# Linear Equations in two variables

Grade 10, topic :1 ( Maths 1)

# Topics

1. Methods of solving linear equations in two variables -
    a. Substitution Method
    b. Elimination Method
    c. Cramer’s Method
2. Equations that can be transformed in linear equation in two variables
3. Application of simultaneous equations

# Engage: How many marbles do they have in all ?

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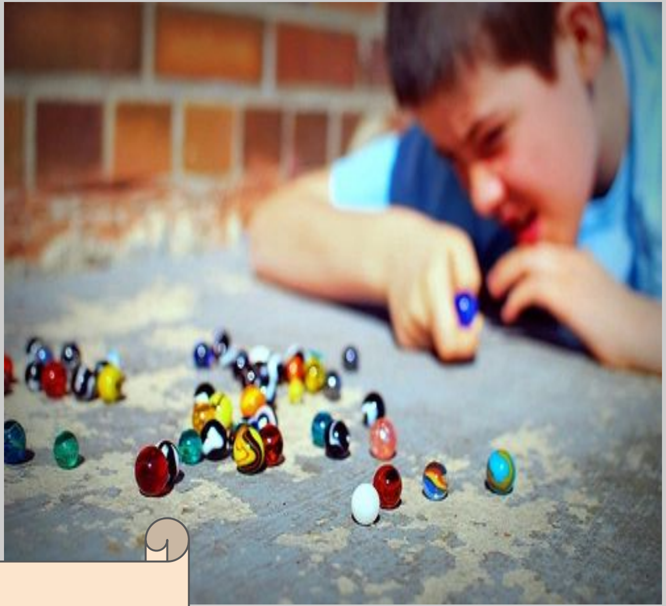

Ram

Ram has 5 marbles .
Shyam has double the number of marbles as Ram has .

राम के 5 कांच के गोले हैं।
राम के पास श्याम की संख्या दोगुनी है।

Shyam

# Explore : How do equation & expression differ ?

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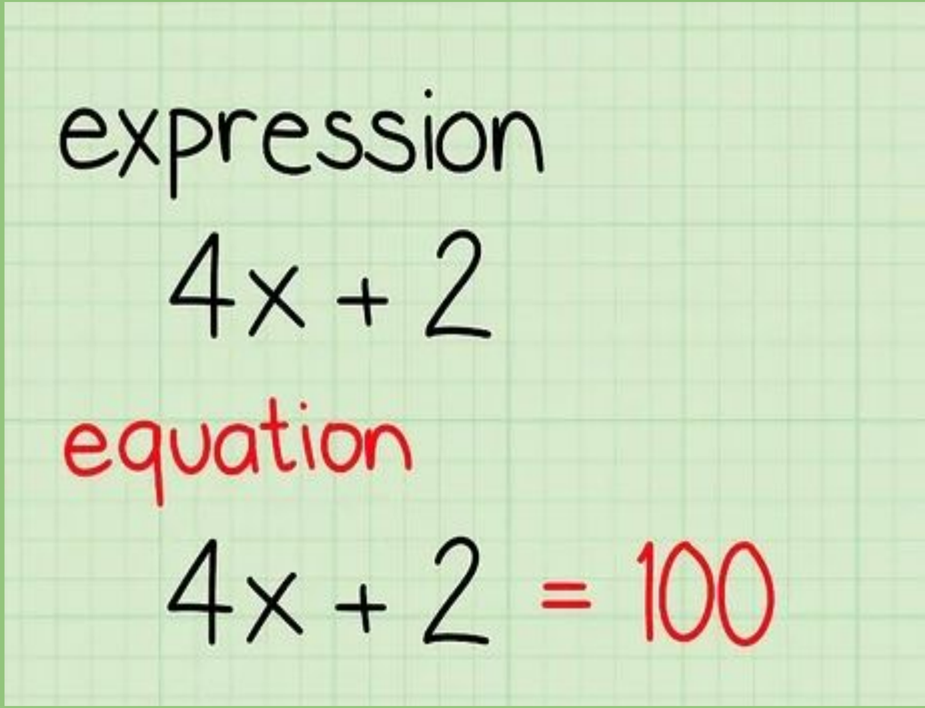


