SUBJEST: **MATHEMATICS**

TOPIC: SIMULTANEOUS LINEAR EQUATIONS I

CLASS : JSS3

OBJECTIVES

At the end of the topic, student should be able to:

1. Understand the meaning of simultaneous equations.
2. Solved simultaneous equations using elimination method.

SIMULTANEOUS LINEAR EQUATIONS

You have already known that a linear equation such as

$$2x - 1 = 5$$

has only one solution. The only value that satisfies $2x - 1 = 5$ is $x = 3$

Now, consider these statements.

The cost of 4 notebooks and 2 pencils is N10 and while the cost of 3 notebooks and 5 pencils is N11. Find the cost of one notebook and one pencil.

The problems show two variables (i.e. Two unknown quantities), note nook and pencil being bought at the same time.

In order to find the costs of the notebooks and pencils above, we need to be able to write equations.

Let n represent the cost of notebook and p represent the cost of pencil.

The first equation can be written as

$$4n + 2p = 10$$

If n = 1 and p = 3 then L.H.S

$$= (4 \times 1) + (2 \times 3) = 4 + 6$$

$$= 10 = R.H.S$$

This means n = 1 and p = 3 are the solutions of the equation

$$4n + 2p = 10$$

There are other pairs of values that also satisfy equation $4n + 2p = 10$

These includes: $n = 2$, $p = 1$, $n = 0$, $p = 5$, $n = 4$, $p = -2$ etc.

This equation $4n + 2p = 10$ has infinite numbers of solutions.

Similarly,

the 2nd equation can also be written as

$$3n + 5p = N11$$

has infinite number of solutions.

A few examples are $n = 2$, $p = 1$, $n = 0$, $p = 2.2$, $n = 4$, $p = -0.2$ etc.

But if we combine the above two equations and solve them at the same time, we find out that there is only one pair of solution i.e. ($n = 2$, $y = 1$) that satisfies them.

Therefore, two equations such as

$4n + 2p = 10$ …………(1)

$3n + 5p = 11$ …………(2)

are called simultaneous equations

SIMULTANEOUS LINEAR EQUATIONS CAN BE SOLVED BY THREE METHODS NAMELY

- Elimination method
- Substitution method
- Graphical method

A. Elimination method

In this method we seek to make one of the two variables becomes zero and then solve for the other variable as in a linear equation in one variable.

To solve simultaneous equations by the elimination method, follow the steps below

(1) The two equations must be in a correct order i.e $x + y = 7$ and $2x – y = 5$

(i) The two equations must be in a correct order e.g.

$$x + y = 7$$

$$2x - y = 5$$

If the equations are mixed up, re-arrange them before solving e.g.

1) $5a = 5 + 2b$ = $5a - 2b = 5$

$4a = -19 - 3b$ $4a + 3b = -19$

2) $9m - 4n = 1$ $9m - 4n = 1$

$-3n + 11m = 5$ $11m - 3n = 5$

2. Check whether the coefficients of the variable you want to eliminate are the same in both equations.

3. If they are the same

(i) add the two equations if the signs of the variables you want to eliminate in the two equations re different (i.e. one is positive and the other is negative)

(ii) subtract, if the signs of that variable in both equations are the same (i.e. either both are negative or positive). Doing this will eliminate the variable.

4. If the coefficients of the variables are not the same, make sure they are the same by multiplying one or both of the equations by a constant.

5. Then solve the remaining equation and find the value of its variable

6. Substitute (or replace) the value of the variable obtained in step 4 above into one of the original equations and solve for the other variable.

Examples:

Solve the following simultaneous equations.

1. $6x + 5y = 15$

$3x + 5y = 12$

Solution

$6x + 5y = 15$ ………………(1) subtract the 2 eqns

\- $3x + 5y = 12$ ………………(2) since the sign

$3x = 3$

$x = 3/3$

$x = 1$

To find y, substitute x = 1 into any eqns

From (1)

$6x + 5y = 15$

$6(1) + 5y = 15$

$6 + 5y = 15$

$5y = 15 - 6$

$5y = 9$

$\therefore\ y = 9/5$

$y = 1\ 4/5$

So the solutions of the equations are x = 1 and y = 1 4/5

2. $4c - 4d = 9$

$5c + 4d = 18$

Solution

$$\begin{array}{rl} & 4c - 4d = 9 \ldots\ldots\ldots\ldots\ldots\ldots(1) \\ + & 5c + 4d = 18 \ldots\ldots\ldots\ldots\ldots\ldots(2) \\ & 9c = 27 \end{array}$$

$\therefore\ c = 27/9$

$c = 3$

from (2)

$$5c + 4d = 18$$

$$5(3) + 4d = 18$$

$$15 + 4d = 18$$

$$4d = 18 - 15$$

$$4d = 3$$

$$d = 3/4$$

$\therefore$ solutions of the equation are

$C = 3$ and $d = \frac{3}{4}$ or $(3, \frac{3}{4})$

3. $7x + 4y = 1$

$2x + 3y = 4$

Solution

$7x + 4y = 1$ ....(1)

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

Multiply (1) by 3 and (2) by 4

$21x + 12y = 3$ ....(3)

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$8x + 12y = 16$ ....(4)

$13x = -13$

$x = (-13)/13$

$x = -1$

from (1), substitute $x = -1$ into (1)

$$7x + 4y = 1$$

$$7(-1) + 4y = 1$$

$$-7 + 4y = 1$$

$$4y = 1 + 7$$

$$4y = 8$$

$$y = 8/4$$

$$y = 2$$

the solutions of equation

$x = -1, \; y = 2$ or $(-1, 2)$

4. $4x - 3y - 23 = 0$

$2x - 5y = 36$

Solution

$4x - 3y = 23$ …………(1){Put in the right order}

$2x - 5y = 36$ …………(2)

Multiply (1) by 1 and (2) by 2

$4x – 3y = 23$ ………..(1)

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$4x - 10y = 72$ ……..(2)

$7y = -49$

$\therefore \quad y = (-49)/7$

$y = -7$

substitute $y = -7$ in (2)

$$2x - 5y = 36$$

$$2x - 5(-7) = 36$$

$$2x + 35 = 36$$

$$2x = 36 - 35$$

$$2x = 1$$

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

$\therefore$ the solutions are $x = \frac{1}{2}$, $y = -7$

5. $5x = 5 + 2y$ wrong order, re-arrange

$4x = -19 - 3y$

Solution

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

$4x + 3y = -19$ ....(2)

Eliminating y , multiply

(1) by 3 and (2) by 2

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

$+ \quad 8x + 6y = -38$ ....(4)

$23x = -23$

$x = (-23)/23$

$x = -1$

from (1), substitute $x = -1$

$$5x - 2y = 5 \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

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

$$-5 - 2y = 5$$

$$-2y = 5 + 5$$

$$-2y = 10$$

$$y = 10/(-2)$$

$$y = -5$$

the solutions are $x = -1$ and $y = -5$

EVALUATION

Use Elimination method to solve the following simultaneous equations.

1. $4x + 3y = 10$

   $4x + 5y = 8$

(2) $x - 5y = 6$

   $4x + 5y = 9$

3. $3x - 2y = 7$

   $4x + 3y = 12$

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

   $3x + 2y = 8$

5. $4y + 3x = 2$

   $Y = x - 3$

Thanks for Watching!!!