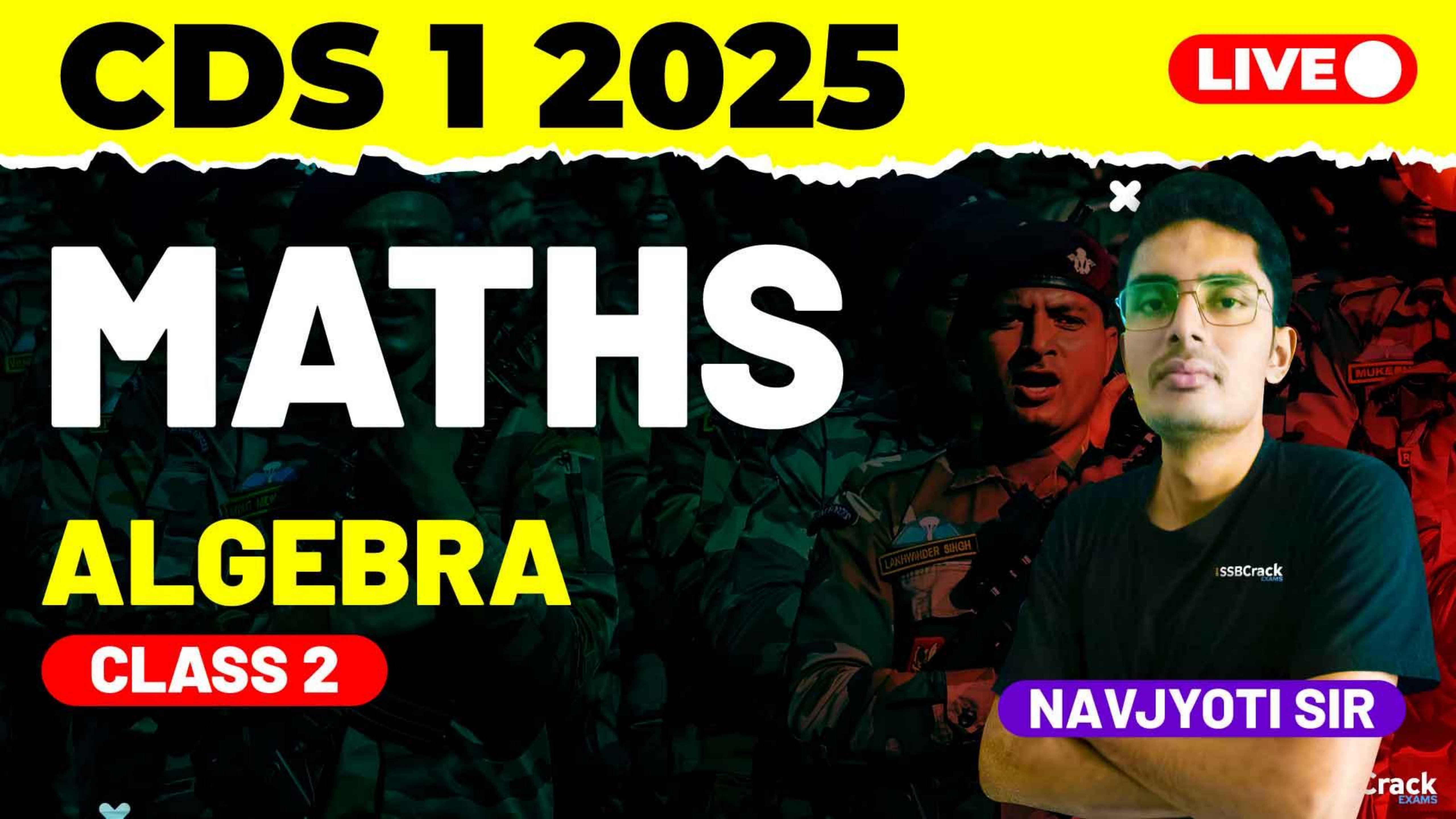

CDS 1 2025
LIVE
MATHS
ALGEBRA
CLASS 2
NAVJYOTI SIR

05 Dec 2024 Live Classes Schedule

8:00AM	05 DEC 2024 DAILY CURRENT AFFAIRS	RUBY MA'AM
9:00AM	05 DEC 2024 DAILY DEFENCE UPDATES	DIVYANSHU SIR

SSB INTERVIEW LIVE CLASSES

9:30AM	OVERVIEW OF OIR & PRACTICE	ANURADHA MA'AM

NDA 1 2025 LIVE CLASSES

1:00PM	PHYSICS - HUMAN EYE & THE COLOURFUL WORLD - CLASS 2	NAVJYOTI SIR
4:30PM	ENGLISH - SYNTHESIS OF SENTENCES - CLASS 1	ANURADHA MA'AM
5:30PM	MATHS - DIFFERENTIABILITY & DIFFERENTIATION - CLASS 2	NAVJYOTI SIR

CDS 1 2025 LIVE CLASSES

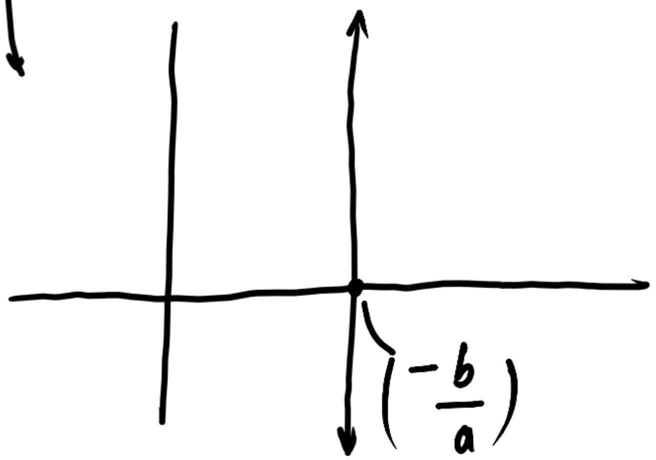
1:00PM	PHYSICS - HUMAN EYE & THE COLOURFUL WORLD - CLASS 2	NAVJYOTI SIR
