

# CAT 2025

*MBA FASTRACK*



**Lecture - 3**

**ALGEBRA**

**Exponents**

**By- RAHUL BATHLA**



# TOPICS

*to be covered*

1

Common Root Question ✓

2

Quadratic Equation – Graph ✓

3

Exponents ✓

# HW QUESTION



#Q. If the roots of the Quadratic Equation  $3x^2 + px - 1 = 0$  are 'a' and 'b' such that  $\frac{1}{a^2} + \frac{1}{b^2} = 15$  then the value of  $(a^3 + b^3)^2$  is

- A** 4
- B** 1
- C** 16
- D** 9

$$a + b = -p/3$$

$$ab = -1/3$$

$$\frac{1}{a^2} + \frac{1}{b^2} = 15$$

$$\frac{a^2 + b^2}{a^2 b^2} = 15$$

$$a^2 + b^2 = 15 \left[ \frac{1}{9} \right]$$

$$a^2 + b^2 = \frac{5}{3} \checkmark$$

$$(a^3 + b^3)^2$$

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



## **Topic: Common Root Question**

## QUESTION - 1



#Q. If  $-4$  is a common root for the quadratic equation  $2x^2 + px + 8 = 0$  and  $p(x^2 + x) + k = 0$  then find the value of  $k$ .

$$2x^2 + px + 8 = 0$$

Roots:  $-4$  and  $-1$

$$\text{Product} = \frac{8}{2} = 4$$

$$(-4)(\beta) = 4$$
$$\beta = -1$$

$$-S = -\frac{p}{2}$$

$$\boxed{p = 10}$$

$$p(x^2 + x) + k = 0$$

Roots:  $-4$  and  $-1$

$$10(-4)^2 + 10(-4) + k = 0$$

$$160 - 40 + k = 0$$

$$\boxed{k = -120} \checkmark$$

## QUESTION - 2



#Q. If Quadratic Equation  $x^2 + ax + 20 = 0$  and  $x^2 + bx - 20 = 0$  have one common root, then what is the value of  $a^2 - b^2$ .

A

75

B

80

C

70

D

85

$$x^2 + ax + 20 = 0 \quad \swarrow \searrow$$

$$\alpha^2 + a\alpha + 20 = 0$$

$$\alpha^2 + b\alpha - 20 = 0$$

$$2\alpha^2 + (a+b)\alpha = 0$$

$$(a+b) = -\frac{2\alpha^2}{\alpha} = -2\alpha$$

$$x^2 + bx - 20 = 0 \quad \swarrow \searrow$$

$$\alpha^2 + a\alpha + 20 = 0$$

$$\alpha^2 + b\alpha - 20 = 0$$

$$(a-b)\alpha + 40 = 0$$

$$(a-b) = -\frac{40}{\alpha}$$

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

$$= \left(+\frac{40}{\cancel{\alpha}}\right) (+2\alpha) = 80$$

#Q. If Quadratic Equation  $x^2 + mx + 9 = 0$ ,  $x^2 + nx + 17 = 0$  and  $x^2 + (m+n)x + 35 = 0$  have one common negative root then what is the value of  $(2m + 3n)$ .

