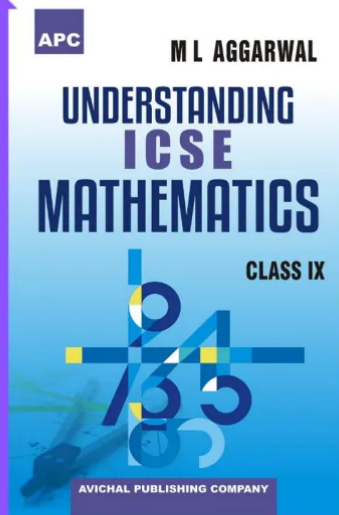


ML Aggarwal Solutions for Class 9 Maths

Chapter 5- Simultaneous Linear Equations



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ML Agrawal Solutions

CLASS 9 MATHS

Chapter 5: Simultaneous
Linear Equations

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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

$$x = 4 + y$$

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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

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$$t = 30/5 = 6$$

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 $y = 17$.

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

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

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

$$\begin{aligned} &= \frac{27}{13 \times 3} \\ &= \frac{9}{13} \end{aligned}$$

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

$29b = 29$

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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

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

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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

$$x = 3$$

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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)

$$2x + 3(75/31) = 23$$

By further calculation

$$2x + 225/31 = 23$$

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We can write it as

$$2x = 23/1 - 225/31$$

Taking LCM

$$2x = (713 - 225)/31 = 488/31$$

So we get

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

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

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

$x + y = 2m$

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

$x/a - y/b = 4$

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

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

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 $y = m - n$.

$$(ii) \frac{2x}{a} + \frac{y}{b} = 2 \dots (1)$$

$$\frac{x}{a} - \frac{y}{b} = 4 \dots (2)$$

Adding both the equations

$$\frac{3x}{a} = 6$$

So we get

$$x = \frac{6a}{3} = 2a$$

Substituting x in equation (1)

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

By further calculation

$$\frac{4a}{a} + \frac{y}{b} = 2$$

So we get

$$4 + \frac{y}{b} = 2$$

$$\frac{y}{b} = 2 - 4 = -2$$

Here

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$$y = -2b$$

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, $x/y = 3$.

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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

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

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

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$$x = 14/7 = 2$$

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

$$2x - 5y = 4 \dots (1)$$

$$3x - 2y = -16 \dots (2)$$

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

$$6x - 15y = 12 \dots (3)$$

$$6x - 4y = -32 \dots (4)$$

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

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

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

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)

$$9x - 8 \times 3 = 12$$

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By further calculation

$$9x - 24 = 12$$

$$9x = 12 + 24 = 36$$

By division

$$x = 36 / 9 = 4$$

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

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

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

We can write it as

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

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

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

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

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

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

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

$29y = -87$

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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 $y = -3$.

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

$$53x + 41y = 147 \dots (2)$$

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

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

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

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

$$x = 6y - 36$$

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

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

By cross multiplication

$$3x = 4(1 + y)$$

So we get

$$3x = 4 + 4y$$

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

Multiply equation (1) by 3

$$3x - 18y = -108$$

$$3x - 4y = 4$$

Subtracting both the equations

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$$-14y = -112$$

So we get

$$y = -112 / -14 = 8$$

Substitute the value of y in equation (1)

$$x - 6 \times 8 = -36$$

By further calculation

$$x - 48 = -36$$

$$x = -36 + 48$$

$$x = 12$$

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

$$3x - 2y = 8/3 \times 3 = 8$$

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

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

Taking LCM

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

By cross multiplication

$$2x - 5y = 7/5 \times 5 = 7$$

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

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

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

We can write it as

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

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

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

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

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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

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

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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 $y = -9/4$.

$$\mathbf{6. \ x - 3y = 3x - 1 = 2x - y.}$$

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)

$$2x + 3y = 1$$

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$$2x + 2y = 2$$

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

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

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

$$\text{Taking LCM}[3(2y + x) - 5(5y + 2)]/3 = 2$$

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

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

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Taking LCM

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

By further calculation

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

So we get

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

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

Taking LCM

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

By further calculation

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

So we get

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

By adding equation (1) and (2)

$$5x + 5y = 100$$

Dividing by 5

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

By subtracting equation (1) and (2)

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

Now add equation (3) and (4)

$$2x = 14$$

$$x = 14/2 = 7$$

Subtracting equation (4) and (3)

$$2y = 26$$

$$y = 26/2 = 13$$

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

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

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

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

$$5a + 6y = 13$$
 (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

$$3a = 15$$

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$$a = 15/3 = 5$$

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

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

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

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

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 $y = 1$.