4:30PM	ENGLISH - SYNTHESIS OF SENTENCES - CLASS 1	ANURADHA MA'AM
7:00PM	MATHS - ALGEBRA - CLASS 2	NAVJYOTI SIR

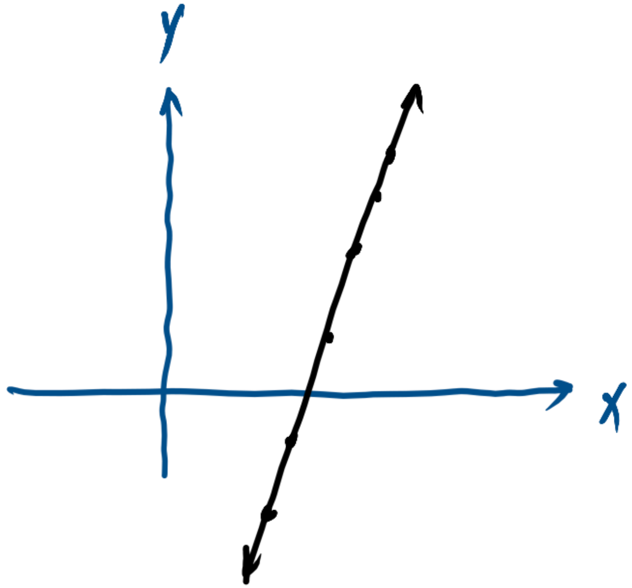
LINEAR EQUATIONS

The equation with degree 1 is known as linear equation and when this equation is plotted on a graph, it gives straight line.

Example: $ax + b = 0$: This is linear equation in one variable.

$ax + by + c = 0$: This is linear equation in two variable.





$2x + 4y = 8$

$(0,2)$, $(4,0)$, $(2,1)$

SSBCrack EXAMS

SIMULTANEOUS LINEAR EQUATION

When two linear equation of two or more variable are solved together to find the value of variables i.e., common solution, then they are known as simultaneous linear equation.

