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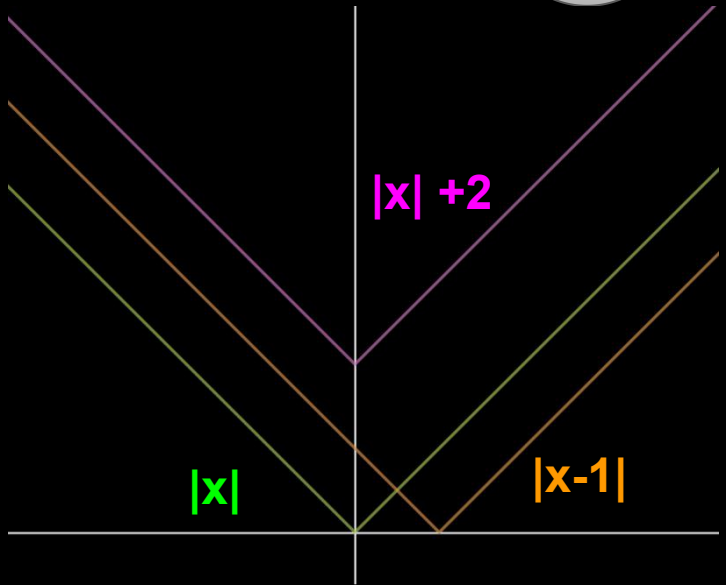
Functions

LECTURE 5

Modulus Function - 2



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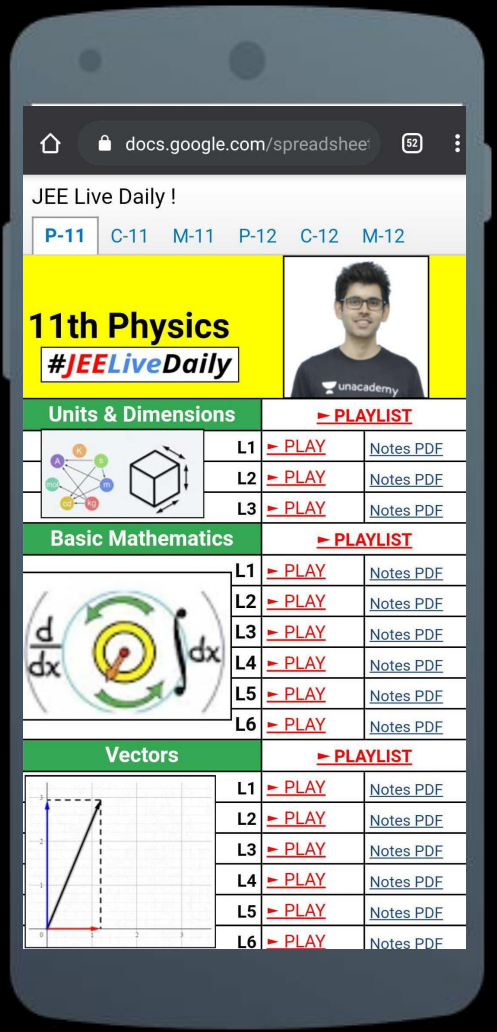

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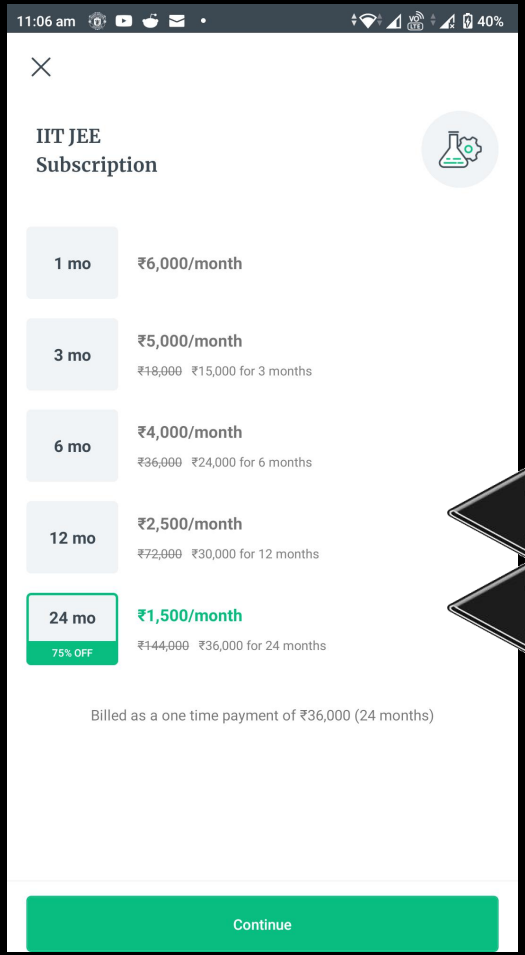