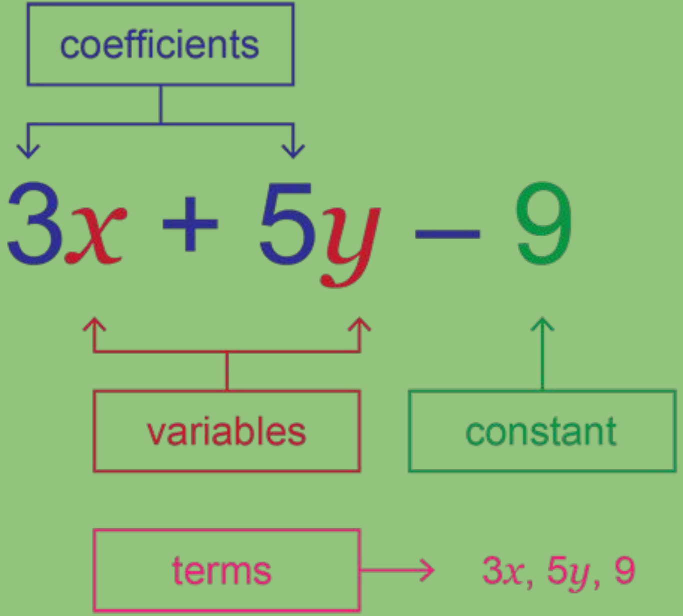

# Explore (answers)

- What is a variable?
  - A variable is a quantity that may change within the context of a mathematical problem or experiment. Typically, we use a single letter to represent a variable. The letters **x, y, and z** are common generic symbols used for variables.
- What is an equation ?
  - an equation is a statement that asserts the equality of two expressions, which are connected by the equals sign "=".
- What is a linear equation ?
  - An equation which involves only those variable whose highest power is 1 is known as a linear equation in that variable. E.g. $x + 4 = 19$
- How to identify if it is a linear equation ?
  - The equation must have a power 1 only.
- How many ways are there to solve a linear equation in two variables
  - There are four ways to solve linear equation in two variables

# Explain & Elaborate

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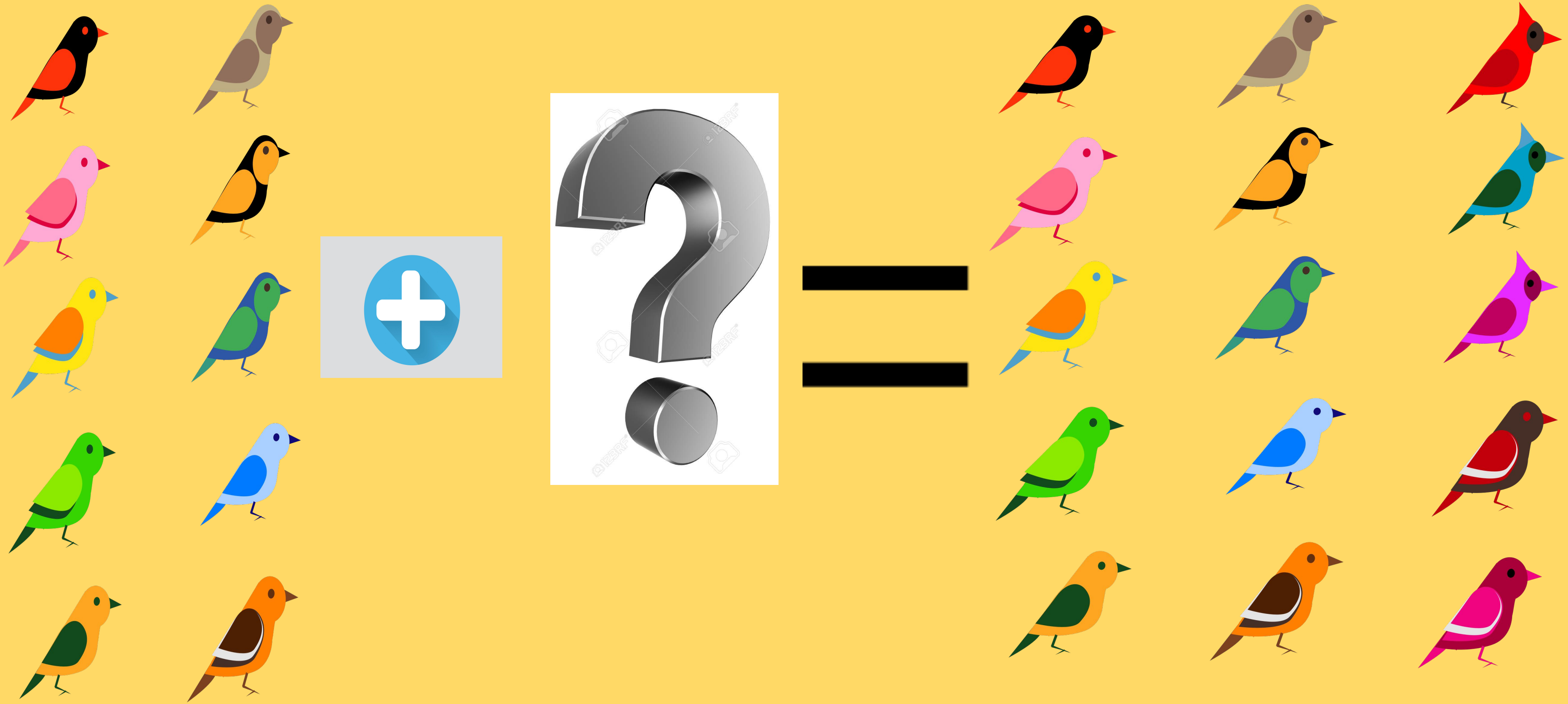