- Solution of these two equations is the point where on graph both the linear equations intersects.

$$a_1 x + b_1 y + c_1 = 0$$
$$a_2 x + b_2 y + c_2 = 0$$

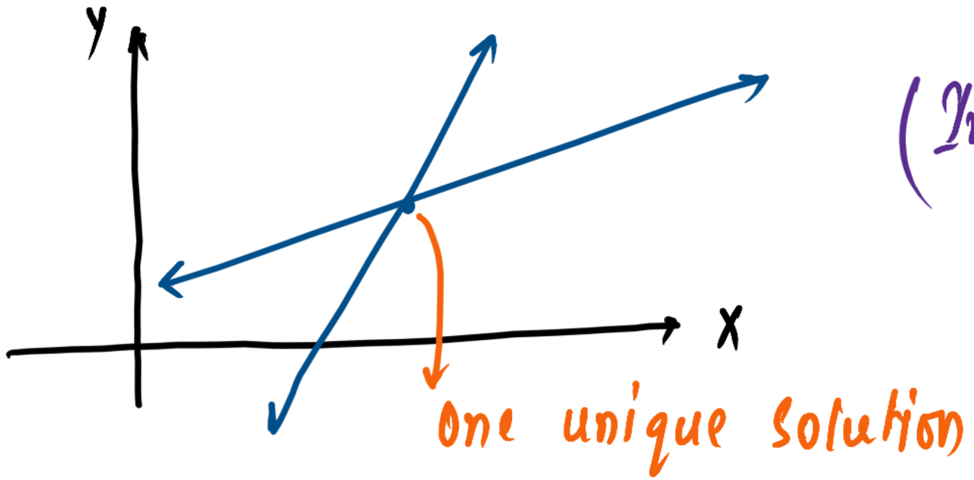
SIMULTANEOUS LINEAR EQUATION

Consistent System- When both the lines intersect at a point, then there is only one solution and in this case these lines is said to be consistent.

- In $a_1x + b_1y + c = 0$ and $a_2x + b_2y + c = 0$ are two linear equations and if

$$\left\{ \frac{a_1}{a_2} \neq \frac{b_1}{b_2} \right\}$$

- Then these equations are consistent and have a unique solution.



(Intersecting lines)

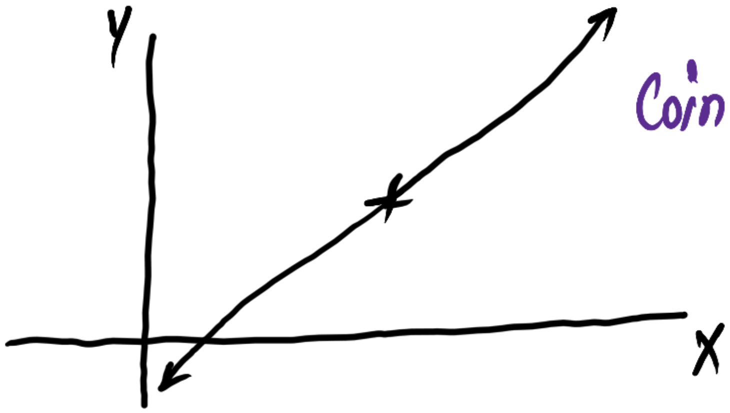
SIMULTANEOUS LINEAR EQUATION

Consistent System- When both the lines coincide each other, then there are infinitely many solutions and in this case these lines is said to be dependent and consistent.

- In $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ are two linear equations and if

$$\underbrace{\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{C_1}{C_2}}$$

- Then these equations are consistent, dependent and have infinite solutions.



Coincident lines,

(infinitely many solutions)

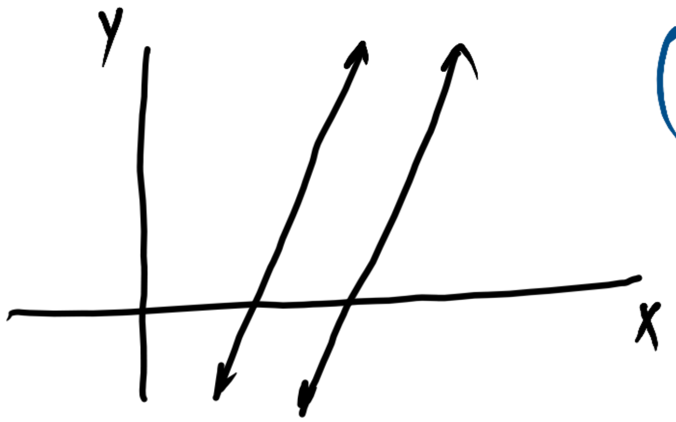
SIMULTANEOUS LINEAR EQUATION

Inconsistent System- If both the lines are parallel to each other, then there are no solutions, in this case these lines is said to be inconsistent.