$$x^2 + mx + 9 = 0$$

$$\checkmark$$

$$x = -3$$

$$2(6) + 26$$

$$12 + 26 = 38 \checkmark$$

$$x^2 + mx + 9 = 0$$

$$x^2 + nx + 17 = 0$$

$$2x^2 + (m+n)x + 26 = 0$$

$$x^2 + (m+n)x + 35 = 0$$

$$x^2 - 9 = 0$$

$$x^2 = 9$$

$$x = \pm 3$$

$$x^2 + (m+n)x + 35 = 0$$

$$x^2 + mx + 9 = 0 \rightarrow \begin{matrix} -3 \\ -3 \end{matrix}$$

$$m = 6$$

$$x^2 + nx + 17 = 0 \rightarrow \begin{matrix} -3 \\ -3 \end{matrix}$$

$$9 - 3n + 17 = 0$$

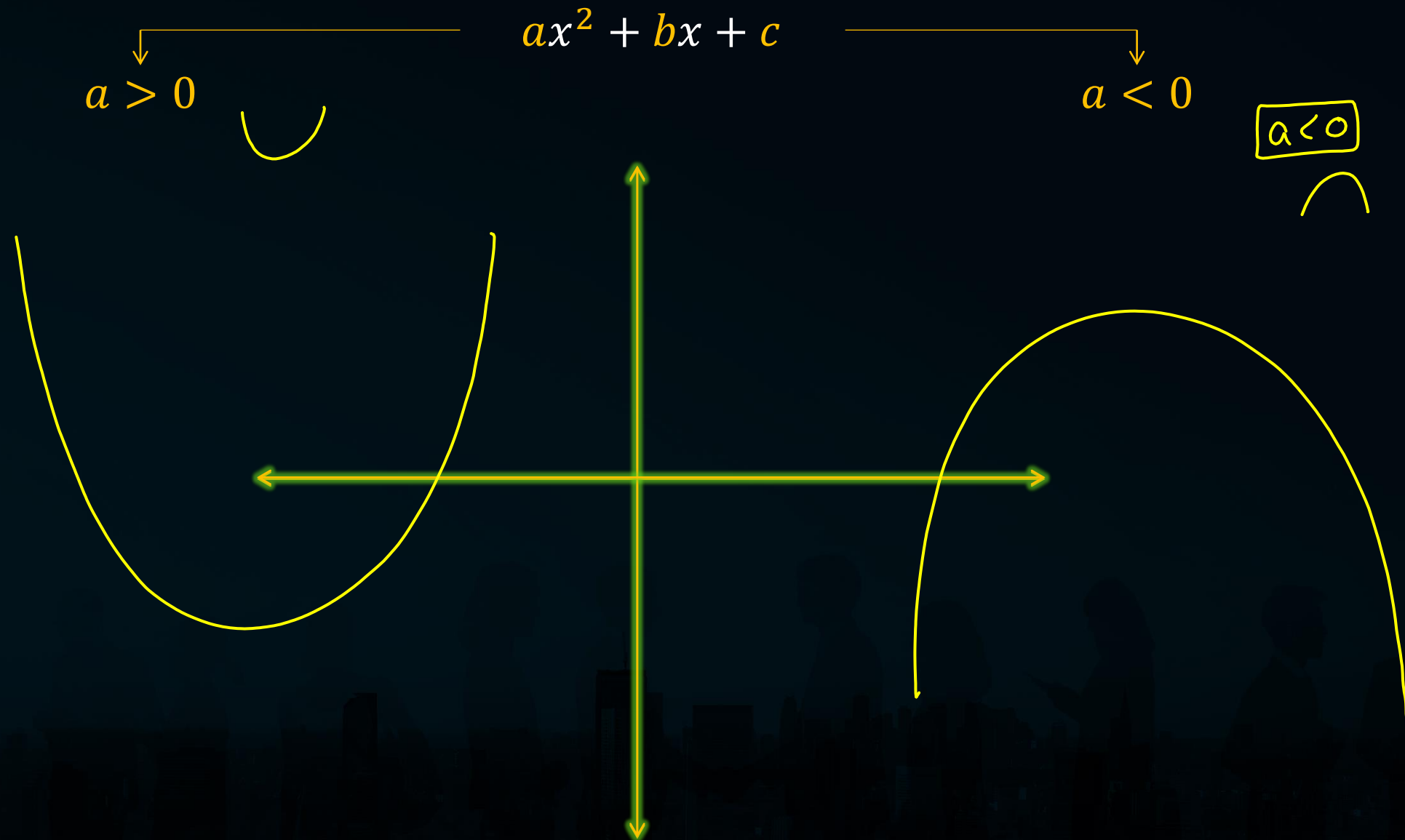
$$3n = 26 \quad n = \frac{26}{3}$$



## **Topics : Quadratic Equation Graph**



# Quadratic Equation on Graph Represents *PARABOLA*



# Quadratic Equation on Graph Represents **PARABOLA**

GRAPH  
CUTS X AXIS  
AT ROOTS

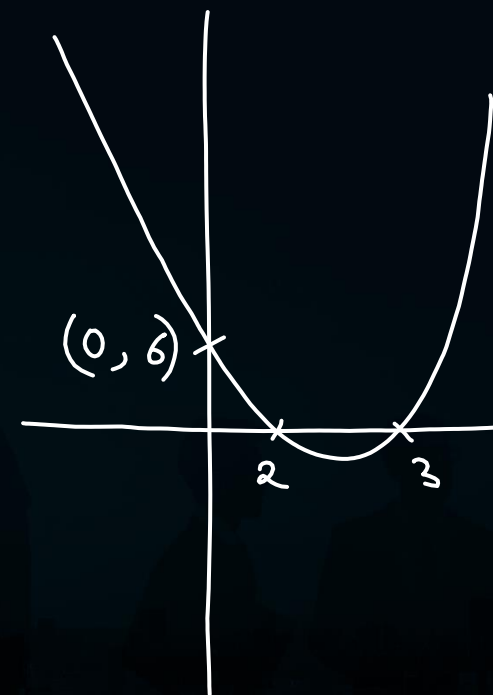
$a > 0$

$$1 \quad x^2 - 5x + \frac{6}{1}$$

↙ ↘

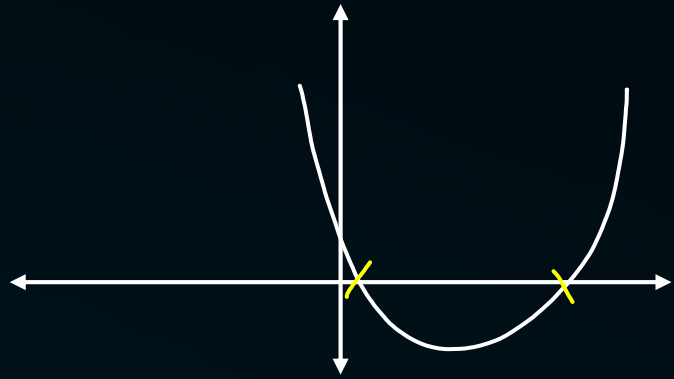
2 3

GRAPH CUT Y AXIS



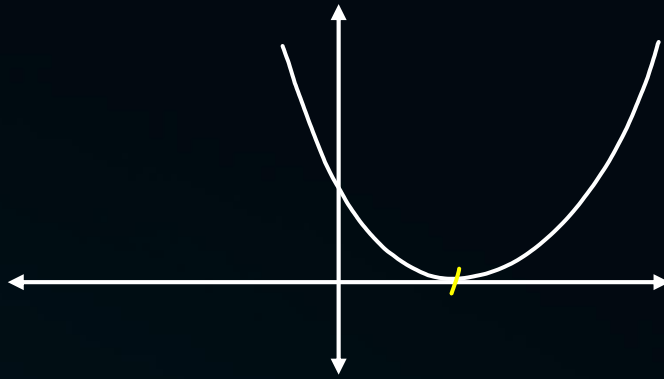


❖ Jitne roots Honge Utne times Parabola X axis ko Touch karega.