9. (i) $px + qy = p - q$

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$$qx - py = p + q$$

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

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

Solution:

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

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

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

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

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

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

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

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

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

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

Here

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

Substituting the values

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

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

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:

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

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

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

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

$$15x - 35y = 35$$

$$77x + 35y = 609$$

By adding both the equations

$$92x = 644$$

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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) $3x + 2y = 4$

$$8x + 5y = 9$$

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

$$y - 2x = 3.$$

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

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

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) $x - y = a + b$

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

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

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

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

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

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:

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

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

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By subtracting both the equations

$$\frac{5}{3}y = -\frac{5}{6}$$

By cross multiplication

$$-15y = 30$$

By division

$$y = 30 / -15 = -2$$

Substitute the value of y in equation (1)

$$\frac{2}{x} + \frac{2}{3 \times (-2)} = \frac{1}{6}$$

By further calculation

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

So we get

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

Taking LCM

$$\frac{2}{x} = \frac{(1 + 2)}{6} = \frac{3}{6}$$

By cross multiplication

$$x = \frac{(2 \times 6)}{3} = \frac{12}{3} = 4$$

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

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

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

Multiply equation (1) by 1 and (2) by $\frac{2}{9}$

$$\frac{3}{2}x + \frac{2}{3}y = 5$$

$$\frac{10}{9}x - \frac{2}{3}y = \frac{2}{9}$$

By adding both the equations

$$(\frac{3}{2} + \frac{10}{9})\frac{1}{x} = 5 + \frac{2}{9}$$

Taking LCM

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

By further calculation

$$47/18x = 47/9$$

By cross multiplication

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

Substitute the value of x in equation (2)

$$5/\frac{1}{2} - 3/y = 1$$

By further calculation

$$10 - 3/y = 1$$

$$3/y = 10 - 1 = 9$$

So we get

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

Therefore, $x = \frac{1}{2}$ 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

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

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

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

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

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

By adding both the equations

$$200/y + 200/x = 1000$$

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Divide by 200

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

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

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

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

$$2y - x = xy$$

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

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

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

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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

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$$x = 5 - 1 = 4$$

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 $y = 5$.

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

$$2/(x + y) + 3/(x - y) = 11/3 \dots (2)$$

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

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

$$4/(x + y) + 6/(x - y) = 22/3 \dots (4)$$

Subtracting both the equations

$$5/(x + y) = 9 - 22/3$$

Taking LCM

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

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By cross multiplication

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

By further calculation

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

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

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

Substitute equation (5) in (1)

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

By further calculation

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

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

So we get

$$2/2 = x - y$$

Here

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

We can write it as

$$x - y = 1$$

$$x + y = 3$$

By adding both the equations

$$2x = 4$$

$$x = 4/2 = 2$$

Substitute $x = 2$ in equation (5)

$$2 + y = 3$$

$$y = 3 - 2 = 1$$

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

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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

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

$$\frac{7}{a} + \frac{4}{b} = 2$$

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

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

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

Subtracting both the equations

$$\frac{10}{b} = \frac{5}{2}$$

So we get

$$b = \frac{(10 \times 2)}{5} = 4$$

Substitute the value of b in equation (2)

$$\frac{7}{a} + \frac{4}{4} = 2$$

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

So we get

$$\frac{7}{a} = 2 - 1 = 1$$

$$a = 7$$

Here

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

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

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

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$$25/6b + 3/5b = -15/4 - 61/60$$

Taking LCM

$$(125 + 18)/30b = (-225 - 61)/60$$

By further calculation

$$143/30b = -286/60$$

By cross multiplication

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

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

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

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

Adding both the equations

$$4x = 2$$

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

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Substitute the value of x in equation (3)

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

By further calculation

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

Taking LCM

$$2y = \frac{5}{2}$$

$$y = \frac{5}{(2 \times 2)} = \frac{5}{4}$$

Therefore, $x = \frac{1}{2}$ and $y = \frac{5}{4}$.