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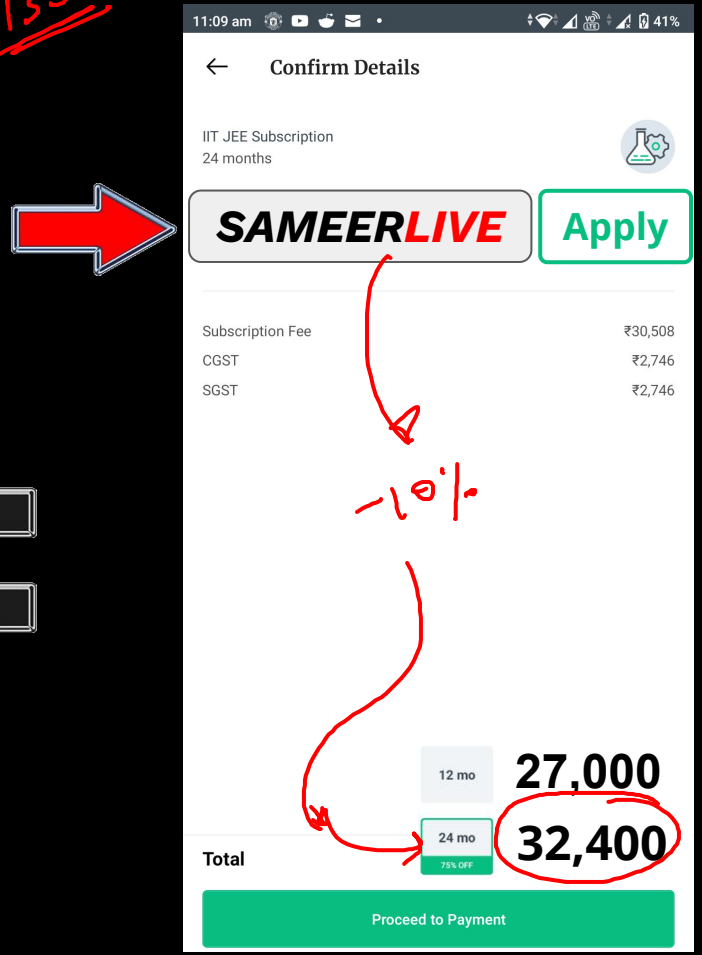

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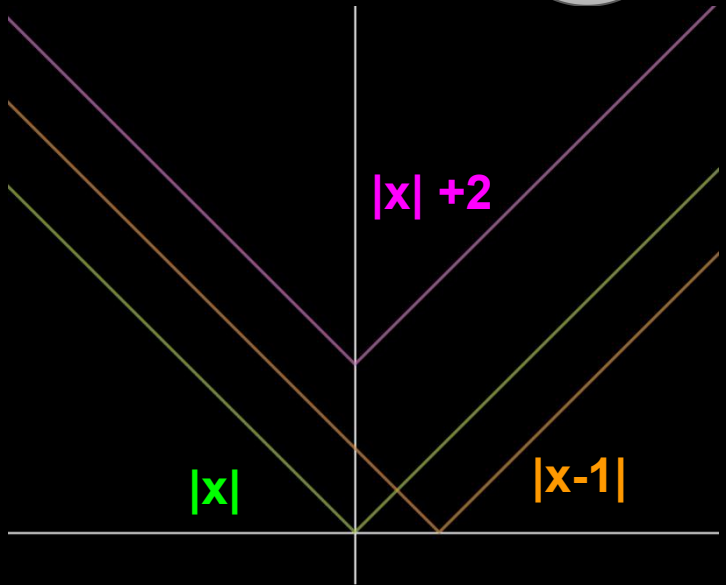
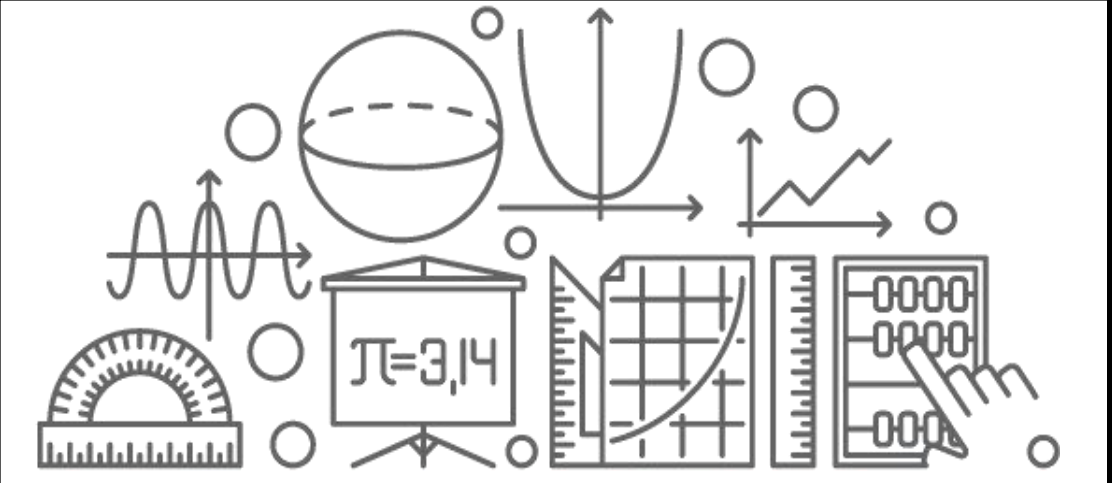
Functions

