)$$



Substitute the value of x in (1)

$$13(3 + y) - y = 12$$

By further calculation

$$39 + 13y - y = 12$$

So we get

$$12y = 12 - 39 = -27$$

By division

$$y = -27/12 = -9/4$$

Substitute the value of y in (3)

$$x = 3 + y$$

$$x = 3 + (-9)/4$$

By further calculation

$$x = 3 - 9/4$$

Taking LCM

$$x = (12 - 9)/4$$

$$x = 3/4$$

Therefore,  $x = 3/4$  and  $y = -9/4$ .

**6.  $x - 3y = 3x - 1 = 2x - y$ .**

**Solution:**

It is given that

$$x - 3y = 3x - 1 = 2x - y$$

Here

$$x - 3y = 3x - 1$$

$$x - 3x - 3y = -1$$

By further calculation

$$-2x - 3y = -1$$

$$2x + 3y = 1 \dots\dots (1)$$

$$3x - 1 = 2x - y$$

$$3x - 2x + y = 1$$

By further simplification

$$x + y = 1 \dots\dots (2)$$

Multiply equation (2) by 2 and subtract from equation (1)

$$2x + 3y = 1$$

$$2x + 2y = 2$$

So we get

$$y = -1$$

Substitute the value of y in equation (1)

$$2x + 3(-1) = 1$$

So we get

$$2x - 3 = 1$$

$$2x = 1 + 3 = 4$$

By division

$$x = 4/2 = 2$$



Therefore,  $x = 2$  and  $y = -1$ .

7. (i)  $4x + (x - y)/8 = 17$

$$2y + x - (5y + 2)/3 = 2$$

(ii)  $(x + 1)/2 + (y - 1)/3 = 8$

$$(x - 1)/3 + (y + 1)/2 = 9.$$

**Solution:**

(i)  $4x + (x - y)/8 = 17$

$$2y + x - (5y + 2)/3 = 2$$

We can write it as

$$4x + (x - y)/8 = 17$$

$$(32 + x - y)/8 = 17$$

By further calculation

$$(33x - y)/8 = 17$$

By cross multiplication

$$33x - y = 136 \dots\dots (1)$$

$$2y + x - (5y + 2)/3 = 2$$

Taking LCM

$$[3(2y + x) - 5(5y + 2)]/3 = 2$$

By further calculation

$$6y + 3x - 5y - 2 = 2 \times 3$$

So we get

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

$$3x + y = 6 + 2$$

$$3x + y = 8 \dots\dots (2)$$

By adding both the equations

$$36x = 144$$

By division

$$x = 144/36 = 4$$

Substitute the value of  $x$  in equation (1)

$$33 \times 4 - y = 136$$

By further calculation

$$132 - y = 136$$

$$-y = 136 - 132$$

So we get

$$-y = 4$$

$$y = -4$$

Therefore,  $x = 4$  and  $y = -4$ .

(ii)  $(x + 1)/2 + (y - 1)/3 = 8$

$$(x - 1)/3 + (y + 1)/2 = 9$$

We can write it as

$$(x + 1)/2 + (y - 1)/3 = 8$$

Taking LCM

$$(3x + 3 + 2y - 2)/6 = 8$$



By further calculation

$$3x + 2y + 1 = 48$$

So we get

$$3x + 2y = 47 \dots (1)$$

$$(x - 1)/3 + (y + 1)/2 = 9$$

Taking LCM

$$(2x - 2 + 3y + 3)/6 = 9$$

By further calculation

$$2x + 3y + 1 = 54$$

So we get

$$2x + 3y = 53 \dots (2)$$

By adding equation (1) and (2)

$$5x + 5y = 100$$

Dividing by 5

$$x + y = 20 \dots (3)$$

By subtracting equation (1) and (2)

$$x - y = -6 \dots (4)$$

Now add equation (3) and (4)

$$2x = 14$$

$$x = 14/2 = 7$$

Subtracting equation (4) and (3)

$$2y = 26$$

$$y = 26/2 = 13$$

Therefore,  $x = 7$  and  $y = 13$ .

**8. (i)  $3/x + 4y = 7$**

**$5/x + 6y = 13$**

**(ii)  $5x - 9 = 1/y$**

**$x + 1/y = 3$ .**

**Solution:**

(i)  $3/x + 4y = 7 \dots (1)$

$5/x + 6y = 13 \dots (2)$

Substitute  $1/x = a$  in equation (1) and (2)

$3a + 4y = 7 \dots (3)$

$5a + 6y = 13 \dots (4)$

Multiply equation (3) by 5 and (4) by 3

$$15a + 20y = 35$$

$$15a + 18y = 39$$

Subtracting both the equations

$$2y = -4$$

So we get

$$y = -4/2 = -2$$

Substitute the value of  $y$  in equation (3)

$$3a + 4(-2) = 7$$



By further calculation

$$3a - 8 = 7$$

$$3a = 7 + 8 = 15$$

So we get

$$3a = 15$$

$$a = 15/3 = 5$$

$$\text{Here } x = 1/a = 1/5$$

Therefore,  $x = 1/5$  and  $y = -2$ .

