CAT 2025

MBA Fastrack

Lecture – 1 | **ALGEBRA**

Linear Equations - 1

By- RAHUL BATHLA

TOPICS *to be covered*

Basic 9-10%

1. Linear Equation
2. Quadratic Equation - Splitting the Middle term

3 PYQs

3. System of Linear Equation — CAT Loves This 2022_2023_2024
4. Word Problems

Topic: LINEAR EQUATION

LINEAR EQUATION (1 Variable)

- $2(x-3) = 9 - x$

$2x - 6 = 9 - x$

$3x = 15$

$\boxed{x = 5}$

- $2x - \frac{x}{2} = 5 - x$

$\frac{3x}{2} = 5 - x$

$3x = 10 - 2x$

$5x = 10$

$\boxed{x = 2}$ ✓

LINEAR EQUATION

- $2x + y = 11$
- $4x - y = 7$

Substitution

$y = 11 - 2x$ $\quad y \to x$

$4x - [\overbrace{11 - 2x}^{y}] = 7$

$4x - 11 + 2x = 7$

$6x = 18$

$\boxed{x = 3}$

$y = 11 - 2(3)$
$= 5$

- $2x + 7y = 41$
- $3x + 7y = 44$

$-x \qquad = -3$

$\boxed{x = 3}$ ✓

$2(3) + 7y = 41$

$7y = 35$

$\boxed{y = 5}$ ✓

QUESTION – 1

#Q: If $\frac{9}{u} - \frac{6}{v} = 1$ $\frac{8}{u} - \frac{2}{v} = 2$

Find $u + v$.

$\frac{9}{3} - \frac{6}{v} = 1$

$3 - \frac{6}{v} = 1$

$2 = \frac{6}{v}$ (3)

$v = 3$

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

$u = 3$

(A) 6 (B) 7 (C) 8 (D) 10

$\frac{1}{u} = A = \frac{1}{3}$

$\frac{1}{v} = B$

$\frac{9}{u} - \frac{6}{v} = 1$

$9\left[\frac{1}{u}\right] - 6\left[\frac{1}{v}\right] = 1$

$9A - 6B = 1$

$24A - 6B = 6$

$15A = 5$ (3)

$\frac{8}{u} - \frac{2}{v} = 2$

$8A - 2B = 2$ (3)

$24A - 6B = 6$

Topic: QUADRATIC EQUATION (Splitting the Middle Term)