- In $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ are two linear equations and if

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{C_1}{C_2}$$

- Then these equations are inconsistent and have no solution.



(no solution)

(parallel lines)

EXAMPLE

Find the type of solution:

a) $x + 2y = 6$ and $x - y = 3$

$x + 2y - 6 = 0$ $\quad$ $x - y - 3 = 0$

$\frac{a_1}{a_2} = \frac{1}{1} = 1$

$\frac{b_1}{b_2} = \frac{2}{-1} = -2$

→ one unique solution

b) $2x - y = 6$ and $x + 4y = 2$

$\frac{a_1}{a_2} = \frac{2}{1}$ $\quad$ $\frac{b_1}{b_2} = \frac{-1}{4}$

$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

one unique solution,

SSBCrack EXAMS

QUADRATIC EQUATIONS

Algebraic equations having degree 2 are known as quadratic equations.

- Standard form of quadratic equation is

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

Here a and b are coefficient of x^2 and x respectively and c is constant and $a \neq 0$

- Examples of different form of quadratic equations :

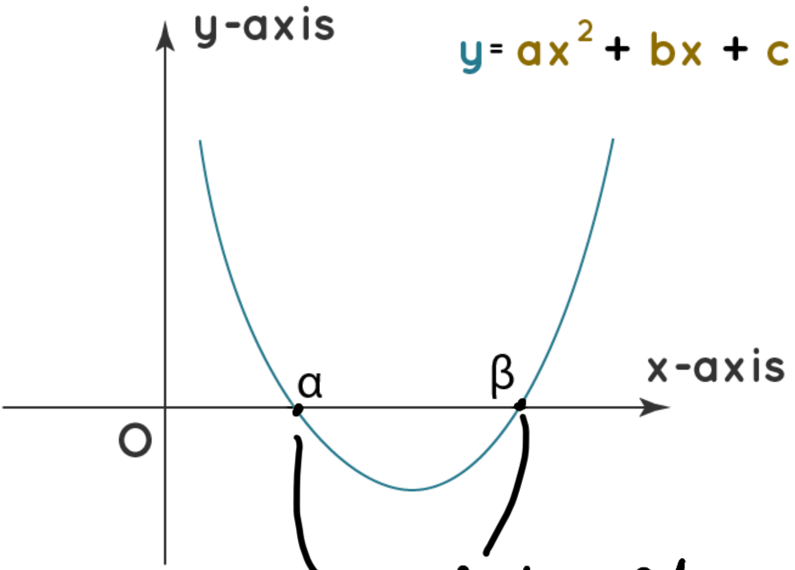
$(x-3)(x-2) = 0,\ x^3 = x(x^2 + x - 3)$

$\boxed{x^2 - 5x + 6 = 0}$

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

$\boxed{0 = x^2 - 3x}$

ROOTS OF QUADRATIC EQUATIONS



points where graph cuts the x-axis are roots.

* For n-degree equation, there will be 'n' roots.

DISCRIMINANT OF QUADRATIC EQUATION

Discriminant for quadratic equation $ax^2 + bx + c = 0$ is given by:

$$D = b^2 - 4ac$$

DISCRIMINANT AND NATURE OF ROOTS

- $D = 0$, the roots are real and equal.

  Here $\alpha = \beta$,

roots are equal and distinct,

$D \geq 0$

- $D > 0$, the roots are real and distinct.

different values,

- $D < 0$, the roots do not exist, or the roots are imaginary.

Values of k for which the quadratic equation $2x^2 - kx + k = 0$ has equal roots is

(A) 0 only (B) 4 (C) 8 only (D) 0, 8

$$2x^2 - kx + k = 0$$

$a = 2 \quad b = -k \quad c = k$

$$D = b^2 - 4ac$$
$$= (-k)^2 - 4 \times 2 \times k$$
$$= k^2 - 8k$$

For equal roots,

$$D = 0$$
$$k^2 - 8k = 0$$
$$k(k-8) = 0$$

$k = 0 \qquad k - 8 = 0$

$k = 8$

Which of the following equations has no real roots?