LECTURE 5

Modulus Function - 2





Modulus Equation

Solving Modulus Equality:

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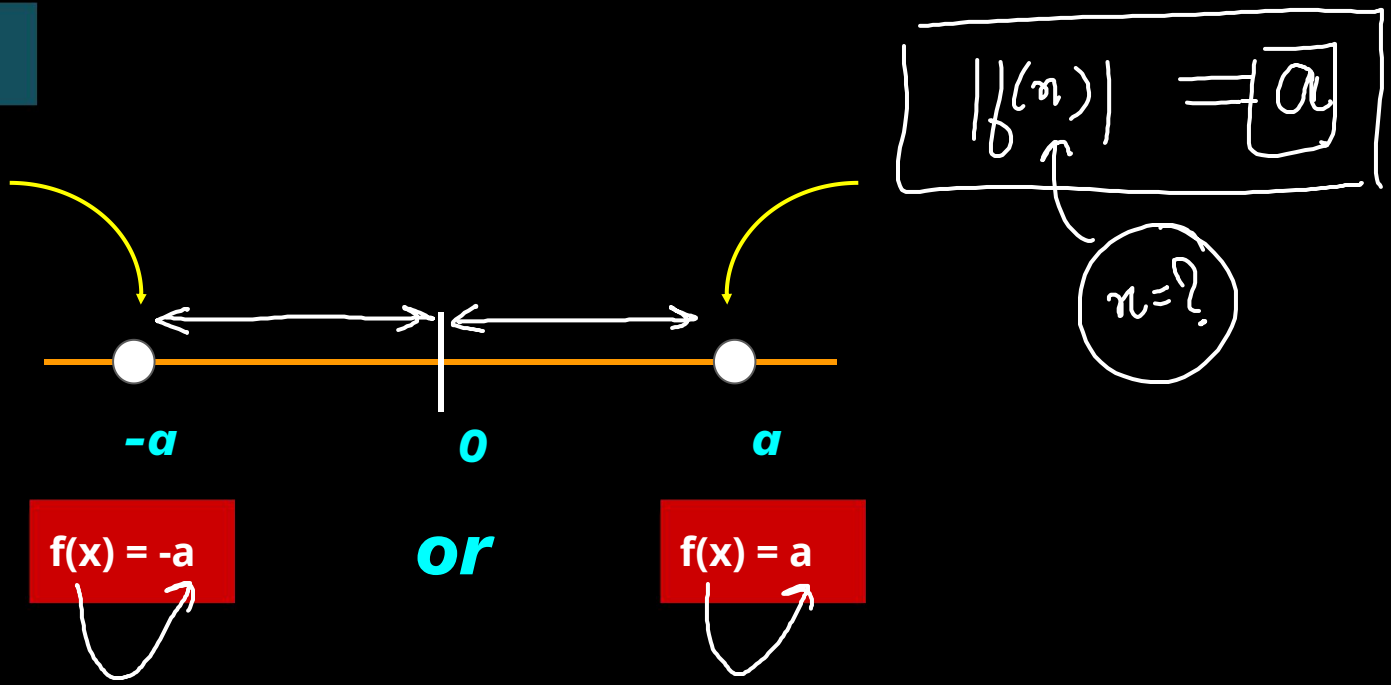
|f(x)| = a