SPLTTING THE MIDDLE TERM

$$x^2 - 8x + 12 = 0$$

$x^2 - 6x - 2x + 12 = 0$

$x(x-6) - 2(x-6) = 0$

$(x-2)(x-6) = 0$

$x - 2 = 0$

$x = 2$

$x = 2$

$x = 6$

$(x-6) = 0$

$x = 6$

SPLTTING THE MIDDLE TERM

$1x^2 - 8x + 12 = 0$

$6 + 2 = 8$

$6 * 2 = 12$

$x = 6/1 = 6$

$x = 2/1 = 2$

$1x^2 - 11x + 18 = 0$

$9 + 2 = 11$

$9 * 2 = 18$

$x = 9$

$x = 2$

$7x^2 - 23x + 18 = 0$

$14 + 9 = 23$

$14 * 9 = 126$

$x = 14/7 = 2$

$x = 9/7 = 9/7$

$3x^2 - 29x + 18 = 0$

$27 + 2 = +29$

$27 * 2 = 54$

$x = 27/3 = 9$

$x = 2/3 = 2/3$

SPLTTING THE MIDDLE TERM

$x^2 - 5\sqrt{3}x + 18 = 0$

$2 + 3 = 5$

$2 * 3 = 6$

$6 + (-1) = +5$

$6 \times (-1) = -6$

$x = 2\sqrt{3}$ $\quad$ $x = 3\sqrt{3}$

$x^2 - 11\sqrt{5}x + 90 = 0$

$9 + 2 = 11$

$9 * 2 = 18$

$x = 9\sqrt{5}$ $\quad$ $x = 2\sqrt{5}$

Topic: System of Linear Equation

Number of Solutions

Unique Solution ✓

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

$$\frac{a1}{a2} \neq \frac{b1}{b2}$$

$$2x + 3y = 7$$

$$4x - 3y = 10$$

$$\frac{1}{2} \neq \frac{-1}{1}$$

x = fixed values
y = fixed values

Infinite Solutions

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

$$\frac{a1}{a2} = \frac{b1}{b2} = \frac{c1}{c2}$$

$$[2x + 3y = 7] \times 2$$

$$4x + 6y = 14$$

$$4x + 6y = 14$$

$$0 + 0 = 0 \checkmark$$

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

No Solutions

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

$$\frac{a1}{a2} = \frac{b1}{b2} \neq \frac{c1}{c2}$$

$$(2x + 3y = 10) \times 2$$

$$4x + 6y = 30$$

$$4x + 6y = 20$$

$$0 + 0 = 10$$

$$\frac{1}{2} = \frac{1}{2} \neq \frac{1}{3}$$

$2x + 3y = 10$

$1x + 1.5y = k$

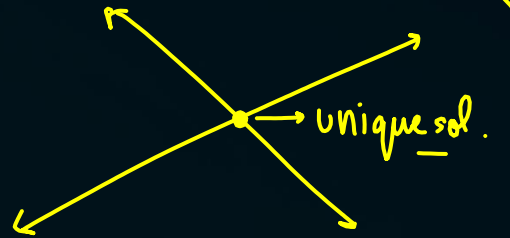
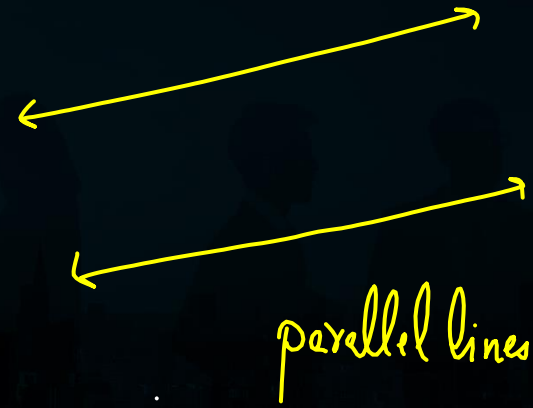
find 'k' such that pair of eqn has represents overlapping line??

$$\frac{2}{1} = \frac{3}{1.5} = \frac{10}{k}$$

$$2 = \frac{10}{k} \qquad k = 10/2 = 5$$

Geometrical Meaning

LINEAR EQ^N → LINE → COORDINATE PLANE

Unique Solution	Infinite Solutions	No Solutions
$a_1x + b_1y + c_1 = 0$	$a_1x + b_1y + c_1 = 0$	$a_1x + b_1y + c_1 = 0$
$a_2x + b_2y + c_2 = 0$	$a_2x + b_2y + c_2 = 0$	$a_2x + b_2y + c_2 = 0$
$\frac{a1}{a2} \neq \frac{b1}{b2}$	$\frac{a1}{a2} = \frac{b1}{b2} = \frac{c1}{c2}$	$\frac{a1}{a2} = \frac{b1}{b2} \neq \frac{c1}{c2}$
		
unique sol.		
intersecting lines	Overlapping lines	parallel lines

QUESTION – 3

#Q: Find the value of '$p + q$' if the pair of equations

$$2x + py = 8$$
$$qx - 6y = 24$$

has infinite solutions. → parallel line / overlapping.

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$

(A) 8 (B) 4 (C) -4 (D) -8

$$\frac{2}{q} = \frac{p}{-6} = \frac{8^1}{24_3}$$

$$\frac{2}{q} \times \frac{1}{3}$$

$q = 6$

$$\frac{p}{-6} \to \frac{1}{3} \qquad p = -\frac{6}{3} = -2$$

QUESTION – 4 (CAT 2020 SLOT 3)

#Q: Let k be a constant. The equations $kx + y = 3$ *and* $4x + ky = 4$ have a unique solution if and only if

(A) K ≠ 2 (B) $k \neq \pm 2$ (C) K = ±2 (D) K = 4

$2^2 = 4$

$(-2)^2 = 4$

$\frac{k}{4} \neq \frac{1}{k}$

$k^2 \neq 4$

$k \neq \pm 2$

QUESTION – 5 (CAT 2024 Slot - 3)

#Q. For some real numbers 'p' , 'k' and 'a'. Consider the system of linear equations $in\ x\ and\ y$

$$px - 4y = 2$$
$$3x + ky = a$$

A necessary condition for the system to have no solutions is

(A) $2a + k \neq 0$ ✓

(B) $ap - 6 = 0$ ✗

(C) $ap + 6 = 0$ ✗

(D) $kp + 12 \neq 0$ ✗

$\frac{p}{3} = \frac{-4}{k} \neq \frac{2}{a}$

① ② ③

② $a, k \neq$

① $p, k, =$

③ $p, a, \neq$

$\frac{p}{3} \neq \frac{2}{a}$

$ap \neq 6$

$ap - 6 \neq 0$

$\frac{-2}{-4} = \frac{k}{a}$

$-2a \neq k$

$0 \neq 2a + k$

QUESTION – 6 (CAT 2023 Slot - 3)

#Q. For some real numbers 'a' and 'b'. The equations $x + y = 4$ *and* $(a+5)x + (b^2-15)y = 8b$ has infinitely many solutions. Then the maximum possible value of ab is