$$\text{(ii) } 5x - 9 = 1/y \dots\dots (1)$$

$$x + 1/y = 3 \dots\dots (2)$$

Substitute  $1/y = b$  in (1) and (2)

$$5x - 9 = b$$

$$5x - b = 9 \dots\dots (3)$$

$$x + b = 3 \dots\dots (4)$$

By adding equation (3) and (4)

$$5x - b = 9 \dots\dots (3)$$

$$x + b = 3 \dots\dots (4)$$

So we get

$$6x = 12$$

By division

$$x = 12/6 = 2$$

Substitute the value of  $x$  in equation (4)

$$2 + b = 3$$

$$b = 3 - 2$$

$$b = 1$$

$$\text{Here } 1/y = 1$$

$$b = 1/y$$

$$y = 1$$

Therefore,  $x = 2$  and  $y = 1$ .

$$\mathbf{9. (i) \quad px + qy = p - q}$$

$$\mathbf{qx - py = p + q}$$

$$\mathbf{(ii) \quad x/a - y/b = 0}$$

$$\mathbf{ax + by = a^2 + b^2.}$$

**Solution:**

$$(i) \quad px + qy = p - q \dots\dots (1)$$

$$qx - py = p + q \dots\dots (2)$$

Now multiply equation (1) by  $p$  and (2) by  $q$

$$p^2x + pqy = p^2 - pq$$

$$q^2x - pqy = pq + q^2$$

By adding both the equations

$$(p^2 + q^2)x = p^2 + q^2$$

By further calculation

$$x = (p^2 + q^2)/(p^2 + q^2) = 1$$



From equation (1)

$$p \times 1 + qy = p - q$$

By further calculation

$$p - qy = p - q$$

So we get

$$qy = p - q - p = -q$$

Here

$$y = -q/q = -1$$

Therefore,  $x = 1$  and  $y = -1$ .

(ii)  $x/a - y/b = 0$

$$ax + by = a^2 + b^2$$

We can write it as

$$x/a - y/b = 0$$

Taking LCM

$$(bx - ay)/ab = 0$$

By cross multiplication

$$bx - ay = 0 \dots\dots (1)$$

$$ax + by = a^2 + b^2 \dots\dots (2)$$

Multiply equation (1) by  $b$  and equation (2) by  $a$

$$b^2x - aby = 0$$

$$a^2x + aby = a^2 + ab^2$$

By adding both the equations

$$(a^2 + b^2)x = a^2 + ab^2 = a(a^2 + b^2)$$

So we get

$$x = a(a^2 + b^2)/a^2 + b^2 = a$$

From equation (2)

$$b \times a - ay = 0$$

By further calculation

$$ab - ay = 0$$

$$ay = ab$$

So we get

$$y = ab/a = b$$

Therefore,  $x = a$  and  $y = b$ .

**10. Solve  $2x + y = 23$ ,  $4x - y = 19$ . Hence, find the values of  $x - 3y$  and  $5y - 2x$ .**

**Solution:**

It is given that

$$2x + y = 23 \dots (1)$$

$$4x - y = 19 \dots\dots (2)$$

Adding both the equations

$$6x = 42$$

$$x = 42/6 = 7$$

Substitute the value of x in equation (1)

$$2 \times 7 + y = 23$$

By further calculation

$$14 + y = 23$$

So we get

$$y = 23 - 14 = 9$$

Therefore,  $x = 7$  and  $y = 9$ .

$$x - 3y = 7 - 3 \times 9 = 7 - 27 = -20$$

$$5y - 2x = 5 \times 9 - 2 \times 7 = 45 - 14 = 31$$

**11. The expression  $ax + by$  has value 7 when  $x = 2, y = 1$ . When  $x = -1, y = 1$ , it has value 1, find a and b.**

**Solution:**

It is given that

$$ax + by = 7 \text{ when } x = 2 \text{ and } y = 1$$

Substituting the values

$$a(2) + b(1) = 7$$

$$2a + b = 7 \dots\dots (1)$$

Here

$$ax + by = 1 \text{ when } x = -1 \text{ and } y = 1$$

Substituting the values

$$a(-1) + b(1) = 1$$

$$-a + b = 1 \dots\dots (2)$$

By subtracting both the equations

$$-3a = -6$$

So we get

$$a = -6 / -3 = 2$$

Substituting the value of a in equation (1)

$$2 \times 2 + b = 7$$

By further calculation

$$4 + b = 7$$

$$b = 7 - 4 = 3$$

Therefore,  $a = 2$  and  $b = 3$ .

**12. Can the following equations hold simultaneously?**

$$3x - 7y = 7$$

$$11x + 5y = 87$$

$$5x + 4y = 43.$$

**If so, find x and y.**

**Solution:**

$$3x - 7y = 7 \dots\dots (1)$$

$$11x + 5y = 87 \dots\dots (2)$$

$$5x + 4y = 43 \dots\dots (3)$$



**ML Aggarwal Solutions for Class 9 Maths Chapter 5 -  
Simultaneous Linear Equations**

Now multiply equation (1) by 5 and (2) by 7

$$15x - 35y = 35$$

$$77x + 35y = 609$$

By adding both the equations

$$92x = 644$$

By division

$$x = 644/92 = 7$$

Substitute the value of x in equation (1)

$$3 \times 7 - 7y = 7$$

By further calculation

$$21 - 7y = 7$$

So we get

$$-7y = 7 - 21 = -14$$

$$y = -14 / -7 = 2$$

Therefore,  $x = 7$  and  $y = 2$ .

