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Equations

coefficient of the variable

$$2x + 3y = 3$$

Variable

Constant

★ Conditional Equation

$x + 3 = 0$

↓

only particular value satisfy this equation.

★ Identity

$$(x+y)^2 = x^2 + 2xy + y^2$$

For all real values of x \$ y will satisfy.

★ Solution / Root of the equation

↓

Value of x.

Ex :- $x + 3 = 0$

$x = -3$ (Solution / Root)

★ Linear Equation (x^1)
or Simple Equation (only 1 variable)

Ex :- $2x + 3$

★ Linear Equation in two variables

$$\boxed{ax + by = c}$$

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METHODS

Elimination method

Cross Product Method

$$a_1x + b_1y + c_1 = 0 \qquad a_2x + b_2y + c_2 = 0$$

$$\frac{x}{\begin{matrix} b_1 & c_1 \\ b_2 & c_2 \end{matrix}} = \frac{y}{\begin{matrix} c_1 & a_1 \\ c_2 & a_2 \end{matrix}} = \frac{1}{\begin{matrix} a_1 & b_1 \\ a_2 & b_2 \end{matrix}}$$

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

$$x = \frac{b_1c_2 - b_2c_1}{a_1b_2 - a_2b_1} \qquad y = \frac{c_1a_2 - c_2a_1}{a_1b_2 - a_2b_1}$$

★ Linear Equation in Three variables.

$$\boxed{ax + by + cz = d}$$

Q. $2x + 3y + 4z = 0$, $\underset{(\times 2)}{x + 2y - 5z = 0}$ $(\times 10)$, $10x + 16y - 6z = 0$

$$\begin{aligned} 2x + 3y + 4z &= 0 \\ 2x + 4y - 10z &= 0 \\ - \quad - \quad + \quad & \\ \hline -y + 14z &= 0 \end{aligned} \qquad \begin{aligned} 10x + 20y - 50z &= 0 \\ 10x + 16y - 6z &= 0 \\ - \quad - \quad + \quad & \\ \hline 4y - 44z &= 0 \end{aligned}$$

$$y = \frac{44z}{4} = 11z$$

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* **Quadratic Equation** (max. power 2)

$$\boxed{ax^2 + bx + c = 0}$$

Factorizing method

$x^2 + 5x + 6 = 0$

$x^2 + 2x + 3x + 6 = 0$

$x(x+2) + 3(x+2) = 0$

$(x+2)(x+3) = 0$

$x = -2, \quad x = -3$

Quadratic Formula / Determinant method

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

a) $b^2 - 4ac = 0$, roots are equal.

b) $b^2 - 4ac > 0$, roots are real no. and unequal.

c) $b^2 - 4ac < 0$, roots are imagina ($\sqrt{-2}$)

d) $b^2 - 4ac$ is perfect square, rational

e) $b^2 - 4ac$ is not perfect square, irration

$\rightarrow \sqrt{b^2 - 4ac}$

$x = 2 + \sqrt{3} \qquad x = 2 - \sqrt{3}$

conjugate pair

* **Sum of roots :-**

$$\alpha + \beta = \frac{-b}{a}$$

$\boxed{x = \alpha, \beta}$

$\downarrow$

Roots

* **Product of roots**

$$\alpha\beta = \frac{c}{a}$$

* If α and β are the roots of a equation, then

$(x - \alpha)(x - \beta) = 0$

* $x^2 - (\alpha + \beta)x + \alpha\beta = 0$

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Q. If $p \neq q$ and $p^2 = 5p - 3$ and $q^2 = 5q - 3$, the equation having roots as $\frac{p}{q}$ and $\frac{q}{p}$ is

$p^2 - 5p + 3 = 0$ — $p \,\&\, q = x$

$q^2 - 5q + 3 = 0$

$x^2 - 5x + 3 = 0$

Roots of equation is $p \,\&\, q$.

$p + q = -5$

$pq = 3$

Ans. — $3x^2 - 19x + 3 = 0$

Q. The value of $2 + \cfrac{1}{2 + \cfrac{1}{2 + \cfrac{1}{2 + \dots}}} = x$

$2 + \frac{1}{x} = x$ Ans. C) $1 + \sqrt{2}$

$2x + 1 = x^2$

$x^2 - 2x - 1 = 0$

$\cancel{x^2 - x - x - 1 = 0}$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \times 1(-1)}}{2 \times 1}$$

$$= \frac{2 \pm \sqrt{8}}{2} = \frac{2 \pm 2\sqrt{2}}{2} = 1 \pm \sqrt{2}$$

$x = 1 + \sqrt{2}$ (Addition में कभी भी negative नहीं आ सकता)

* Cubic Equation (max. power 2)

$$\boxed{ax^3 + bx^2 + cx + d = 0}$$

Method :-

$x^3 + x^2 - x - 1 = 0$

$x^2(x+1) - (x+1) = 0$

$(x+1)(x^2-1) = 0$

$(x+1)(x-1)(x+1) = 0$

$\Rightarrow (x+1) = 0 \Rightarrow x = -1$

$\Rightarrow (x-1) = 0 \Rightarrow x = 1$

$\Rightarrow (x+1) = 0 \Rightarrow x = -1$

* Roots p, q, r.

$p + q + r = \frac{-b}{a}$

$pq + qr + pr = \frac{c}{a}$

$pqr = \frac{-d}{a}$

Q. If $\boxed{L+M+N=0}$ and L, M, N are rationals the roots of the equation $(M+N-L)x^2 + (N+L-M)x + (L+M-N) = 0$

$(-L-L)x^2 + (-M-M)x + (-N-N) = 0$

$-2Lx^2 + (-2M)x + (-2N) = 0$

$-2(Lx^2 + \cancel{2}Mx + N) = 0$

$Lx^2 + Mx + N = 0$

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$\Rightarrow b^2 - 4ac$

$\Rightarrow m^2 - 4NL$

$\Rightarrow (N+L)^2 - 4LN$ $\quad \left[L+m+N = 0 \right.$

$\Rightarrow (N^2 + L^2 + 2LN - 4LN)$ $\quad -m = L+N$

$\Rightarrow (N^2 + L^2 - 2LN)$ $\quad \left. m^2 = (N+L)^2 \right]$

$\Rightarrow (N-L)^2$

If N and L are rationals, then $(N-L)^2$ is also a rational and a perfect square.

So, $\boxed{\text{ans} - \text{real and rational}}$