# Create equations on your own now .

Now can the ? of the previous picture be replaced by any alphabet or variable ? (Like  or y etc..)

क्या हम x का उपयोग करके पिछली तस्वीर को फिर से लिख सकते हैं?

10 birds + x birds  = 15 birds .

# Explain & Elaborate



$$x + 7 = 30$$

$$7 + 4y = 19$$

If x does not have any coefficient , what does it mean ?

How are these two equations different ?

# Try to solve them in your notebook

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## What is the solution to this equation?

| | | |
|---|---|---|
| $4x + 8 = 16$ | $-5x - 1 + 4x = 3$ | $2(x - 4) = 3x - 9$ |

Name: ___________ Grade: VIII

## Linear Equations / Linear equations in one variable

1. Solve for unknown.

   a. $x + 4 = 9$
   b. $x - 28 = -20$
   c. $k - \frac{1}{4} = -2$
   d. $4(k + 2) = 5$
   e. $\frac{x}{0.05} = 0.05$


2. Identify the number.

   a. Five times a number is equal to 54.
   b. Half of the number is 120
   c. I thought of a number. If I multiply this number by 9, the number will be 117 .
   d. $\frac{1}{5}$ of a number is 105

3. Write an equation and solve.

   a. Three times Jack's pocket money is 90. What is his pocket money?
   b. 30% of a sum of money is ₹ 900. What is the amount?
   c. A student has obtained 55% marks in a test. If the student scored 49 marks, find the