If  $x = 7$  and  $y = 2$  satisfy the equation (3) then we can say that the equations hold simultaneously

Substitute the value of x and y in equation (3)

$$5x + 4y = 43$$

By further calculation

$$5 \times 7 + 4 \times 2 = 43$$

So we get

$$35 + 8 = 43$$

$$43 = 43 \text{ which is true.}$$

Therefore, the equations hold simultaneously.



**Exercise 5.3**

**1. Solve the following systems of simultaneous linear equations by cross-multiplication method:**

(i)  $3x + 2y = 4$

$8x + 5y = 9$

(ii)  $3x - 7y + 10 = 0$

$y - 2x = 3.$

**Solution:**

(i)  $3x + 2y = 4$

$8x + 5y = 9$

We can write it as

$3x + 2y - 4 = 0$

$8x + 4y - 9 = 0$

By cross multiplication method

$x / (-18 + 20) = y / (-32 + 27) = 1 / (15 - 16)$

By further calculation

$x/2 = y/-5 = 1/-1$

So we get

$x/2 = -1$

$x = -2$

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

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

(ii)  $3x - 7y + 10 = 0$

$y - 2x = 3$

We can write it as

$3x - 7y + 10 = 0$

$y - 2x - 3 = 0$

By cross multiplication method

$x / (21 - 10) = y / (-20 + 9) = 1 / (3 - 14)$

By further calculation

$x/11 = y/-11 = 1/-11$

So we get

$x/11 = 1/-11$

$x = -1$

Similarly

$y/-11 = 1/-11$

$y = 1$

Therefore,  $x = -1$  and  $y = 1.$

**2. Solve the following pairs of linear equations by cross-multiplication method:**

(i)  $x - y = a + b$

$ax + by = a^2 - b^2$

(ii)  $2bx + ay = 2ab$

$bx - ay = 4ab.$

**Solution:**

(i)  $x - y = a + b$



ML Aggarwal Solutions for Class 9 Maths Chapter 5 -  
Simultaneous Linear Equations

$$ax + by = a^2 - b^2$$

We can write it as

$$x - y - (a + b) = 0$$

$$ax + by - (a^2 - b^2) = 0$$

By cross multiplication method

$$x/[a^2 - b^2 + b(a + b)] = y/[-a(a + b) + a^2 - b^2] = 1/(b + a)$$

By further calculation

$$x/(a^2 - b^2 + ab + b^2) = y/(-a^2 - ab + a^2 - b^2) = 1/(a + b)$$

So we get

$$x/[a(a + b)] = y/[-b(a + b)] = 1/(a + b)$$

$$x = a(a + b)/(a + b) = a$$

$$y = [-b(a + b)]/(a + b) = -b$$

Therefore,  $x = a$  and  $y = -b$ .

(ii)  $2bx + ay = 2ab$

$$bx - ay = 4ab$$

We can write it as

$$2bx + ay - 2ab = 0$$

$$bx - ay - 4ab = 0$$

By cross multiplication method

$$x/(-4a^2b - 2a^2b) = y/(-2ab^2 + 8ab^2) = 1/(-2ab - ab)$$

By further calculation

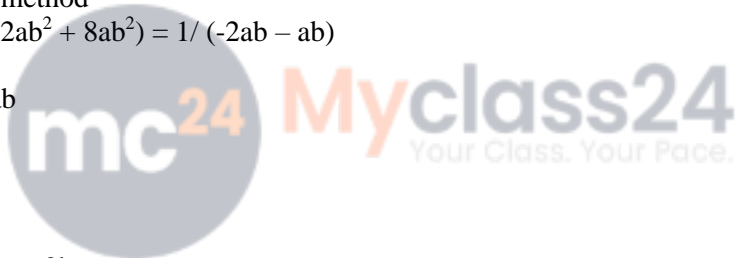
$$x/-6a^2b = y/6ab^2 = 1/-3ab$$

So we get

$$x = -6a^2b/-3ab = 2a$$

$$y = 6ab^2/-3ab = -2b$$

Therefore,  $x = 2a$  and  $b = -2b$ .



**Exercise 5.4**

Solve the following pairs of linear equations (1 to 5):

1. (i)  $2/x + 2/3y = 1/6$

$2/x - 1/y = 1$

(ii)  $3/2x + 2/3y = 5$

$5/x - 3/y = 1$ .

**Solution:**

(i)  $2/x + 2/3y = 1/6$  ..... (1)

$2/x - 1/y = 1$  ..... (2)

By subtracting both the equations

$5/3y = -5/6$

By cross multiplication

$-15y = 30$

By division

$y = 30/-15 = -2$

Substitute the value of y in equation (1)

$2/x + 2/(3 \times (-2)) = 1/6$

By further calculation

$2/x - 1/3 = 1/6$

So we get

$2/x = 1/6 + 1/3$

Taking LCM

$2/x = (1 + 2)/6 = 3/6$

By cross multiplication

$x = (2 \times 6)/3 = 12/3 = 4$

Therefore,  $x = 4$  and  $y = -2$ .

