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Ch- Equation

* Equation:-

eq:- $x^2 + 2x + 3 = 5x + 7$

* Linear Equation:- Eq^n in which degree of variable (x, y, z)
highest power

Eq:- $2x + 3y = 0$; HP = 1 ; 2 variable
$2x + 3y^2 = 0$; HP = 0 ; No L.E
$2x + 3 = 0$; HP = 1 ; One variable / Simple eq^n

Standard form of Single Eq^n:-
$ax + b = 0$
$a \neq 0$

Standard form of linear eq^n in two variable

$ax + by + c = 0$
Eq :- $2x + 3y + 5 = 0$; Infinite Solution, Represent line

Pair of linear eq^n in two variable

$a_1x + b_1y + c_1 = 0$; ~~One~~ Unique Solution
$a_2x + b_2y + c_2 = 0$; No Solution
Infinite Solution

* Solution of linear eq^n in two variable

- Substitution
- Elimination
- Cross- Multiplication

* Quadratic Equation:-

Degree of variable is 2.

Eg:- $x^2+2x+3=0 \rightarrow$ Q.E in one variable

$x^2+2y+3=0 \rightarrow$ Q.E in two variable

Standard form:- $ax^2+bx+c=0$

$a \neq 0$

* Solution of Quadratic Equation:-

1. Factorisation
   - Direct
   - Middle Term Splitting (MTS)

2. Quadratic Formula

$ax^2+bx+c=0$; $a \neq 0$

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

b^2-4ac = Discriminant (D)

Eg:- $x^2+2x-4=0$

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

$$x = \frac{-2 \pm \sqrt{4+16}}{2} \Rightarrow \frac{-2 \pm \sqrt{20}}{2}$$

* Nature of roots:- Solutions or zeroes

$$ax^2 + bx + c = 0$$

equal roots $\Rightarrow$ $b^2 - 4ac = D$ → Discriminant

i) If $D > 0$ (+ve) → Real and unequal roots
ii) If $D = 0$ → Real and equal roots
iii) If $D < 0$ (−ve) → No real roots
iv) If $D \geq 0$ → Real roots

* Roots and Coefficients:-

$$ax^2 + bx + c = 0$$

Two roots → α, β

alpha, Beta

* Sum of roots = $\alpha + \beta = \frac{-b}{a}$

* Product of roots = $\alpha\beta = \frac{c}{a}$

* If one root is reciprocal of other = $\boxed{a = c}$

* If one root is negative of other. = $\boxed{b = 0}$

* Identities

i) $(\alpha + \beta)^2 = \alpha^2 + \beta^2 + 2\alpha\beta$
ii) $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

iii) $\frac{1}{\alpha} + \frac{1}{\beta} = \frac{\beta + \alpha}{\alpha\beta}$

iv) $(\alpha + \beta)^3 = \alpha^3 + \beta^3 + 3\alpha\beta(\alpha+\beta)$

v) $\alpha - \beta = \sqrt{(\alpha+\beta)^2 - 4\alpha\beta}$

Or

$(\alpha-\beta)^2 = (\alpha+\beta)^2 - 4\alpha\beta$

* Formation of Quadratic Equations:-

If α and β are roots

quadratic Eqn $\Rightarrow x^2 - (\alpha+\beta)x + \alpha\beta = 0$

Cubic Equation:-

Standard form : $ax^3 + bx^2 + cx + d = 0$; $a \neq 0$

roots = α ; β ; γ

1. Sum of roots = $\alpha + \beta + \gamma = -\frac{b}{a}$
2. Sum of product of roots = $\alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a}$
3. Product of roots = $\alpha\beta\gamma = -\frac{d}{a}$