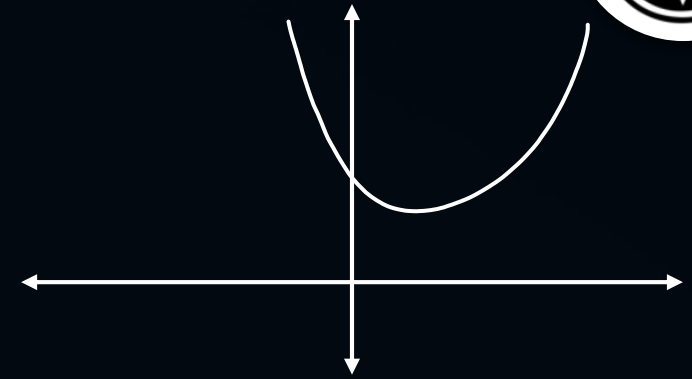
$a > 0 ; D > 0$  [2 Roots]

2 Roots (Real and Unequal Roots)



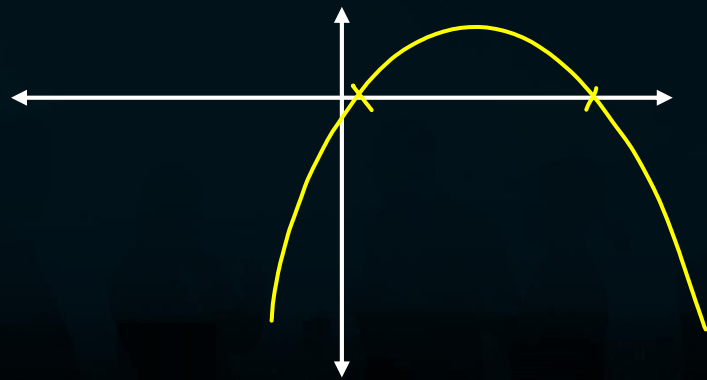
$a > 0 ; D = 0$  [1 Root]

1 Roots (Real and equal Roots)

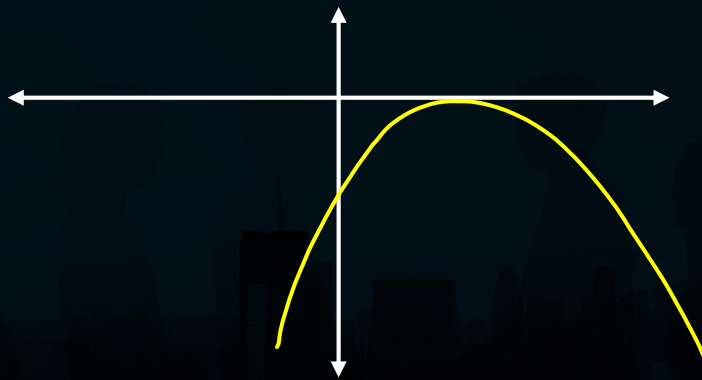


[No Root]  $a > 0 ; D < 0$

0 Roots (No Roots)



$a < 0 ; D > 0$



$a < 0 ; D = 0$

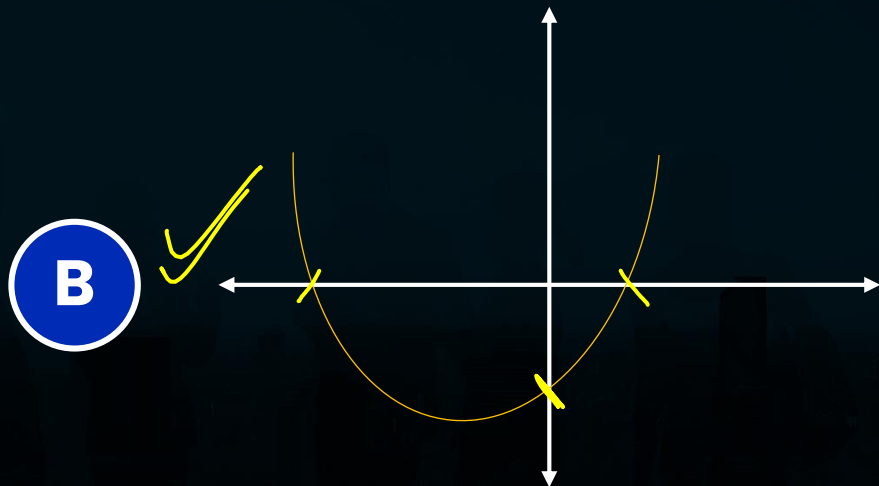
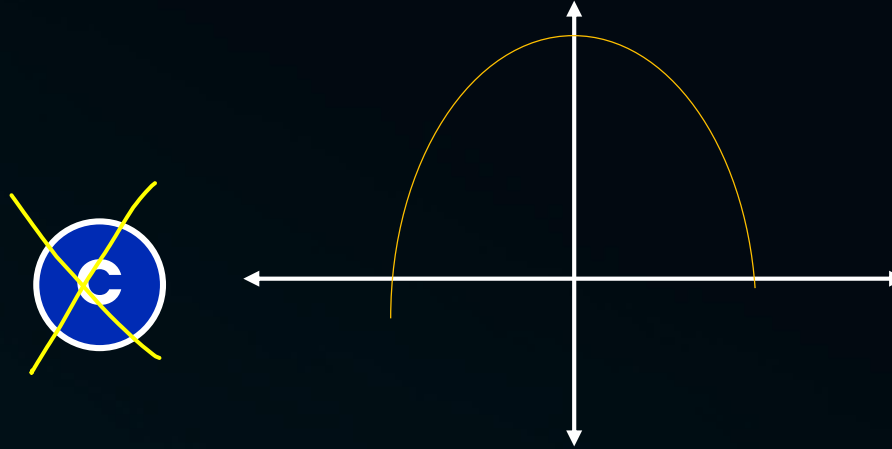
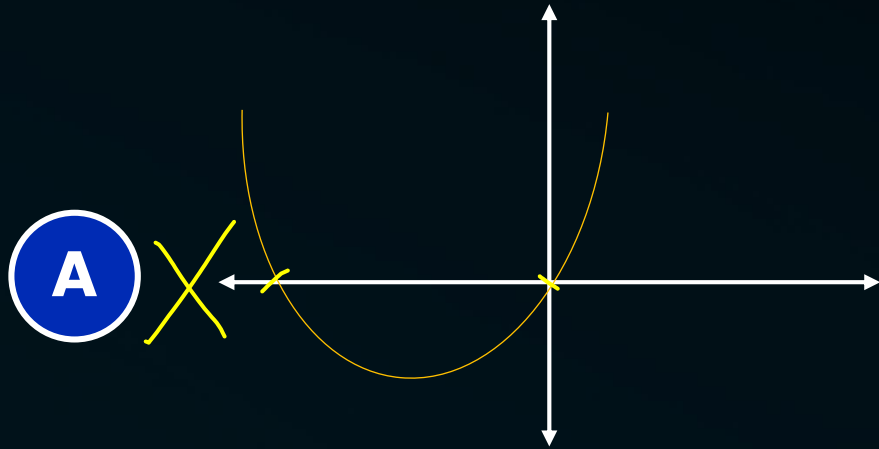