(ii)  $3/2x + 2/3y = 5$  ..... (1)

$5/x - 3/y = 1$  ..... (2)

Multiply equation (1) by 1 and (2) by  $2/9$

$3/2x + 2/3y = 5$

$10/9x - 2/3y = 2/9$

By adding both the equations

$(3/2 + 10/9)1/x = 5 + 2/9$

Taking LCM

$(27 + 20)/18 \times 1/x = (45 + 2)/9$

By further calculation

$47/18x = 47/9$

By cross multiplication

$x = (47 \times 9)/(47 \times 18) = 1/2$

Substitute the value of x in equation (2)

$5/1/2 - 3/y = 1$

By further calculation

$10 - 3/y = 1$

$3/y = 10 - 1 = 9$

So we get



$$y = 3/9 = 1/3$$

Therefore,  $x = 1/2$  and  $y = 1/3$ .

**2. (i)  $(7x - 2y)/xy = 5$**

**$(8x + 7y)/xy = 15$**

**(ii)  $99x + 101y = 499xy$**

**$101x + 99y = 501xy$ .**

**Solution:**

(i)  $(7x - 2y)/xy = 5$

$(8x + 7y)/xy = 15$

We can write it as

$7x/xy - 2y/xy = 5$

$8x/xy + 7y/xy = 15$

By further simplification

$7/y - 2/x = 5 \dots (1)$

$8/y + 7/x = 15 \dots (2)$

Now multiply equation (1) by 7 and (2) by 2

$49/y - 14/x = 35$

$16/y + 14/x = 30$

By adding both the equations

$65/y = 65$

So we get

$y = 65/65 = 1$

Substitute the value of  $y$  in equation (1)

$7/1 - 2/x = 5$

By further calculation

$2/x = 7 - 5 = 2$

So we get

$x = 2/2 = 1$

Therefore,  $x = 1$  and  $y = 1$ .

(ii)  $99x + 101y = 499xy$

$101x + 99y = 501xy$

Now divide each term by  $xy$

$99x/xy + 101y/xy = 499xy/xy$

$101y/xy + 99x/xy = 501xy/xy$

By further calculation

$99/y + 101/x = 499 \dots (1)$

$101/y + 99/x = 501 \dots (2)$

By adding both the equations

$200/y + 200/x = 1000$

Divide by 200

$1/y + 1/x = 5 \dots (3)$

Subtracting both the equations

$-2/y + 2/x = -2$



Divide by 2

$$-1/y + 1/x = -1 \dots (4)$$

By adding equation (3) and (4)

$$2/x = 4$$

So we get

$$x = 2/4 = 1/2$$

By subtracting equation (3) and (4)

$$2/y = 6$$

So we get

$$y = 2/6 = 1/3$$

Therefore,  $x = 1/2$  and  $y = 1/3$  if  $x \neq 0$ ,  $y \neq 0$ .

**3. (i)  $3x + 14y = 5xy$**

**$21y - x = 2xy$**

**(ii)  $3x + 5y = 4xy$**

**$2y - x = xy$ .**

**Solution:**

(i)  $3x + 14y = 5xy$

$21y - x = 2xy$

Now dividing each equation by  $xy$  of  $x \neq 0$ ,  $y \neq 0$

$3x/xy + 14y/xy = 5xy/xy$

By further calculation

$3/y = 14/x = 5 \dots (1)$

(ii)  $3x + 5y = 4xy$

$2y - x = xy$

We can write it as

$3x + 5y = 4xy$

$-x + 2y = xy$

Divide each equation by  $xy$  if  $x \neq 0$  and  $y \neq 0$

$3x/xy + 5y/xy = 4xy/xy$

So we get

$3/y + 5/x = 4 \dots (1)$

$-x/xy + 2y/xy = xy/xy$

So we get

$-1/y + 2/x = 1 \dots (2)$

Now multiply equation (1) by 1 and (2) by 3

$3/y + 5/x = 4$

$-3/y + 6/x = 3$

By adding both the equations

$11/x = 7$

So we get

$x = 11/7$



Substitute the value of x in equation (2)

$$-1/y + 2/11/7 = 1$$

By further calculation

$$-1/y + (2 \times 7)/11 = 1$$

$$-1/y + 14/11 = 1$$

We can write it as

$$-1/y = 1 - 14/11$$

Taking LCM

$$-1/y = (11 - 14)/11$$

So we get

$$-1/y = -3/11$$

By cross multiplication

$$-3y = -11$$

$$y = -11/-3 = 11/3$$

Therefore,  $x = 11/7$  and  $y = 11/3$ .

**4. (i)  $20/(x + 1) + 4/(y - 1) = 5$**

**$10/(x + 1) - 4/(y - 1) = 1$**

**(ii)  $3/(x + y) + 2/(x - y) = 3$**

**$2/(x + y) + 3/(x - y) = 11/3$ .**

**Solution:**

(i)  $20/(x + 1) + 4/(y - 1) = 5$  ..... (1)

$10/(x + 1) - 4/(y - 1) = 1$  ..... (2)

Add equation (1) and (2)

$$30/(x + 1) = 6$$

By cross multiplication

$$30 = 6(x + 1)$$

By further calculation

$$30/6 = x + 1$$

$$5 = x + 1$$

So we get

$$x = 5 - 1 = 4$$

Substitute the value of x in equation (1)

$$20/(x + 1) + 4/(y - 1) = 5$$

$$20/(4 + 1) + 4/(y - 1) = 5$$

By further calculation

$$20/5 + 4/(y - 1) = 5$$

$$4 + 4/(y - 1) = 5$$

We can write it as

$$4/(y - 1) = 5 - 4 = 1$$

$$4/(y - 1) = 1$$

By cross multiplication

$$4 = 1(y - 1)$$

So we get

$$4 = y - 1$$

$$y = 4 + 1 = 5$$



Therefore,  $x = 4$  and  $y = 5$ .