A. 25

B. 15

C. 55

D. 33 ✓

$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

$\begin{cases} (a+5)x + (b^2-15)y = 8b \\ 1x + 1y = 4 \end{cases}$

$a+5 = b^2-15 = 2b$

$b^2 - 15 = 2b$

$b^2 - 2b - 15 = 0$

$5 + (-3) = 2$

$5 \times (-3) = -15$

$b = 5 \quad a = 5$

$ab = 25$

$b = -3 \quad a = -11$

$ab = 33$

$a+5 = 2b$

if $b = 5$: $a+5 = 10$, $a = 5$

if $b = -3$: $a+5 = -6$, $a = -11$

Topic: Word Problems

Words to Equation

A = 6 B = 3
6 = 2(3)

A = 6 B = 4
A = B + 2
6 = 4 + 2

- A is twice of B Vs A is two more than B Vs A is two Times of B

$A = 2B$ $A = B + 2$ $A = 2B$

- 5 more than A is twice of 2 more than B.

$(A + 5) = 2[B + 2]$

- A father's age is 3 times his son.
- 3 Year Later,
- Father would be 20 Years older than the son

	F	S
Present Age	$3x$	x
3 Yrs Later	$3x+3$	$x+3$

$3x + 3 = (x + 3) + 20$

Words to Equation

- A Taxi cost structure comprises of two costs: Fixed Cost(x) and Per Km/Cost(y)
- Cost of 10 Kms is 58 Rs.

$$x + 10y = 58$$

- A person agreed to work for a company in exchange of 45000 Rs and a Bike. Try to write the equation for monthly salary. (ANUALLY)
- After 7 Months he left and got 20000 and the Bike

12 MONTHS $\longrightarrow$ 45000 + B

1 MONTH $\longrightarrow$ $\frac{1}{12}[45000+B]$

7 MONTH $\longrightarrow$ $\frac{7}{12}(45000+B)$

$$\frac{7}{12}(45000+B) = 20000+B$$

Words to Equation

- A person answered 10 questions. He got +3 for correct answer and -1 for wrong.
- He got 18 marks.

- A two digit number is such that....
- If 9 is added to the number, the digits are reversed.

QUESTION – 7

#Q: In an exam a person is awarded +3 for correct answer and -1 for wrong answer. A person scored 17 marks for a certain response. If the total questions in the exam were 15. Find the total number of correctly answered questions given that the student attempted all questions.

A 5 B 6 C 3 D 8 E 11

15 Qus → 'x Correct' 'y Wrong'

$3x$ $-y$

$3x - y = 17$

$x + y = 15$

$4x = 32$

$x = 8$

QUESTION – 8

#Q: Three years back, a father was 24 years older than his son. At present the father is 5 times as old as the son. How old will the son be three years from now?

(A) 12 (B) 6 (C) 3 (D) 9

	F	S
3 Yr Back	$5x-3$	$x-3$
Present	$5x=30$	6 / x
Three Yr later		9 ✓

$$(x-3)+24=(5x-3)$$

$$x+21=5x-3$$

$$24=4x$$

$$\boxed{6=x}$$

QUESTION – 9

#Q: A poultry farm has only chickens and pigs. When the manager of the poultry counted the heads of the stock in the farm, the number totalled up to 200. However , when the number of legs was counted, the number totalled up to 540. How many more chickens were there in the farm? Note: Each pig had 4 legs and each chicken had 2 legs.

(A) 70 (B) 120 (C) 60 (D) 130

$C + P = 200$

$2C + 4P = 540$

$2C + 2P = 400$

$2P = 140$

$P = 70$

$C = 130$

QUESTION – 10

#Q: An auto charges a fixed cost of x $ for a ride and y $ for each km travelled. If a person gave 58 $ for riding 9 Kms and another person paid 43 $ for travelling 6 Kms. Find the value of $x - y$.

A 6 B 9 C 8 D 4

$x + 9y = 58$

$x + 6y = 43$

$3y = 15$

$y = 5$

$x + 30 = 43$

$x = 13$ ✓

Linear Equation in 3 Variables

QUESTION- 11

#Q. Find the value of $11x + 11y + 11z$

3 VAR / 2 EQN

$2(2x + 5y + 8z = 12)$

$3(5x + 7y + 9z = 31)$

$4x + 10y + 16z = 24$

$15x + 21y + 27z = 93$

$-11x - 11y - 11z = -69$

$11x + 11y + 11z = 69$

$11(x + y + z) = 69$

$x + y + z = 69/11$

$7x + 7y + 7z = \frac{483}{11}$

A. 70

B. 69

C. 38

D. 71

QUESTION- 12

#Q. Find the value of $x - 23y$.