Example

Solve for **x:** $|x + 7| = 3$

$(x+7) = 3$

$x = -4$

$(x+7) = -3$

$x = -10$

Example

Solve for **x:** $||x + 1| - 4| = 5$

$f(x)$

$|x+1| - 4 = 5$

$|x+1| = 9$

$x+1 = 9$ | $x+1 = -9$

$x = 8$ | $x = -10$

$|x+1| - 4 = -5$

$|x+1| = -1$

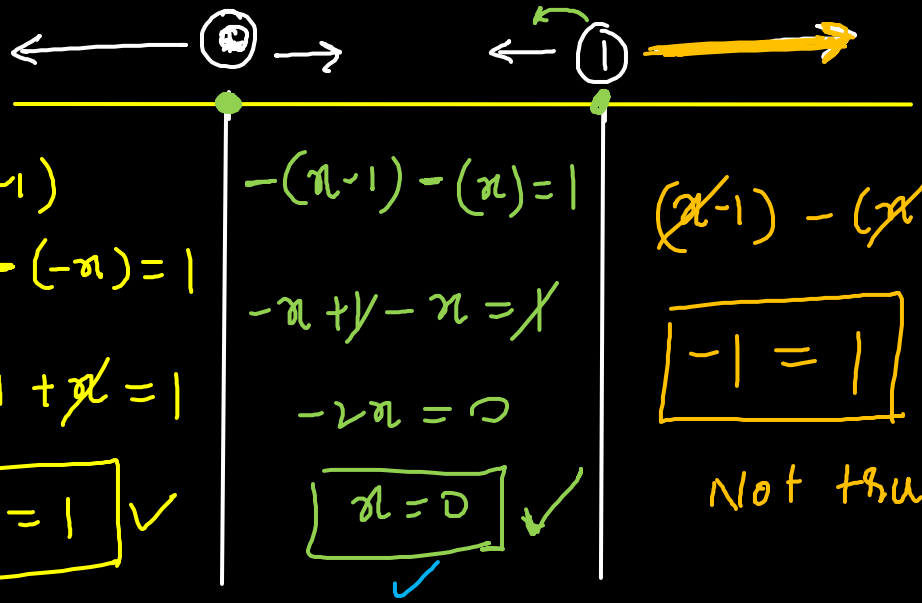
always +ve

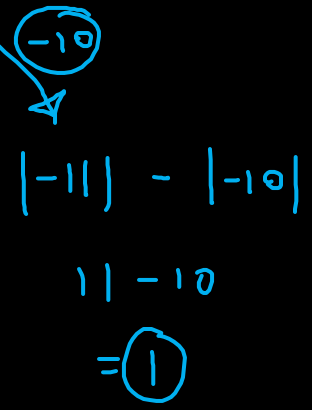
No sol^{n}

Example

Solve for x: $|x - 1| - |x| = 1$ ✓

$|b^{|x|}| = a$ ✗





$x \in (-\infty, 0]$

Example Solve for x: $x^2 + 7|x| + 10 = 0$

$x^2 - 7x + 10 = 0$

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

$x = 2, 5$

✗ ignore

$x^2 + 7x + 10 = 0$

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