$$(ii) \frac{3}{x+y} + \frac{2}{x-y} = 3 \dots (1)$$

$$\frac{2}{x+y} + \frac{3}{x-y} = \frac{11}{3} \dots (2)$$

Multiply equation (1) by 3 and (2) by 2

$$\frac{9}{x+y} + \frac{6}{x-y} = 9 \dots (3)$$

$$\frac{4}{x+y} + \frac{6}{x-y} = \frac{22}{3} \dots (4)$$

Subtracting both the equations

$$\frac{5}{x+y} = 9 - \frac{22}{3}$$

Taking LCM

$$\frac{5}{x+y} = \frac{5}{3}$$

By cross multiplication

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

By further calculation

$$(5 \times 3) / 5 = x + y$$

$$x + y = (3 \times 1) / 3$$

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

Substitute equation (5) in (1)

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

By further calculation

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

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

So we get

$$\frac{2}{2} = x - y$$

Here

$$1 = x - y \dots (6)$$

We can write it as

$$x - y = 1$$

$$x + y = 3$$

By adding both the equations

$$2x = 4$$

$$x = \frac{4}{2} = 2$$

Substitute  $x = 2$  in equation (5)

$$2 + y = 3$$

$$y = 3 - 2 = 1$$

Therefore,  $x = 2$  and  $y = 1$ .

$$5. (i) \frac{1}{2}(2x + 3y) + \frac{12}{7}(3x - 2y) = \frac{1}{2}$$

$$\frac{7}{2}(2x + 3y) + 4(3x - 2y) = 2$$

$$(ii) \frac{1}{2}(x + 2y) + \frac{5}{3}(3x - 2y) = -\frac{3}{2}$$

$$\frac{5}{4}(x + 2y) - \frac{3}{5}(3x - 2y) = \frac{61}{60}.$$

**Solution:**

$$(i) \frac{1}{2}(2x + 3y) + \frac{12}{7}(3x - 2y) = \frac{1}{2}$$

$$\frac{7}{2}(2x + 3y) + 4(3x - 2y) = 2$$

Consider  $2x + 3y = a$  and  $3x - 2y = b$

We can write it as

$$\frac{1}{2}a + \frac{12}{7}b = \frac{1}{2}$$



$$7/a + 4/b = 2$$

Now multiply equation (1) by 7 and (2) by  $\frac{1}{2}$

$$7/2a + 12/b = 7/2$$

$$7/2a + 2/b = 1$$

Subtracting both the equations

$$10/b = 5/2$$

So we get

$$b = (10 \times 2)/5 = 4$$

Substitute the value of b in equation (2)

$$7/a + 4/4 = 2$$

$$7/a + 1 = 2$$

So we get

$$7/a = 2 - 1 = 1$$

$$a = 7$$

Here

$$2x + 3y = 7 \dots (3)$$

$$3x - 2y = 4 \dots (4)$$

Multiply equation (3) by 2 and (4) by 3

$$4x + 6y = 14$$

$$9x - 6y = 12$$

So we get

$$13x = 26$$

$$x = 26/13 = 2$$

Substitute the value of x in (3)

$$2 \times 2 + 3y = 7$$

By further calculation

$$4 + 3y = 7$$

So we get

$$3y = 7 - 4 = 3$$

$$y = 3/3 = 1$$

Therefore,  $x = 2$  and  $y = 1$ .

$$(ii) \frac{1}{2}(x + 2y) + \frac{5}{3}(3x - 2y) = -\frac{3}{2}$$

$$\frac{5}{4}(x + 2y) - \frac{3}{5}(3x - 2y) = \frac{61}{60}$$

Consider  $x + 2y = a$  and  $3x - 2y = b$

$$\frac{1}{2}a + \frac{5}{3}b = -\frac{3}{2} \dots (1)$$

$$\frac{5}{4}a - \frac{3}{5}b = \frac{61}{60} \dots (2)$$

Now multiply equation (1) by  $\frac{5}{2}$  and (2) by (1)

$$\frac{5}{4}a + \frac{25}{6}b = -\frac{15}{4}$$

$$\frac{5}{4}a - \frac{3}{5}b = \frac{61}{60}$$

Subtracting both the equations

$$\frac{25}{6}b + \frac{3}{5}b = -\frac{15}{4} - \frac{61}{60}$$

Taking LCM

$$\frac{(125 + 18)}{30}b = \frac{(-225 - 61)}{60}$$

By further calculation

$$\frac{143}{30}b = -\frac{286}{60}$$

By cross multiplication



**ML Aggarwal Solutions for Class 9 Maths Chapter 5 -  
Simultaneous Linear Equations**

$$30b \times (-286) = 60 \times 143$$

So we get

$$b = (60 \times 143) / (30 \times -286) = -1$$

Substitute the value of b in equation (1)

$$1/2a + 5/3 \times -1 = -3/2$$

By further calculation

$$1/2a - 5/3 = -3/2$$

We can write it as

$$1/2a = -3/2 + 5/3$$

Taking LCM

$$1/2a = (-9 + 10) / 6 = 1/6$$

So we get

$$a = 6/2 = 3$$

Here

$$x + 2y = 3 \dots (3)$$

$$3x - 2y = -1 \dots (4)$$

Adding both the equations

$$4x = 2$$

$$x = 2/4 = 1/2$$

Substitute the value of x in equation (3)

$$1/2 + 2y = 3$$

By further calculation

$$2y = 3 - 1/2$$

Taking LCM

$$2y = 5/2$$

$$y = 5 / (2 \times 2) = 5/4$$

Therefore,  $x = 1/2$  and  $y = 5/4$ .