$a < 0 ; D < 0$

## QUESTION - 4



#Q. Which of the following is the graph of  $x^2 + 4x - 5$ ?  $\xrightarrow{-5}$   
 $\xrightarrow{-5}$





**Topics : Minimum Maximum Value**

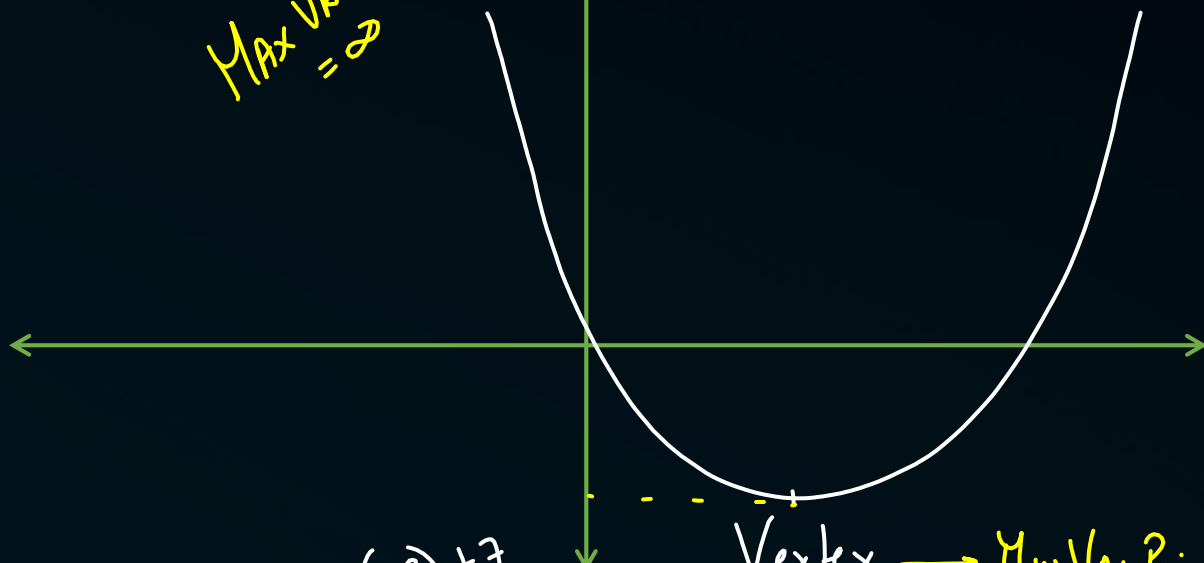
$$ax^2 + bx + c$$

$$a > 0$$

$$a < 0$$

Max Value  
=  $\infty$

Quadratic



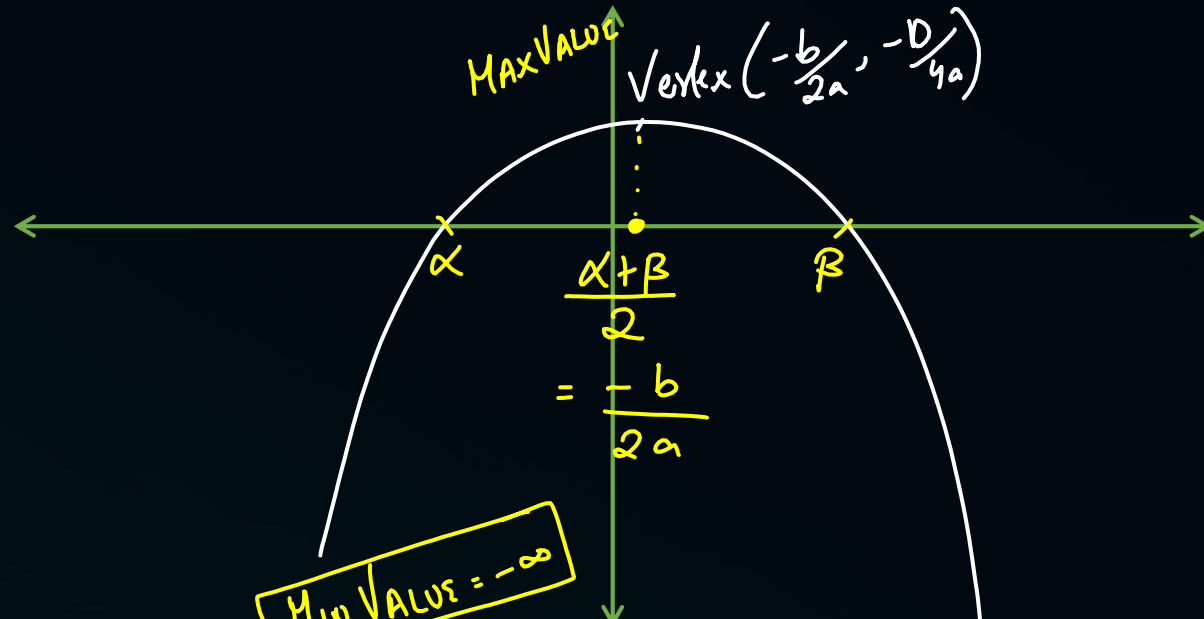
$$(-2)^2 + (-8) + 7 = 3$$

$$\left(\frac{-b}{2a}, -\frac{D}{4a}\right)$$

$x$

$$x^2 + 4x + 7$$

MIN VALUE occurs at  $x = \frac{-b}{2a} = \frac{-4}{2} = -2$



MIN VALUE =  $-\infty$

$$D = 16 - 28 = -12$$

$$\frac{-D}{4a} = \frac{12}{4} = 3$$

## QUESTION - 5



#Q. At what value of  $x$  will you get the minimum value of the quadratic expression  $x^2 - 4x + 11$ . Also find the minimum Value.

$$a > 0$$

**A**  $x = 2$ ; minimum value = 7

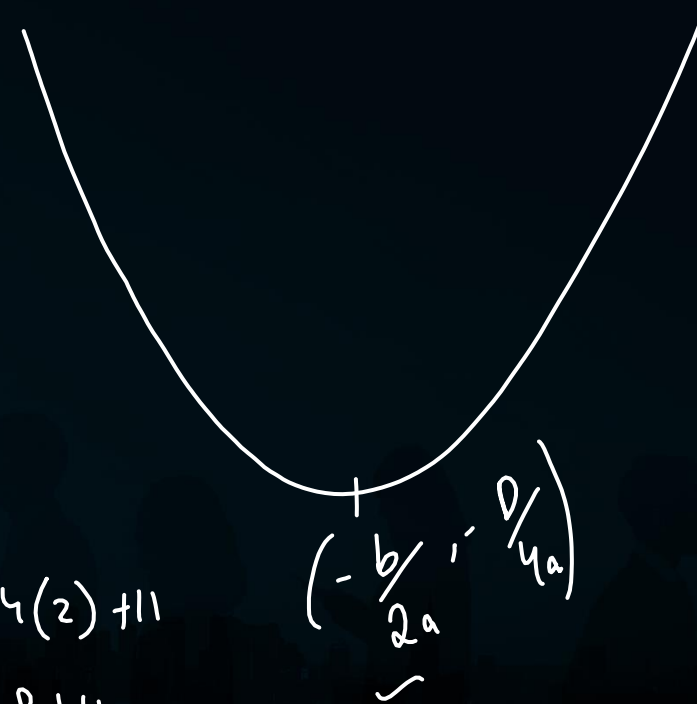
**B**  $x = 2$ ; minimum value = -7

**C**  $x = 4$ ; minimum value = 7

**D**  $x = 4$ ; minimum value = -7

$$\begin{aligned} x_{\text{MIN}} &= \frac{-b}{2a} \\ &= \frac{4}{2} \\ &= 2 \end{aligned}$$

$$\begin{aligned} \text{Min Value} &= 2^2 - 4(2) + 11 \\ &= 4 - 8 + 11 \\ &= 7 \end{aligned}$$



## QUESTION – 6



#Q. If the minimum value of the quadratic expression  $x^2 - 6x + c$  is 12. Find  $c$ .

**A** 10

**B** 12

**C** 21 ✓

**D** 44

$$x^2 - 6x + c$$
$$x_{\min} = \frac{-(-6)}{2} = 3$$

$$y_{\min} = 9 - 18 + c$$

$$12 = -9 + c$$

$$\boxed{21 = c}$$



## QUESTION - 7 (MIX' EM ALL)



#Q. If the minimum value of the quadratic expression  $2x^2 - bx + c$  occurs at  $x = 2$  and product of roots of equation is 12. Find  $\frac{c}{b}$ .