Discriminant < 0

(A) $x^2 - 4x + 3\sqrt{2} = 0$

(B) $x^2 + 4x - 3\sqrt{2} = 0$

(C) $x^2 - 4x - 3\sqrt{2} = 0$

(D) $3x^2 + 4\sqrt{3}\,x + 4 = 0$

(A) $D = b^2 - 4ac = 16 - 4 \times 3\sqrt{2} = 16 - 12\sqrt{2}$ ✓

(B) $D = 16 - 4 \times 3 \times -3\sqrt{2} = 16 + 36\sqrt{2} > 0$

(C) $D = 16 - 4 \times 3 \times -3\sqrt{2} = 16 + 36\sqrt{2} > 0$

(D) $D = (4\sqrt{3})^2 - 4 \times 3 \times 4 = 48 - 48 = 0$

+ve or 0,

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RELATION BETWEEN ROOTS AND COEFFICIENTS

#

If α and β are the roots of equation $ax^2 + bx + c = 0$,

Then, $\alpha + \beta = \frac{-b}{a}$ ✓ (Sum of roots)

$$- \frac{\text{coefficient of } x}{\text{" " of } x^2}$$

$\alpha\beta = \frac{c}{a}$ ✓ ✓ (Product of roots)

$$\frac{\text{constant term}}{\text{coefficient of } x^2}$$

- Thus, using these values, new way of writing quadratic equation in terms of roots will be:

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

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CUBIC EQUATION

$$ax^3 + bx^2 + cx + d = 0$$

degree = 3 $\Rightarrow$ roots = 3 (α, β, γ)

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

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

$$\alpha\beta\gamma = -\frac{d}{a}$$

Degree - 4 equation — Biquadratic equation

$ax^4 + bx^3 + cx^2 + dx + e = 0$ Roots — 4 $(\alpha, \beta, \gamma, \delta)$

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

$$\alpha\beta + \beta\gamma + \gamma\delta + \alpha\gamma + \alpha\delta + \beta\delta = \frac{c}{a}$$

$$\alpha\beta\gamma + \beta\gamma\delta + \gamma\delta\alpha = \frac{-d}{a}$$

$$\alpha\beta\gamma\delta = \frac{e}{a}$$

Which of the following equations has the sum of its roots as 3?

(A) $2x^2 - 3x + 6 = 0$

(B) $-x^2 + 3x - 3 = 0$ ✓

(C) $\sqrt{2}x^2 - \frac{3}{\sqrt{2}}x + 1 = 0$

(D) $3x^2 - 3x + 3 = 0$

(A) $\alpha + \beta = \frac{-b}{a} = -\frac{(-3)}{2} = \frac{3}{2}$

(B) $\alpha + \beta = -\frac{3}{(-1)} = 3$ ✓

QUADRATIC FORMULA

#

This formula is used to solve quadratic equation i.e.; it gives us the root of given quadratic equation.

$D = b^2 - 4ac$

- If we have quadratic equation $ax^2 + bx + c = 0$, then roots of this equation is:

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

$$x = \frac{-b \pm \sqrt{D}}{2a}$$

Ex: Find the roots of equation $x^2 - 3x - 4 = 0$

$$\alpha = \frac{-b + \sqrt{D}}{2a} \qquad \beta = \frac{-b - \sqrt{D}}{2a}$$

$D = 9 - 4 \times 1 \times -4 = 9 + 16 = 25$

$\sqrt{D} = 5$

$\alpha = \frac{3 + 5}{2} = 4$ $\qquad$ $\beta = \frac{3 - 5}{2} = -1$

$\alpha = 4$

$\beta = -1$

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EXAMPLE

If α and β are the roots of quadratic equation. $\alpha + \beta = 8$ and $\alpha - \beta = 2\sqrt{5}$, then for which equation the roots will be α^4 and β^4.