## Chapter Test

Solve the following simultaneous linear equations (1 to 4):

$$\begin{aligned} 1.(i) \quad 2x - \frac{3}{4}y &= 3, \\ 5x - 2y &= 7 \end{aligned}$$

**Solution:**

$$2x - \frac{3}{4}y = 3$$

$$\frac{8x - 3y}{4} = 3$$

$$8x - 3y = 12 \quad \dots(i)$$

$$5x - 2y = 7 \quad \dots(ii)$$

Multiply (i) by 5 and (ii) by 8, we get

$$40x - 15y = 60 \quad (iii)$$

$$40x - 16y = 56 \quad (iv)$$

Subtract (iv) from (iii), we get

$$y = 4$$

Substitute y in (i)

$$8x - 3 \times 4 = 12$$

$$\therefore 8x = 12 + 12$$

$$\therefore 8x = 24$$

$$\therefore x = 24/8$$

$$\therefore x = 3$$

Hence  $x = 3$  and  $y = 4$ .

$$(ii) \quad 2(x-4) = 9y+2$$

$$x - 6y = 2$$

**Solution:**

$$2(x-4) = 9y+2$$

$$2x-8 = 9y+2$$

$$2x-9y = 2+8$$

$$2x-9y = 10 \quad \dots(i)$$

$$x-6y = 2 \quad \dots(ii)$$

Multiply (ii) by 2, we get

$$2x - 12y = 4 \quad \dots(iii)$$

Subtract (iii) from (i), we get

$$2x-9y = 10$$

$$-2x + 12y = -4$$

$$\text{-----}$$

$$0+3y = 6$$

$$\therefore 3y = 6$$

$$\therefore y = 6/3$$

$$\therefore y = 2$$

Substitute the value of y in (i)



$$\Rightarrow 2x - 9 \times 2 = 10$$

$$2x - 18 = 10$$

$$2x = 10 + 18$$

$$2x = 28$$

$$\therefore x = 28/2$$

$$\therefore x = 14$$

Hence  $x = 14$  and  $y = 2$ .

**2. (i)  $97x + 53y = 177$**

**$53x + 97y = 573$**

**Solution:**

Given equations are as follows.

$$97x + 53y = 177 \quad \dots(i)$$

$$53x + 97y = 573 \quad \dots(ii)$$

Multiply (i) by 53 and (ii) by 97

$$53(97x + 53y) = 53 \times 177$$

$$5141x + 2809y = 9381 \quad \dots(iii)$$

$$97(53x + 97y) = 97 \times 573$$

$$5141x + 9409y = 55581 \quad \dots(iv)$$

Subtract (iv) from (iii)

$$5141x + 2809y = 9381 \quad \dots(iii)$$

$$5141x + 9409y = 55581 \quad \dots(iv)$$

-----  
 $0x - 6600y = -46200$

$$\Rightarrow -6600y = -46200$$

$$\Rightarrow y = -46200 / -6600$$

$$\Rightarrow y = 7$$

Substitute the value of  $y$  in (i)

$$\Rightarrow 97x + 53 \times 7 = 177$$

$$\Rightarrow 97x + 371 = 177$$

$$\Rightarrow 97x = 177 - 371$$

$$\Rightarrow 97x = -194$$

$$\Rightarrow x = -194/97$$

$$\Rightarrow x = -2$$

Hence  $x = -2$  and  $y = 7$ .

**(ii)  $x + y = 5.5$**

**$x - y = 0.9$**

**Solution:**

$$x + y = 5.5 \quad \dots(i)$$

$$x - y = 0.9 \quad \dots(ii)$$

-----  
Adding (i) and (ii), we get

$$2x = 5.5 + 0.9$$

$$2x = 6.4$$

$$\Rightarrow x = 6.4/2$$

$$\Rightarrow x = 3.2$$



Substitute value of x in (i)

$$3.2 + y = 5.5$$

$$\Rightarrow y = 5.5 - 3.2$$

$$\Rightarrow y = 2.3$$

Hence  $x = 3.2$  and  $y = 2.3$ .

