



SUBJECT: MATHEMATICS

CHAPTER: 3

TOPIC: Pair of Linear Equations in Two Variables

STEP 1: GUIDELINES AND INTRODUCTION

Dear students kindly refer to the following notes/video links for the Chapter- “Pair of Linear Equations in Two Variables” and thereafter do the questions in your Math Notebook.

(Chapter3 – Part 3)

Link for the chapter:-<http://ncert.nic.in/textbook/textbook.htm?jemh1=3-15>

Introduction: We have already learnt that **there are three algebraic methods to solve a pair of linear equations in two variables.**

- 1) **Substitution Method**
- 2) **Elimination Method by Equating the Coefficients**
- 3) **Cross Multiplication Method**

Today, we are going to learn **Cross Multiplication Method** to solve system of linear equations.

STEP 2:

Subtopics:-

- a) Cross Multiplication Method
- b) Real Life Application (statement questions) based on pair of linear equations

STEP 3:

Key points and important links for reference:

1. Solution by Cross Multiplication method:

Refer to the following link:

https://www.youtube.com/watch?v=Isasku_3lDk

Steps to Remember the Formula

Write the two equations in the form:

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

At first, express the co-efficient of the two equations as:



Now, multiply the co-efficient according to the arrow heads and subtract the upward product from the downward product. Place the three differences under x, y and 1 respectively, forming three fractions and connect them by two signs of equality.

$$\text{We get } \frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1} \longrightarrow (i)$$

which means

$$\frac{x}{b_1c_2 - b_2c_1} = \frac{1}{a_1b_2 - a_2b_1} \quad \text{and} \quad \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1}$$

$$\text{Thus } x = \frac{b_1c_2 - b_2c_1}{a_1b_2 - a_2b_1} \quad \text{and} \quad y = \frac{c_1a_2 - c_2a_1}{a_1b_2 - a_2b_1}$$

Observe that the denominator remains same in both the values of x and y, i.e. $a_1b_2 - a_2b_1$

Read page number 60 of the NCERT textbook.

Let us solve a question

Solve the two variables linear equation:

$$8x + 5y = 11$$

$$3x - 4y = 10$$

Solution:

On transposition, we get

$$8x + 5y - 11 = 0$$

$$3x - 4y - 10 = 0$$

By writing the co-efficient in the following way, we get:

$$\begin{array}{cccc} 5 & -11 & 8 & 5 \\ -4 & -10 & 3 & -4 \end{array}$$

By cross-multiplication method:

$$\frac{x}{(5)(-10) - (-4)(-11)} = \frac{y}{(-11)(3) - (-10)(8)} = \frac{1}{(8)(-4) - (3)(5)} \longrightarrow (i)$$

$$\text{or, } \frac{x}{-50 - 44} = \frac{y}{-33 + 80} = \frac{1}{-32 - 15}$$

$$\text{or, } \frac{x}{-94} = \frac{y}{47} = \frac{1}{-47}$$

Or $\frac{x}{-94} = \frac{1}{47}$ and $\frac{y}{47} = \frac{1}{-47}$

Therefore, the solution is $x = 2, y = -1$

Solution of Exercise 3.5, Q4 - iv and v part is given below:

(v) Let length and breadth of the rectangle be x and y respectively.

\therefore Area = xy

A.T.Q.

1st Condition:

$$\begin{aligned} (x - 5)(y + 3) &= xy - 9 &\Rightarrow xy + 3x - 5y - 15 &= xy - 9 \\ \Rightarrow 3x - 5y - 15 &= -9 \\ \Rightarrow 3x - 5y &= 6 && \dots (i) \end{aligned}$$

2nd Condition:

$$\begin{aligned} (x + 3)(y + 2) &= xy + 67 &\Rightarrow xy + 2x + 3y + 6 &= xy + 67 \\ \Rightarrow 2x + 3y + 6 &= 67 \\ \Rightarrow 2x + 3y &= 61 && \dots (ii) \end{aligned}$$

Solving equations (i) and (ii)

By cross multiplication method

$$\begin{array}{ccccccc} & & x & & y & & -1 \\ & & -5 & & 6 & & 3 & & -5 \\ & & 3 & & 61 & & 2 & & 3 \end{array}$$

$$\frac{x}{-305 - 18} = \frac{y}{12 - 183} = \frac{-1}{9 + 10} \Rightarrow \frac{x}{-323} = \frac{y}{-171} = \frac{-1}{19}$$

$$\Rightarrow x = \frac{323}{19} = 17 \Rightarrow \boxed{x = 17 \text{ units}}$$

and $y = \frac{171}{19} = 9 \Rightarrow \boxed{y = 9 \text{ units}}$

\therefore Length of rectangle = 17 units
and breadth of rectangle = 9 units

(iv) Let speed of car starting from point A = x km/h

Speed of car starting from point B = y km/h

A.T.Q.

1st Condition:

If the cars travel in same direction, then

$$5x - 5y = 100$$

or, $x - y = 20$... (i)

If they travel in opposite directions, then

$$x + y = 100 \quad \dots (ii)$$

Solving (i) and (ii) for x and y

By cross multiplication method

$$\begin{array}{r} x \quad y \quad -1 \\ -1 \quad 20 \quad 1 \quad -1 \\ 1 \quad 100 \quad 1 \quad 1 \end{array}$$
$$\frac{x}{-100 - 20} = \frac{y}{20 - 100} = \frac{-1}{1 + 1} \Rightarrow \frac{x}{-120} = \frac{y}{-80} = \frac{-1}{2}$$
$$\Rightarrow x = \frac{120}{2} = 60 \text{ and } y = \frac{80}{2} = 40$$

\therefore $x = 60 \text{ km/h}$ and $y = 40 \text{ km/h}$

\therefore Speed of car starting from point A = 60 km/h

Speed of car starting from point B = 40 km/h.

Note: We can use any method to solve the pair of equations, if not specified in the question.

STEP 4: **Points to Remember**

1. Any method can be applied to solve the statement questions. Each method is mandatory to be well understood and practiced.

2. Before beginning to solve the question by any algebraic method, check $a_1/b_1 \neq a_2/b_2$

Or $a_1b_2 - a_2b_1 \neq 0$

3. You can either learn the formula given in the link or use the steps explained in the above question.

4. If we use the equations in the form $a_1x + b_1y = c_1$

$$a_2x + b_2y = c_2$$

use -1 in place of 1 in equation (i) above.

ASSIGNMENT:

1. Do NCERT Exercise 3.5, except question 2 (Q-2. to be discussed in the next lesson.)

2. A and B are two points 150 km apart on a highway. Two cars start with different speeds from A and B at the same time. If they move in the same direction, they meet in 15 hours. If they move in the opposite direction, they meet in one hour. Find their speed.

3. The area of a rectangle gets reduced by 9 square units, if its length is reduced by 4 units and the breadth is increased by 3 units. The area is increased by 59 square units, if the length is increased by 3 units and breadth is increased by 2 units. Find the perimeter of the rectangle.

Answer Key

2. 80, 70 3. 13 units and 9 units

NOTE

1. Refer to the following links to practise more questions.

a)

https://diksha.gov.in/play/collection/do_312796455240941568116824?referrer=utm_source%3Ddiksha_mobile%26utm_content%3Ddo_312796455240941568116824%26utm_campaign%3Dshare_content

b) **From Khan Academy Assignments**

<https://www.khanacademy.org/math/in-in-grade-10-ncert>

c) www.examfear.com

d) <http://www.ei-india.com/mindspark-math> (free trial for 60 days)