a) $x^2 - 1522x + 14641 = 0$ ✓

b) $x^2 + 1921x + 14641 = 0$

c) $x^2 + 1764x + 14641 = 0$

d) $x^2 + 2520x + 14641 = 0$

$\alpha + \beta = 8$

$+ \quad \alpha - \beta = 2\sqrt{5}$

$-$

$2\alpha = 8 + 2\sqrt{5} \Rightarrow \alpha = 4 + \sqrt{5}$

$2\beta = 8 - 2\sqrt{5} \Rightarrow \beta = 4 - \sqrt{5}$

$\alpha^4 + \beta^4 = \left((4+\sqrt{5})^2\right)^2 + \left((4-\sqrt{5})^2\right)^2$

$= (16 + 5 + 8\sqrt{5})^2 + (16 + 5 - 8\sqrt{5})^2$

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$$= (16 + 5 + 8\sqrt{5})^2 + (16 + 5 - 8\sqrt{5})^2$$

$$= (21 + 8\sqrt{5})^2 + (21 - 8\sqrt{5})^2$$

$$= 2\left(21^2 + (8\sqrt{5})^2\right)$$

$$= 2(441 + 320)$$

$$= 2 \times 761$$

$$= \underline{1522}$$

$$(a+b)^2 + (a-b)^2$$

$$= 2(a^2 + b^2)$$

$$\alpha^4 + \beta^4 = \underline{1522} = -\frac{b}{a}$$

$$1522 = -\frac{b}{1} \Rightarrow \underline{b = -1522}$$

If the product of the roots of the equation $mx^2 + 6x + (2m - 1) = 0$ is -1, then the value of m is

(a) $m = \frac{1}{3}$ ✓ (b) $m = \frac{1}{2}$ (c) $m = \frac{2}{3}$ (d) $m = 2$

$\alpha\beta = -1$

$\frac{c}{a} = -1$

$\frac{2m-1}{m} = -1$

$2m - 1 = -m$

$3m = 1$

$m = \frac{1}{3}$

Q) If r and s are roots of $x^2 + px + q = 0$, then what is the value of $(1/r^2) + (1/s^2)$?

(a) $p^2 - 4q$ (b) $\frac{p^2 - 4q}{2}$

(c) $\frac{p^2 - 4q}{q^2}$ (d) $\frac{p^2 - 2q}{q^2}$ ✓

$$\begin{cases} r + s = -p \\ rs = q \end{cases}$$

$$\frac{1}{r^2} + \frac{1}{s^2} = \frac{s^2 + r^2}{r^2 s^2}$$

$$= \frac{(r+s)^2 - 2sr}{(rs)^2} = \frac{(-p)^2 - 2q}{q^2} = \frac{p^2 - 2q}{q^2}$$

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Q) If r and s are roots of $x^2 + px + q = 0$, then what is the value of $(1/r^2) + (1/s^2)$?

(a) $p^2 - 4q$

(b) $\dfrac{p^2 - 4q}{2}$

(c) $\dfrac{p^2 - 4q}{q^2}$

(d) $\dfrac{p^2 - 2q}{q^2}$

Ans: (d)

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MAXIMUM & MINIMUM VALUE

Case I $a > 0$

$\because \quad ax^2 + bx + c \geq \dfrac{4ac - b^2}{4a}$

$\therefore$ Minimum value of $ax^2 + bx + c$ is $\dfrac{4ac - b^2}{4a}$ and this value attains at $x = -\dfrac{b}{2a}$.

Case II $a < 0$

$\because \quad ax^2 + bx + c \leq \dfrac{4ac - b^2}{4a}$ ✓

$\therefore$ Maximum value of $ax^2 + bx + c$ is $\dfrac{4ac - b^2}{4a}$ and this value attains at $x = -\dfrac{b}{2a}$

Q) If $x^2 + 1 = 2x$, then the value of $\dfrac{x^4 + \dfrac{1}{x^2}}{x^2 - 3x + 1}$ is