**3. (i)  $x + y = 7xy$**

**$2x - 3y + xy = 0$**

**Solution:**

$$x + y = 7xy \quad \dots(i)$$

$$2x - 3y + xy = 0 \quad \dots(ii)$$

Divide (i) by  $xy$ , we get

$$\frac{x}{xy} + \frac{y}{xy} = \frac{7xy}{xy}$$

$$\frac{1}{y} + \frac{1}{x} = 7$$

$$\frac{1}{x} + \frac{1}{y} = 7 \quad \dots(iii)$$

Divide (ii) by  $xy$ , we get

$$\frac{2x}{xy} - \frac{3y}{xy} + \frac{xy}{xy} = 0$$

$$\frac{2}{y} - \frac{3}{x} + 1 = 0$$

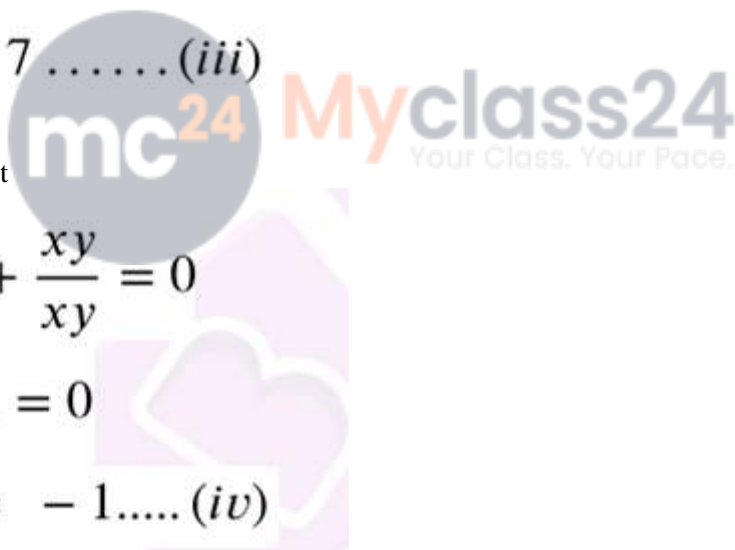
$$-\frac{3}{x} + \frac{2}{y} = -1 \quad \dots(iv)$$

Multiplying (iii) by 3, we get

$$\frac{3}{x} + \frac{3}{y} = 3 \times 7$$

$$\frac{3}{x} + \frac{3}{y} = 21 \quad \dots(v)$$

Adding (v) and (iv), we get



$$\frac{5}{y} = 20$$

$$y = \frac{5}{20}$$

$$y = \frac{1}{4}$$

Substitute value of y in (iv)

$$-\frac{3}{x} + 2 \times 4 = -1$$

$$-\frac{3}{x} + 8 = -1$$

$$-\frac{3}{x} = -1 - 8$$

$$-\frac{3}{x} = -9$$

$$x = \frac{3}{9}$$

$$x = \frac{1}{3}$$



Hence  $x = 1/3$  and  $y = 1/4$ .

(ii)

$$\frac{30}{x-y} + \frac{44}{x+y} = 10$$

$$\frac{40}{x-y} + \frac{55}{x+y} = 13$$

**Solution:**

$$\frac{30}{x-y} + \frac{44}{x+y} = 10 \dots (i)$$

$$\frac{40}{x-y} + \frac{55}{x+y} = 13 \dots (ii)$$

Multiply (i) by 4 and (ii) by 3, we get

$$\frac{120}{x-y} + \frac{176}{x+y} = 40 \dots (iii)$$

$$\frac{120}{x-y} + \frac{165}{x+y} = 39 \dots (iv)$$

Subtracting (iv) from (iii), we get

$$0 + \frac{11}{x+y} = 1$$

$$x + y = 11 \dots (v)$$

Substitute (v) in (i), we get

$$\frac{30}{x-y} + \frac{44}{11} = 10$$

$$\frac{30}{x-y} + 4 = 10$$

$$\frac{30}{x-y} = 10 - 4$$

$$\frac{30}{x-y} = 6$$

$$x - y = \frac{30}{6}$$

$$x - y = 5 \dots (vi)$$

Now solve for (v) and (vi)

$$x+y = 11$$

$$x-y = 5$$

Add (v) and (vi)

$$2x = 16$$

$$\therefore x = 16/2 = 8$$

Substitute x in (v)

$$8+y = 11$$

$$\therefore y = 11-8$$

$$\therefore y = 3$$

Hence  $x = 8$  and  $y = 3$ .



**4. (i)  $ax+by = a-b$**

**$bx-ay = a+b$**

**Solution:**

$$ax+by = a-b \dots (i)$$

$$bx-ay = a+b \dots (ii)$$

multiplying (i) by a and (ii) by b, we get

$$a(ax+by) = a(a-b)$$

$$a^2x + aby = a^2-ab \dots (iii)$$

$$b(bx-ay) = b(a+b)$$

$$b^2x - aby = ab+b^2 \dots (iv)$$

Adding (iii) and (iv)

$$a^2x + aby = a^2-ab$$

$$b^2x - aby = ab+b^2$$

$$\text{-----}$$

$$(a^2+b^2)x = (a^2+b^2)$$

$$\Rightarrow x = (a^2+b^2)/(a^2+b^2)$$

$$\Rightarrow x = 1$$

Substitute the value of x in (i), we get

$$a \times 1 + by = a - b$$

$$a + by = a - b$$

$$\Rightarrow by = -b$$

$$\Rightarrow y = -b/b$$

$$\Rightarrow y = -1$$

Hence  $x = 1$  and  $y = -1$ .

(ii)  $3x + 2y = 2xy$

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

**Solution:**

$$3x + 2y = 2xy \quad \dots(i)$$

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

$$\frac{1}{x} + \frac{2}{y} = \frac{7}{6} \dots\dots(ii)$$

Divide (i) by  $xy$

$$\frac{3x}{xy} + \frac{2y}{xy} = \frac{2xy}{xy}$$

$$\frac{3}{y} + \frac{2}{x} = 2 \dots(iii)$$

Multiply (ii) by 2, we get

$$\frac{2}{x} + \frac{4}{y} = \frac{7}{3} \dots(iv)$$

Subtract (iii) from (iv)

$$\frac{2}{x} + \frac{4}{y} = \frac{7}{3}$$

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

$$0 + \frac{1}{y} = \frac{7}{3} - 2$$

$$\frac{1}{y} = \frac{7-6}{3}$$

$$\frac{1}{y} = \frac{1}{3}$$

$$y = 3$$

Substitute y in (iii)

$$(3/3) + (2/x) = 2$$

$$1 + (2/x) = 2$$

$$(2/x) = 1$$

$$\therefore x = 2$$



Hence  $x = 2$  and  $y = 3$ .