Chapter Test

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

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

$$5x - 2y = 7$$

Solution:

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

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

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

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

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

$$40x - 15y = 60 \text{ (iii)}$$

$$40x - 16y = 56 \text{ (iv)}$$

Subtract (iv) from (iii), we get

$$y = 4$$

Substitute y in (i)

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

$$8x = 12 + 12$$

$$8x = 24$$

$$x = 24/8$$

$$x = 3$$

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

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

$x - 6y = 2$

Solution:

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

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

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

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

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

Multiply (ii) by 2, we get

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

Subtract (iii) from (i), we get

$$2x-9y = 10$$

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

$$0+3y = 6$$

$$3y = 6$$

$$y = 6/3$$

$$y = 2$$

Substitute the value of y in (i)

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

$$2x - 18 = 10$$

$$2x = 10 + 18$$

$$2x = 28$$

$$x = 28/2$$

$$x = 14$$

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

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

$53x + 97y = 573$

Solution:

Given equations are as follows.

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

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

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

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

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

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

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

Subtract (iv) from (iii)

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

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

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

$$-6600y = -46200$$

$$y = -46200/-6600$$

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$$y = 7$$

Substitute the value of y in (i)

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

$$97x + 371 = 177$$

$$97x = 177 - 371$$

$$97x = -194$$

$$x = -194/97$$

$$x = -2$$

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

(ii) $x + y = 5.5$

$x - y = 0.9$

Solution:

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

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

Adding (i) and (ii), we get

$$2x = 5.5 + 0.9$$

$$2x = 6.4$$

$$x = 6.4/2$$

$$x = 3.2$$

Substitute value of x in (i)

$$3.2 + y = 5.5$$

$$y = 5.5 - 3.2$$

$$y = 2.3$$

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

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

$2x-3y+xy = 0$

Solution:

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

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

Divide (i) by xy , we get

$$\begin{aligned}\frac{x}{xy} + \frac{y}{xy} &= \frac{7xy}{xy} \\ \frac{1}{y} + \frac{1}{x} &= 7 \\ \frac{1}{x} + \frac{1}{y} &= 7 \dots\dots(iii)\end{aligned}$$

Divide (ii) by xy , we get

$$\begin{aligned}\frac{2x}{xy} - \frac{3y}{xy} + \frac{xy}{xy} &= 0 \\ \frac{2}{y} - \frac{3}{x} + 1 &= 0 \\ -\frac{3}{x} + \frac{2}{y} &= -1 \dots\dots(iv)\end{aligned}$$

Multiplying (iii) by 3, we get

$$\begin{aligned}\frac{3}{x} + \frac{3}{y} &= 3 \times 7 \\ \frac{3}{x} + \frac{3}{y} &= 21 \dots(v)\end{aligned}$$

Adding (v) and (iv), we get

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

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

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

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:

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

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

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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)

$$2x = 16$$

$$x = 16/2 = 8$$

Substitute x in (v)

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$$8+y = 11$$

$$y = 11-8$$

$$y = 3$$

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)

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

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

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

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

$$x = 1$$

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

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

$$a+by = a-b$$

$$by = -b$$

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$$y = -b/b$$

$$y = -1$$

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

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

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

Solution:

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

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

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

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)

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

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

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

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

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

$$y = 3$$

Substitute y in (iii)

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

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

$$(2/x) = 1$$

$$x = 2$$

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:

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

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

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

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

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

Subtracting (iv) from (iii), we get

$$-23/y = 23$$

$$y = 23/-23$$

$$y = -1$$

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Substitute y in (i)

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

$$2x + 3 = 9$$

$$2x = 9 - 3$$

$$2x = 6$$

$$x = 6/2$$

$$x = 3$$

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

Given $x = ky + 5$

Substitute x and y in above eqn

$$3 = k(-1) + 5$$

$$3 = -k + 5$$

$$k = 5 - 3$$

$$k = 2$$

Hence the value of k is 2.

6. Solve,

.

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 $(x+y) = a$

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

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

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

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)

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

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

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

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

$$1/a = 6/30$$

$$a = 30/6$$

$$a = 5$$

Substitute a in $x+y = a$

$$3+y = 5$$

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$$y = 5-3$$

$$y = 2$$

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

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

$$= 2 \times 9 - 4$$

$$= 18 - 4$$

$$= 14$$

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)

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$$31/x = 95-2$$

$$31/x = 93$$

$$x = 31/93$$

$$x = 1/3$$

Substitute x in (i)

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

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

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

$$(2/y) = 4$$

$$y = 2/4$$

$$y = 1/2$$

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.



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M. L. Aggarwal, is an Indian mechanical engineer, educator. His achievements include research in solutions of industrial problems related to fatigue design. Recipient Best Paper award, Manipal Institute of Technology, 2004. Member of TSTE.

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