(a) 0 (b) 1 (c) 2 (d) -2

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

$(x-1)^2 = 0$

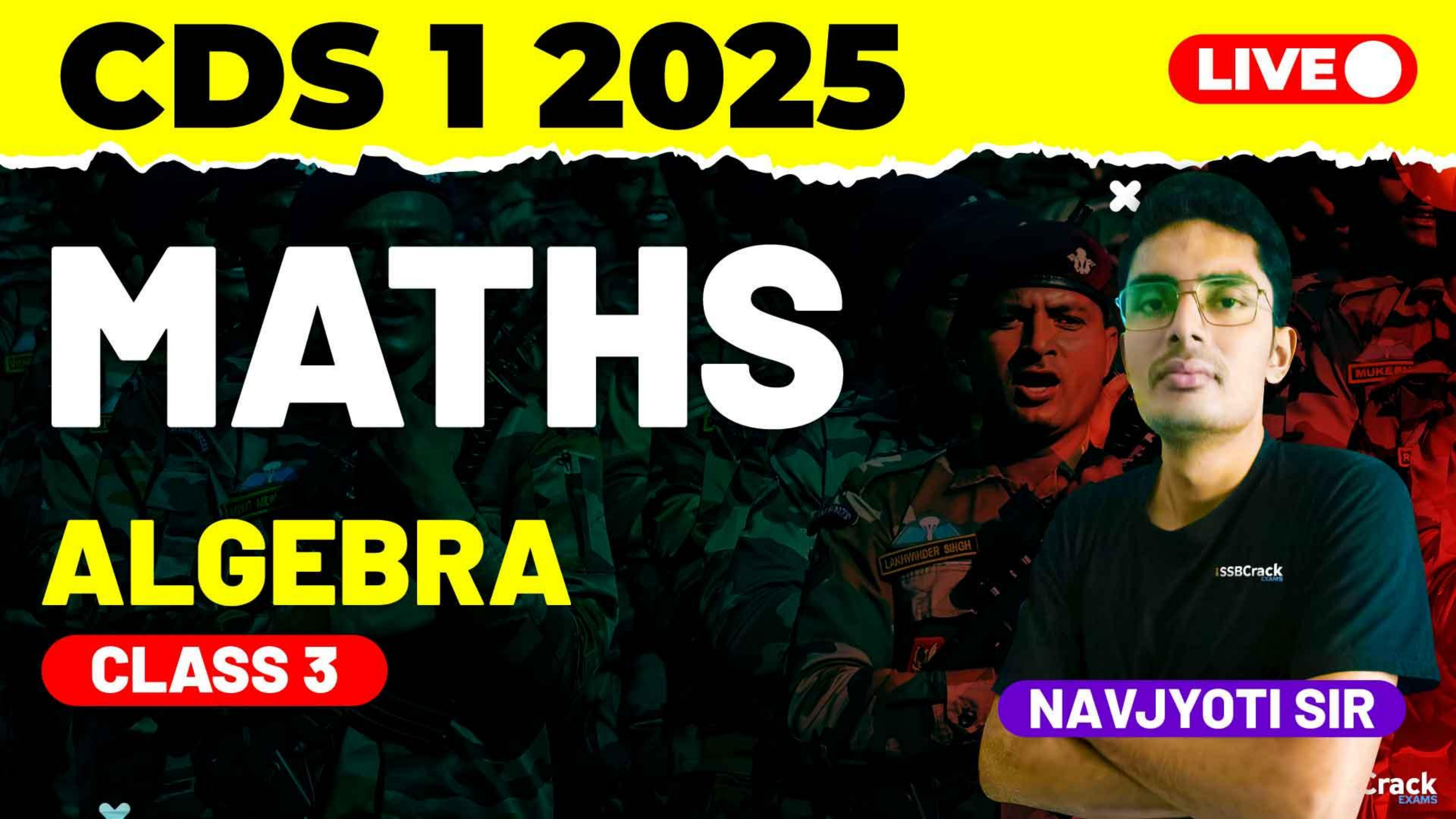
$x = 1$

$\dfrac{1 + \dfrac{1}{1}}{1 - 3 + 1} = \dfrac{2}{-2+1} = \dfrac{2}{-1} = -2$

Q) If $x^2 + 1 = 2x$, then the value of $\dfrac{\dfrac{x^4 + \frac{1}{x^2}}{x^2}}{x^2 - 3x + 1}$ is

(a) 0 (b) 1 (c) 2 (d) -2

Ans: (d)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