**5. Solve  $2x - (3/y) = 9$**

**$3x + (7/y) = 2$ .**

**Hence find the value of  $k$  if  $x = ky + 5$ .**

**Solution:**

$$2x - (3/y) = 9 \quad \dots(i)$$

$$3x + (7/y) = 2 \quad \dots(ii)$$

Multiply (i) by 3 and (ii) by 2, we get

$$6x - (9/y) = 27 \quad \dots(iii)$$

$$6x + (14/y) = 4 \quad \dots(iv)$$

Subtracting (iv) from (iii), we get

$$-23/y = 23$$

$$\Rightarrow y = 23/-23$$

$$\Rightarrow y = -1$$

Substitute  $y$  in (i)

$$2x - (3/-1) = 9$$

$$2x + 3 = 9$$

$$2x = 9 - 3$$

$$2x = 6$$

$$\Rightarrow x = 6/2$$

$$\Rightarrow x = 3$$

Hence  $x = 3$  and  $y = -1$ .

Given  $x = ky + 5$

Substitute  $x$  and  $y$  in above eqn

$$3 = k \times -1 + 5$$

$$3 = -k + 5$$

$$\Rightarrow k = 5 - 3$$

$$\Rightarrow k = 2$$

Hence the value of  $k$  is 2.

**6. Solve,**

$$\frac{1}{x+y} - \frac{1}{2x} = \frac{1}{30}$$

$$\frac{5}{x+y} + \frac{1}{3} = \frac{4}{3}$$

**Hence find the value of  $2x^2 - y^2$ .**

**Solution:**

$$\frac{1}{x+y} - \frac{1}{2x} = \frac{1}{30} \dots\dots (i)$$

$$\frac{5}{x+y} + \frac{1}{3} = \frac{4}{3} \dots\dots (ii)$$

Let  $(x+y) = a$

$$(1/a) - (1/2x)$$



$$\frac{1}{a} - \frac{1}{2x} = \frac{1}{30} \dots (iii)$$

$$\frac{5}{a} + \frac{1}{x} = \frac{4}{3}$$

Multiply (iii) by 5

$$\frac{5}{a} - \frac{5}{2x} = \frac{1}{6} \dots (iv)$$

$$\frac{5}{a} + \frac{1}{x} = \frac{4}{3}$$

Subtracting (ii) from (iv)

$$-\frac{5}{2x} - \frac{1}{x} = \frac{1}{6} - \frac{4}{3}$$

$$\frac{(-5-2)}{2x} = \frac{(1-8)}{6}$$

$$-\frac{7}{2x} = -\frac{7}{6}$$

$$2x = 6$$

$$x = 3$$

Substitute x in (iii)

$$(1/a) - 1/(2 \times 3) = 1/30$$

$$(1/a) - (1/6) = 1/30$$

$$1/a = (1/30) + (1/6)$$

$$1/a = (1+5)/30$$

$$1/a = 6/30$$

$$\Rightarrow a = 30/6$$

$$\Rightarrow a = 5$$

Substitute a in  $x+y = a$

$$3+y = 5$$

$$\therefore y = 5-3$$

$$\therefore y = 2$$

$$\text{Hence } x = 3, y = 2.$$

$$\therefore 2x^2 - y^2 = 2 \times 3^2 - 2^2$$

$$= 2 \times 9 - 4$$

$$= 18 - 4$$

$$= 14$$

Hence the value of  $2x^2 - y^2$  is 14.

7. Can x, y be found to satisfy the following equations simultaneously ?

$$\frac{2}{y} + \frac{5}{x} = 19$$

$$\frac{5}{y} - \frac{3}{x} = 1$$

$$3x + 8y = 5$$

If so, find them.

**Solution:**



$$\frac{2}{y} + \frac{5}{x} = 19 \dots (i)$$

$$\frac{5}{y} - \frac{3}{x} = 1 \dots (ii)$$

$$3x + 8y = 5 \dots (iii)$$

Multiply (i) by 5 and (ii) by 2, we get

$$\frac{10}{y} + \frac{25}{x} = 95 \dots (iv)$$

$$\frac{10}{y} - \frac{6}{x} = 2 \dots (v)$$

Subtract (v) from (iv)

$$31/x = 95 - 2$$

$$31/x = 93$$

$$\therefore x = 31/93$$

$$\therefore x = 1/3$$

Substitute x in (i)

$$(2/y) + 5 \div (1/3) = 19$$

$$(2/y) + 5 \times 3 = 19$$

$$(2/y) = 19 - 15$$

$$(2/y) = 4$$

$$\therefore y = 2/4$$

$$\therefore y = 1/2$$

Substitute x and y in (iii)

$$3 \times (1/3) + 8 \times (1/2) = 5$$

$$1 + 4 = 5$$

The value of x and y satisfies (iii).

Hence the given equations are simultaneous.