$2(2x - y + 3z = 12)$

$3(x + 7y + 2z = 3)$

A 12

B 15

C 18

D 24

$4x - 2y + 6z = 24$

$3x + 21y + 6z = 9$

$x - 23y = 15$

QUESTION- 13

#Q. If $\begin{matrix} a + 2b + c = 30 \\ 2a + b + 3c = 90 \end{matrix}$ 3

Find $\frac{a}{b}$.

(A) -5

(B) 5

(C) 1/5

(D) -1/5

$$3a + 6b + 3c = 90$$

$$2a + b + 3c = 90$$

$$a + 5b = 0$$

$$a = -5b$$

$$\frac{a}{b} = -5$$

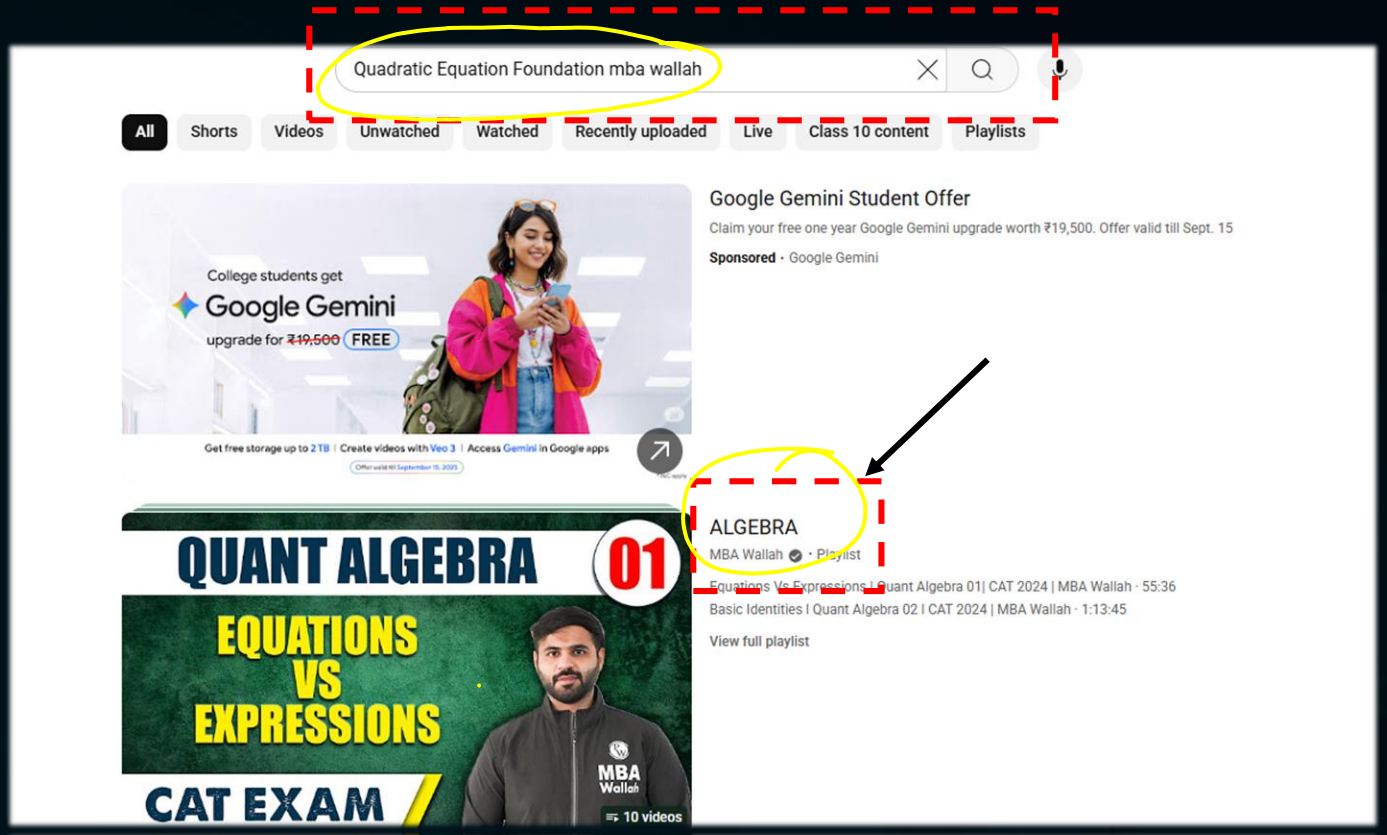
If $a + 2b + c = 8$

$2a + b + 3c = 13,$

$2a - b + 6c = 18$

HW

ESSENTIALS EQ. MBAWALLAH



SUMMARY

BASICs → FAST

THANK
You
52%
64%
85%
26,465.54
28,161.92
26,465.54
198.45
37,492.43
201.55
1,097.95
0.00
26,717.43
7,534.44
12,512.54
28,875.56