$x = -2, -5$

✗ ignore

No sol^n

M-2

$$x^2 + 7|x| + 10 = 0$$

$$(-2)^2 = |-2|^2$$

$\checkmark$ $\checkmark$

$\therefore$ $\boxed{x^2 = |x|^2}$

$$|x|^2 + 7|x| + 10 = 0$$

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

$$|x| = -2 \quad \text{or} \quad |x| = -5$$

$\times$ $\times$

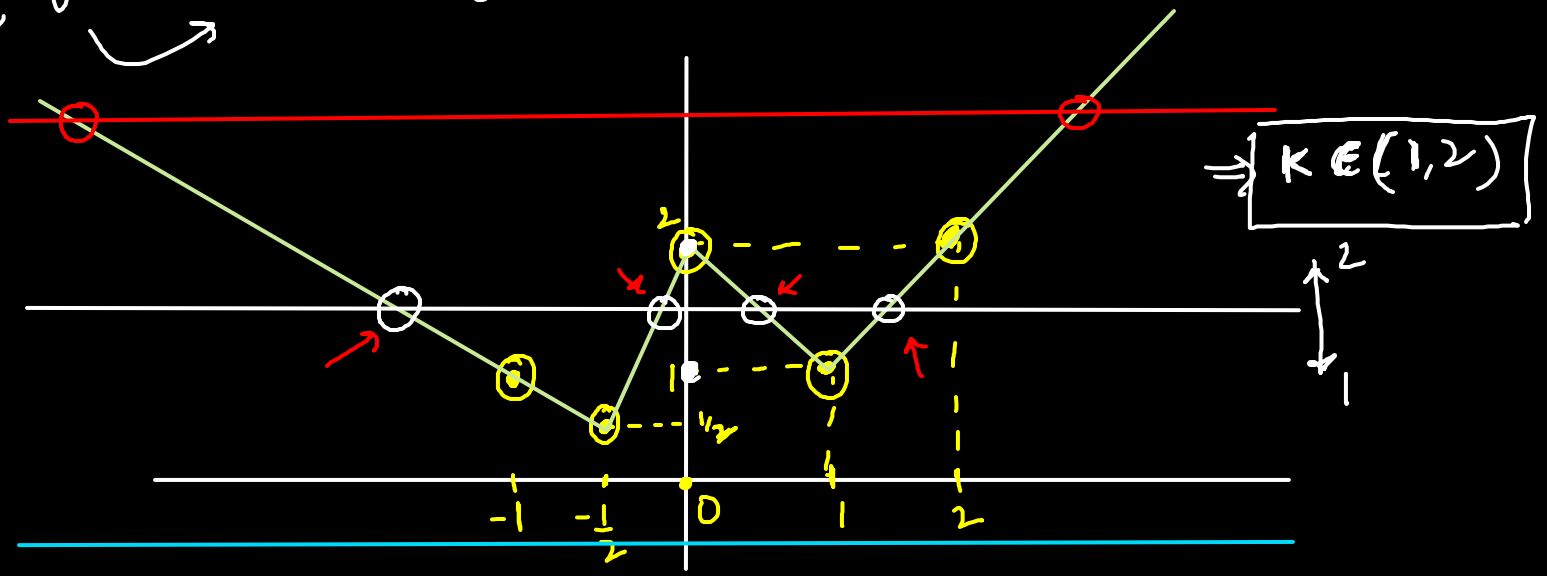
No soln

Example Find ‘k’ for which following equation has 4 solutions

$$|x - 1| - 2|x| + |2x + 1| = k$$

$$\begin{cases} y = LHS & \Rightarrow y = |x-1| - 2|x| + |2x+1| \quad (1) \\ y = RHS & \Rightarrow y = k \quad (2) \end{cases}$$

$$\left|-\tfrac{1}{2}-1\right| - 2\left|-\tfrac{1}{2}\right| = \tfrac{3}{2} - 1 = \tfrac{1}{2}$$