# Some examples for support

**Ex. (1)** Solve the following equations.

(i) $2(x - 3) = \frac{3}{5}(x + 4)$

**Solution:** Multiplying both sides by 5

$10(x - 3) = 3(x + 4)$

$\therefore\ 10x - 30 = 3x + 12$

Adding 30 to both sides

$\therefore\ 10x - 30 + 30 = 3x + 12 + 30$

$10x = 3x + 42$

Subtracting $3x$ from both sides

$\therefore\ 10x - 3x = 3x + 42 - 3x$

$\therefore\ 7x = 42$

Dividing both sides by 7

$\frac{7x}{7} = \frac{42}{7}$

$\therefore\ x = 6$

(ii) $9x - 4 = 6x + 29$

**Solution:** Adding 4 to both sides

$9x - 4 + 4 = 6x + 29 + 4$

$\therefore\ 9x = 6x + 33$

Subtracting $6x$ from both sides

$\therefore\ 9x - 6x = 6x + 33 - 6x$

$\therefore\ 3x = 33$

Dividing both sides by 3

$\therefore\ \frac{3x}{3} = \frac{33}{3}$

$\therefore\ x = 11$

# Some more examples

**Solution: Method I**

$$\frac{2}{3} + 5a = 4$$

Multiplying each term by 3

$$3 \times \frac{2}{3} + 3 \times 5a = 4 \times 3$$

$$\therefore 2 + 15a = 12$$

$$\therefore 15a = 12 - 2$$

$$\therefore 15a = 10$$

$$\therefore a = \frac{10}{15}$$

$$\therefore a = \frac{2}{3}$$

**Method II**

Subtracting $\frac{2}{3}$ from both the sides,

$$\frac{2}{3} + 5a - \frac{2}{3} = 4 - \frac{2}{3}$$

$$\therefore 5a = \frac{12-2}{3}$$

$$\therefore 5a = \frac{10}{3}$$

Dividing both sides by 5

$$\frac{5a}{5} = \frac{10}{3} \times \frac{1}{5}$$

$$\therefore a = \frac{2}{3}$$

If A, B, C, D are nonzero expressions such that $\frac{A}{B} = \frac{C}{D}$ then multiplying both sides by B × D we get the equation AD = BC. Using this we will solve examples.

**Now let us see something new . What if two different things are related by a single equation ?**

# Identify the difference

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$$2x + 17 = 40$$

Do you observe 2X + 17 has only one variable x , while 2x + 17 y = 40 has two variables x and 7 ?

$$2x + 17y = 40$$

# Derive a relationship between ...

Take bananas as X
Oranges Y

Total number of fruits =1000

Relate them .

# Linear equation

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An equation has two side, left hand side and right hand side with an equal in between

Eg. $x + y = 25$ is a linear equation

There are many ways of writing linear equations, but they usually have constants (like "2" or "c") and must have simple variables (like "x" or "y").

Examples: These are linear equations:

- ✓ $y = 3x - 6$
- ✓ $y - 2 = 3(x + 1)$
- ✓ $y + 2x - 2 = 0$
- ✓ $5x = 6$
- ✓ $y/2 = 3$

# Not linear equation



But the variables (like "x" or "y") in Linear Equations do NOT have:

(1) Exponents (like the 2 in $x^2$)
(2) Square roots, cube roots, etc

Examples: These are NOT linear equations:

$$y^2 - 2 = 0$$

$$3\sqrt{x} - y = 6$$

$$x^3/2 = 16$$

# Substitution Method

- $3x + 2y = 19$
- $x + y = 8$

We can start with any equation and any variable.

Let's use the second equation and the variable "y" (it looks the simplest equation).

Write one of the equations so it is in the style "variable = ...":

We can subtract x from both sides of $x + y = 8$ to get $y = 8 - x$. Now our equations look like this:

- $3x + 2y = 19$
- $y = 8 - x$

# Substitution Method

Now replace "y" with "8 − x" in the other equation:

- $3x + 2(8 - x) = 19$

Solve using the usual algebra methods:

Expand 2(8−x):

- $3x + 16 - 2x = 19$
- $X = 19 - 16$
- $X = 3$

# From your text book

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| No. | Equation | Is the equation a linear equation in 2 variables ? |
|---|---|---|
| 1 | $4m + 3n = 12$ | Yes |
| 2 | $3x^2 - 7y = 13$ | |
| 3 | $\sqrt{2}\,x - \sqrt{5}\,y = 16$ | |
| 4 | $0x + 6y - 3 = 0$ | |
| 5 | $0.3x + 0y - 36 = 0$ | |
| 6 | $\frac{4}{x} + \frac{5}{y} = 4$ | |
| 7 | $4xy - 5y - 8 = 0$ | |

# Explain

Solve the following simultaneous equations (Elimination Method). $5x - 3y = 8$; $3x + y = 2$

**Method I :** $5x - 3y = 8 \ldots$ (I)

$3x + y = 2 \ldots$ (II)

Multiplying both sides of equation (II) by 3.