**A** 1

**B** 2

**C** 3 ✓✓

**D** 4

$$2x^2 - bx + c \begin{matrix} \nearrow \alpha \\ \searrow \beta \end{matrix}$$

$$x_{\min} = \frac{-(-b)}{2(2)} = \frac{b}{4}$$

$$2 = \frac{b}{4}$$

$$\boxed{8 = b}$$

$$\alpha\beta = \frac{c}{2}$$

$$12 = \frac{c}{2}$$

$$\boxed{24 = c}$$



## Topics : Exponents



# Identities Set



$$a^0 = 1$$

$$a^{-m} = \frac{1}{a^m}$$

$$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$$

✓  $(a^m) \times (a^n) = a^{m+n}$

$$2^3 \times 2^4 = 2^7 = 128$$

✓  $(a^m/a^n) = a^{m-n}$

$$\frac{3^5}{3^2} : 3^3 = 27$$

$$\checkmark (a^m)^n = a^{mn} = (a^n)^m$$

$$(2^3)^2 = 2^6 = (2^2)^3$$

✓  $a^{m^n}$

$$2^{2^3} = 2^8$$

$y = a^2x$

[illegible]

$$\checkmark (a^m \times b^m)^n = (a^m)^n \times (b^m)^n = a^{mn} \times b^{mn}$$

$(21)^3$	$(2^2 \times 3^3)^4$	$(2^3 \times 3^2 \times 5)^2$
$(3 \times 7)^3$	$(2^2)^4 \times (3^3)^4$	$2^6 \times 3^4 \times 5^2$
$3^3 \times 7^3$	$2^8 \times 3^{12}$	



# Exponents



$$\checkmark \sqrt{a} = a^{1/2}$$

$$\checkmark \sqrt[3]{a^4} \neq a^{4/3}$$

$$\checkmark \sqrt[3]{a} = a^{1/3}$$

$$(17^{12})$$

$$\begin{array}{l} 2^1 \longrightarrow 2^{10} \\ 3^1 \longrightarrow 3^6 \\ 5^1 \longrightarrow 5^4 \\ 6^1 \longrightarrow 6^3 \\ 7^1 \longrightarrow 7^3 \end{array} \left\{ \right.$$

$$\checkmark \sqrt[3]{3^{12}} = 3^{12/3} = 3^4 = 81$$



# Exponents



**Be Careful Here !! || YAHAN DHIYAN RAKHNA**

➤  $(a + b)^n \neq a^n + b^n$

➤  $(a - b)^n \neq a^n - b^n$

➤  $A^x > 0$  for all values of  $x$  if  $A > 0$

$$\begin{aligned} (3)^3 &= 27 \\ (3)^0 &= 1 \\ (3)^{-2} &= \frac{1}{9} \end{aligned}$$

$$(2^2 \times 3)^2 = 2^4 \times 3^2$$

$$(3^2 + 5^3)^3 \neq 3^6 + 5^9$$

## QUESTION - 7



#Q. Find the value of  $\underline{2^6 \times 2^4} \times 2^{\frac{1}{2}} \times 4^{\frac{-3}{2}} \times 2^{-\frac{9}{2}} \times 5^3$

**A** 1000 ✓

**B** 100

**C**  $600\sqrt{2}$

**D**  $1000\sqrt{2}$

$$2^{10} \times 2^{\frac{1}{2}} \times \underbrace{(2^2)^{-\frac{3}{2}}}_{2^{-3}} \times 2^{-\frac{9}{2}} \times 5^3$$

$$2^7 \times 2^{-4} \times 5^3$$

$$2^3 \times 5^3$$

$$8 \times 125$$

$$= 1000$$

## QUESTION - 8



#Q. Find the value of  $\underline{343}^{\frac{2}{3}} \times \underline{125}^{\frac{1}{6}} \times \sqrt{\underline{625}^{-1/4}}$

**A**

7

$$(\cancel{7^3})^{2/3} \times (\cancel{5^3})^{1/6} \times \sqrt{(\cancel{5^4})^{-1/4}}$$

**B**

49 ✓

$$7^2 \times 5^{1/2} \times \sqrt[2]{5^{-1}}$$

**C**

245

$$7^2 \times 5^{1/2} \times 5^{-1/2}$$

**D**

Can not be determined

$$7^2$$

$$= 49$$





# Exponents

---

**Reciprocal property in equations**

---



$$3^a = 5$$

$$3 = 5^{\frac{1}{a}}$$

$$x^3 = 8$$

$$x = 8^{\frac{1}{3}}$$

$$x = (2^3)^{\frac{1}{3}}$$

$$\boxed{x = 2}$$

$$x^7 = 2$$

$$x = 2^{\frac{1}{7}}$$

$$4^m = 20$$

$$4 = 20^{\frac{1}{m}}$$

$$\frac{1}{m}$$



## QUESTION - 9



#Q. If  $8^m = 0.02^n = 20$ , Find  $\boxed{\frac{1}{m} - \frac{1}{n}}$ .

A 1

B 2 ✓

C 0.1

D 0.2

$$\begin{array}{l|l} 8^m = 20 & (0.02)^n = 20 \\ 8 = 20^{1/m} & 0.02 = 20^{1/n} \end{array}$$

$$\frac{8}{0.02} = \frac{20^{1/m}}{20^{1/n}}$$

$$400 = 20^{1/m - 1/n}$$

$$20^2 = 20^{1/m - 1/n}$$

## Concept of Rationalisation



$$\frac{1}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}}$$

$$\frac{2+\sqrt{3}}{(2)^2 - (\sqrt{3})^2} = \frac{2+\sqrt{3}}{4-3}$$
$$= 2+\sqrt{3}$$

$$x^{7+4\sqrt{3}} = 9$$

$$x = 9^{\frac{1}{7+4\sqrt{3}}}$$

$$x = 9^{7-4\sqrt{3}}$$
$$x = \frac{9^7}{9^{4\sqrt{3}}}$$

## QUESTION- 10 (CAT 2020 Slot -1)



#Q. If  $x = (4096)^{7+4\sqrt{3}}$ , then which of the following equals 64?

**A**  $\frac{X^{\frac{7}{2}}}{x^{\frac{4}{\sqrt{3}}}}$

**B**  $\frac{X^7}{x^{4\sqrt{3}}}$

✓ **C**  $\frac{X^{\frac{7}{2}}}{x^{2\sqrt{3}}}$

**D**  $\frac{X^7}{x^{2\sqrt{3}}}$

$$x^{\frac{1}{7+4\sqrt{3}}} = 64^2 \quad 64 = \frac{x^{7/2}}{x^{2\sqrt{3}}}$$

$$x^{7-4\sqrt{3}}$$

$$\frac{x^7}{x^{4\sqrt{3}}} = 64^2$$

$$\begin{aligned} 64 &= 2^6 \\ 4096 &= 2^{12} \\ 4096 &= 64^2 \end{aligned}$$

# Exponents

## HOW to take Common

$$2^1 - 2^{12}$$

$$3^1 - 3^6$$

$$4^1 - 4^6$$

$$5^1 - 5^4$$

$$7^1 - 7^3$$

$$6^1 - 6^3$$

$$8^1 - 8^5$$



$$5^{\check{x+1}} + 5^{\check{x-3}}$$

$$5^x [5^1 + 5^{-3}]$$

$$5^x \left[ 5 + \frac{1}{125} \right]$$

$$\frac{626}{125} (5^x)$$

## QUESTION- 11



#Q. Simplify:  $\frac{5^{3n} + 5^{3n+2}}{26}$  .

A

$5^3$

B

$5^n$

C

$5^{3n}$



D

$5^{3n+1}$

$$\frac{5^{3n} [1 + 5^2]}{\cancel{26}}$$
$$5^{3n}$$



## QUESTION- 12



#Q.  $5 \times 2^{x+3} - 21 \times 2^{x-1} = 236$

$$2^x [5(2^3) - 21(2^{-1})] = 236$$

$$2^x \left[ 40 - \frac{21}{2} \right] = 236$$

$$2^x \left[ \frac{59}{2} \right] = 236$$

$$2^x = 8$$

$$2^x = 2^3$$

$$\boxed{x=3} \checkmark$$



# Exponents

---

## EXPONENTS & FACTORIZATION

---



## QUESTION- 13



#Q.  $15^3 \times 27^2 = 9^x \times 25 \times 15^y$  find value of  $x - y$ .

A

5

$$(15)^3 \times (27)^2 = 9^x \times 25 \times 15^y$$

B

3 ✓

$$(3 \times 5)^3 =$$

$$3^3 \times 5^3 \times 3^6 = 3^{2x} \times 5^2 \times 3^y \times 5^y$$

C

1

$$\boxed{9 = 2x + y}$$

$$x = 4$$

$$\boxed{3 = 2 + y}$$

$$y = 1$$

D

0



# Time for a BGT

$$2^x = 3^x$$
$$\left\{ \begin{array}{l} \frac{2^x}{3^x} = 1 \\ \left(\frac{2}{3}\right)^x = 1 \\ x = 0 \end{array} \right\} \quad \text{obs} \quad \boxed{x=0}$$

$$2^x = 3^{-x}$$
$$2^x = \frac{1}{3^x}$$
$$\left\{ \begin{array}{l} 2^x \times 3^x = 1 \\ (2 \times 3)^x = 1 \\ 6^x = 1 \\ \boxed{x=0} \end{array} \right\} \quad \text{obs} \quad \boxed{x=0}$$

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

$$2x - 3y = 0$$

$$\boxed{2x = 3y}$$

$$\left(\frac{7}{3}\right)^{2x-3y} = \left(\frac{3}{2}\right)^{3y-2x}$$

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

## QUESTION- 14



#Q. If  $2^{2x+y} = \frac{2^5}{32}$  and  $\left(\frac{2}{3}\right)^{x-2y} = \left(\frac{3}{4}\right)^{2y-x}$  find value of  $x + y$ .

A

5

$$2x + y = 5$$

$$x - 2y = 0 \rightarrow x = 2y$$

B

3

$$5y = 5$$

$$y = 1$$

C

2

$$x = 2$$

D

4

## QUESTION- 15 (CAT 2022 Slot 3)



#Q.  $\left(\sqrt{\frac{7}{5}}\right)^{3x-y} = \frac{875}{2401}$  and  $\left(\frac{4a}{b}\right)^{6x-y} = \left(\frac{2a}{b}\right)^{y-6x}$  for all non-zero real values of 'a' and 'b', then the value of  $x + y$  is

$$6x - y = 0$$

$$\boxed{6x = y}$$

$$-3x = -6$$

$$\left. \begin{array}{l} \boxed{x = 2} \\ \boxed{y = 12} \end{array} \right\} 14$$

$$\left[\sqrt{\frac{7}{5}}\right]^{3x-y} = \frac{125}{2401}$$

$$\left(\frac{7}{5}\right)^{\frac{3x-y}{2}} = \left(\frac{5}{7}\right)^3$$

$$\left(\frac{5}{7}\right)^{-\left(\frac{3x-y}{2}\right)} = \left(\frac{5}{7}\right)^3$$