$9x + 3y = 6 \ldots$ (III)

$5x - 3y = 8 \ldots$ (I)

Now let us add equations (I) and (III)

$$\begin{array}{r} 5x - 3y = 8 \\ + \; 9x + 3y = 6 \\ \hline 14x = 14 \end{array}$$

$\therefore \; x = 1$

substituting $x = 1$ in equation (II)

$3x + y = 2$

$\therefore \; 3 \times 1 + y = 2$

$\therefore \; 3 + y = 2$

$\therefore \; y = -1$

solution is $x = 1$, $y = -1$; it is also written as $(x, y) = (1, -1)$

# Explain

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# Explain

Solve the following simultaneous equations (Substitution method). 5x - 3y = 8; 3x + y = 2

$5x - 3y = 8 \ldots$ (I)

$3x + y = 2 \ldots$ (II)

Let us write value of y in terms of x from equation (II) as

$y = 2 - 3x \ldots$ (III)

Substituting this value of $y$ in equation (I).

$5x - 3y = 8$

$\therefore\ 5x - 3(2 - 3x) = 8$

$\therefore\ 5x - 6 + 9x = 8$

$\therefore\ 14x - 6 = 8$

$\therefore\ 14x = 8 + 6$

$\therefore\ 14x = 14$

$\therefore\ x = 1$

Substituting $x = 1$ in equation (III).

$y = 2 - 3x$

$\therefore\ y = 2 - 3 \times 1$

$\therefore\ y = 2 - 3$

$\therefore\ y = -1$

$x = 1$, $y = -1$ is the solution.

# Determinant

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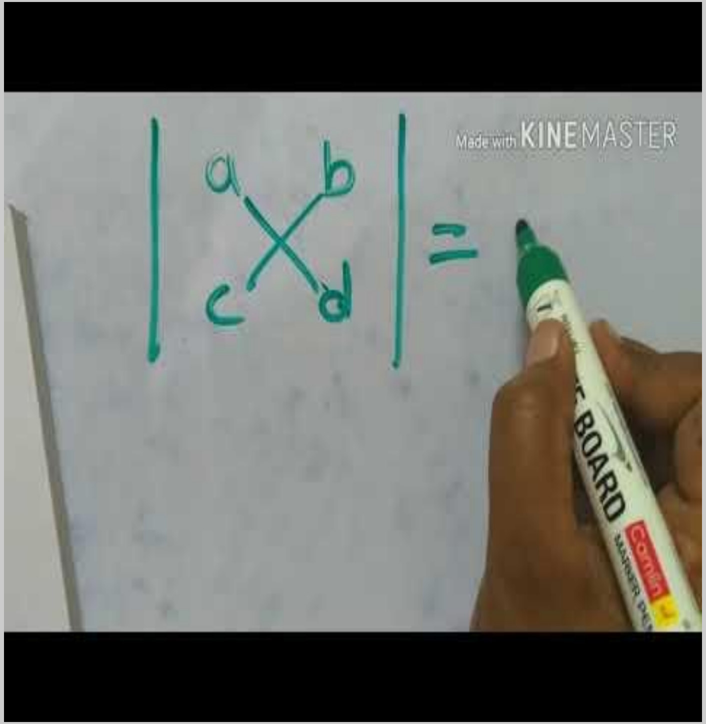



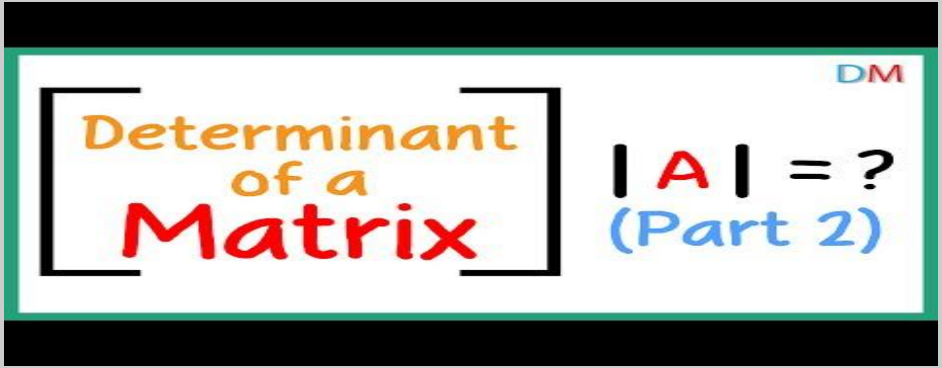

# Determinant and cramer’s rule

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