$$-\left(\frac{3x-y}{2}\right) = 3$$

$$3x - y = -6$$



**Topics : Exponents – CAT ka FAVOURITE**

**GAME OF 1**



# QUESTION- 16 (CAT 2022 Slot 2)



#Q. The number of integer solutions of the equation

452 ✓

$$(x^2 - 10)^{\overbrace{x^2 - 3x - 10}} = 1$$

$$(-1)^{\text{odd}} = (-1)^3 = -1$$

$$(-1)^{\text{even}} = (-1)^4, (-1)^8 \dots$$

power = 0

$$(\quad)^0 = 1$$

$$x^2 - 3x - 10 = 0$$

$$(x - 5)(x + 2) = 0$$

$$x = 5 \checkmark$$

$$x = -2 \checkmark$$

Base = 1

$$(1)^{-} = 1$$

$$x^2 - 10 = 1$$

$$x^2 = 11$$

$$x = \pm \sqrt{11}$$

X

$$x^2 - 10 = -1$$

$$x^2 = 9$$

$$x = \pm 3$$

$$\frac{1}{(-1)^{10}} = \frac{1}{1}$$

	Base	Power	
$x = 3$	-1	$9 - 9 - 10 = -10$	$(-1)^{\text{even}} \checkmark$
$x = -3$	-1 ✓	$9 + 9 - 10 = 8$ ✓	$(-1)^{\text{even}} \checkmark$



## QUESTION- 17 (CAT 2020 Slot 1)



#Q. The number of distinct positive integer solutions of the equation

$$(x^2 - 7x + 11)^{x^2 - 13x + 42} = 1 \text{ are}$$

**A** 6

**B** 2

**C** 4

**D** 8

HW



# EXPONENTS

---

**CAT ka FAVORITE** || Assume t

---

## QUESTION- 18



#Q. The number of solutions of the equation

$$\underline{4^x} - 3(\underline{2})^x - 4 = 0 \quad \text{are}$$

**A** 0

**B** 1

**C** 2

**D** 3

$3^x$   $9^x$  ?!

MBA Algebra Foundation



All

Shorts

Videos

Unwatched

Watched

Recently uploaded

Live

Playlists



**AMRITA**  
VISWA VIDYAPEETHAM  
INDIAN INSTITUTE OF TECHNOLOGY (IIT) HARIDWAR

PROGRAMS OFFERED AT HARIDWAR CAMPUS  
**B.Tech. CSE • B.Tech. AI & DS**  
**B.Tech. ECE**

APPLY NOW WITH JEE MAINS 2025 OR +2 PCM MARKS  
**080-691 50838** [amrita.edu/haridwar](https://amrita.edu/haridwar)

75% FEE WAIVER\* | 92% PLACEMENTS IN 2024 | ₹80.49 LAKH HIGHEST CTC IN 2025

nirf 7<sup>TH</sup> RANKED UNIVERSITY IN INDIA | NAAC A++ ACCREDITED | CATEGORY 1 GRANTED AUTONOMY IIT, GOVT. OF INDIA | No.1 IN INDIA | Times Higher Education Impact Rankings 2025

B.Tech CSE, AI, ECE: Amrita Haridwar.

Secure your spot. Amrita Haridwar offers excellent B.Tech programs. Apply now

Sponsored · AMRITA



**QUANT ALGEBRA** **01**

**EQUATIONS VS EXPRESSIONS**

**CAT EXAM**

MBA Wallah  
10 videos

ALGEBRA

MBA Wallah · Playlist

Equations Vs Expressions | Quant Algebra 01 | CAT 2024 | MBA Wallah · 55:36

Basic Identities | Quant Algebra 02 | CAT 2024 | MBA Wallah · 1:13:45

View full playlist

YouTube MBA Algebra Foundation × Q + Create 🔔



# CAT 2023

## FOUNDATION

**Lecture-06**

**Exponents**



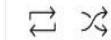
BY **RAHUL BATHLA SIR**

0:02 / 55:33 • Introduction >

CC ⚙️ 📺 🔍

**ALGEBRA**

MBA Wallah - 6 / 10



- 3 **LINEAR EQUATION** 1:13:50 Algebra 03 | CAT 2024 | MBA Wallah
- 4 **QUANT ALGEBRA** 1:31:06 Linear Equation Practice + Quadratic Equations-1 | Quant Algebra 04 | CAT 2024 | MBA Wallah
- 5 **QUANT ALGEBRA** 1:04:04 Quadratic Equation (Theory of Roots) | Quant Algebra 05 | CAT 2024 | MBA Wallah
- 6 **QUANT ALGEBRA** 55:34 Exponents | Quant Algebra 06 | CAT 2024 | MBA Wallah
- 7 **QUANT ALGEBRA** 49:48 Inequalities 1 | Quant Algebra 07 | CAT 2024 | MBA Wallah
- 8 **QUANT ALGEBRA** 58:51 Inequalities- 2 | Quant Algebra 08 | CAT 2024 | MBA Wallah
- 9 **QUANT ALGEBRA** 1:09:36 Functions Meaning and Modulus Function | Quant Algebra 09 | CAT 2024 | MBA Wallah
- 10 **QUANT ALGEBRA** 1:11:29 Logarithm | Quant Algebra 10 | CAT 2024 | MBA Wallah

$L \cdot \mathbb{E}Q$

$Q \cdot \mathbb{E}Q$

$\mathbb{E}x p_0$

≡ INEQUALITIES

≡ func





THANK  
*You*