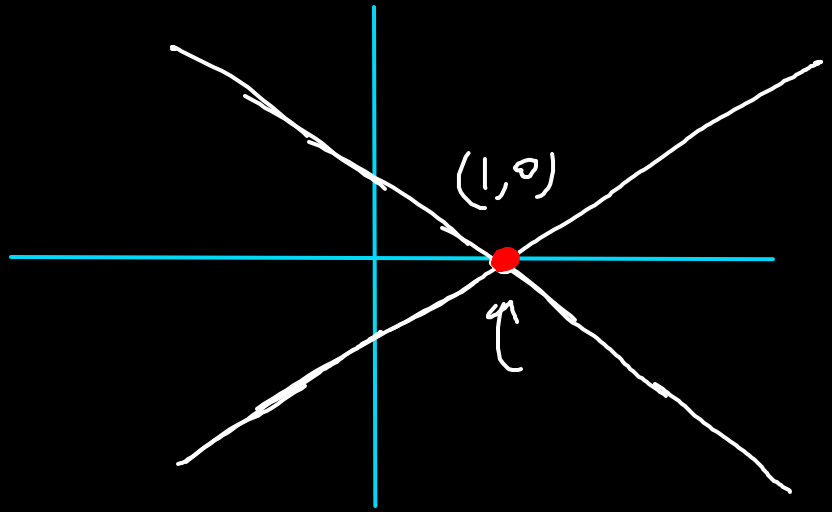
$$\Rightarrow k \in (1, 2)$$

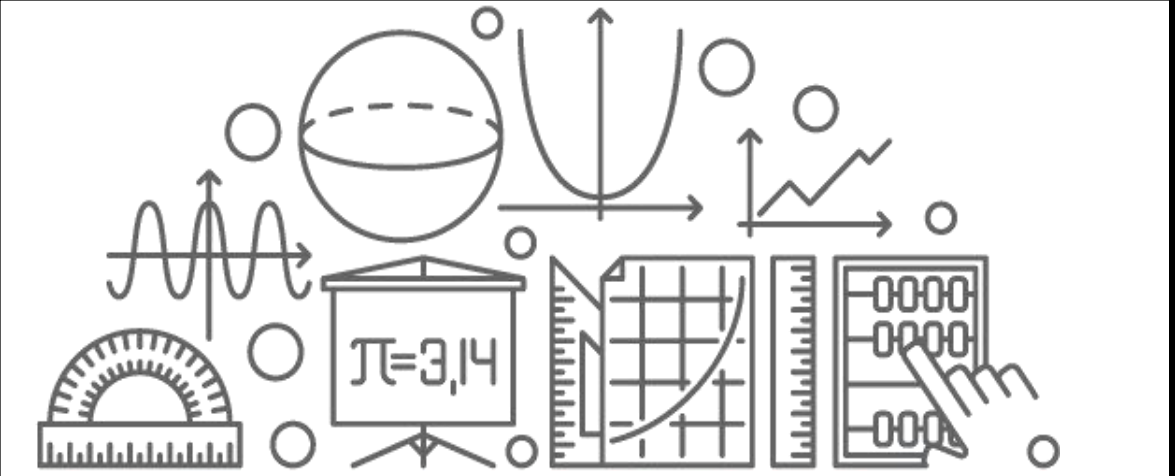
$$\begin{cases} y = x - 1 & -(1) \\ y = 1 - x & -(2) \end{cases}$$

$$2y = 0$$

$$\Rightarrow y = 0 \Rightarrow x = 1$$

$\therefore$ $(1, 0)$ → intersection point





Modulus Inequality

Solving Modulus Inequality:

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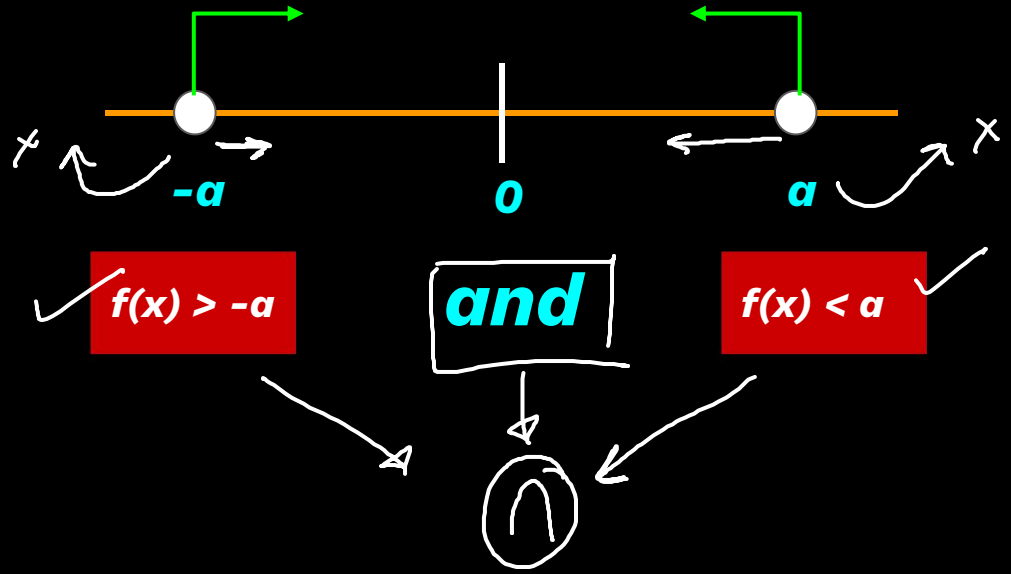
$|f(x)| < a$

$|f^{(n)}| < a$

$n = ?$



Solving Modulus Inequality:

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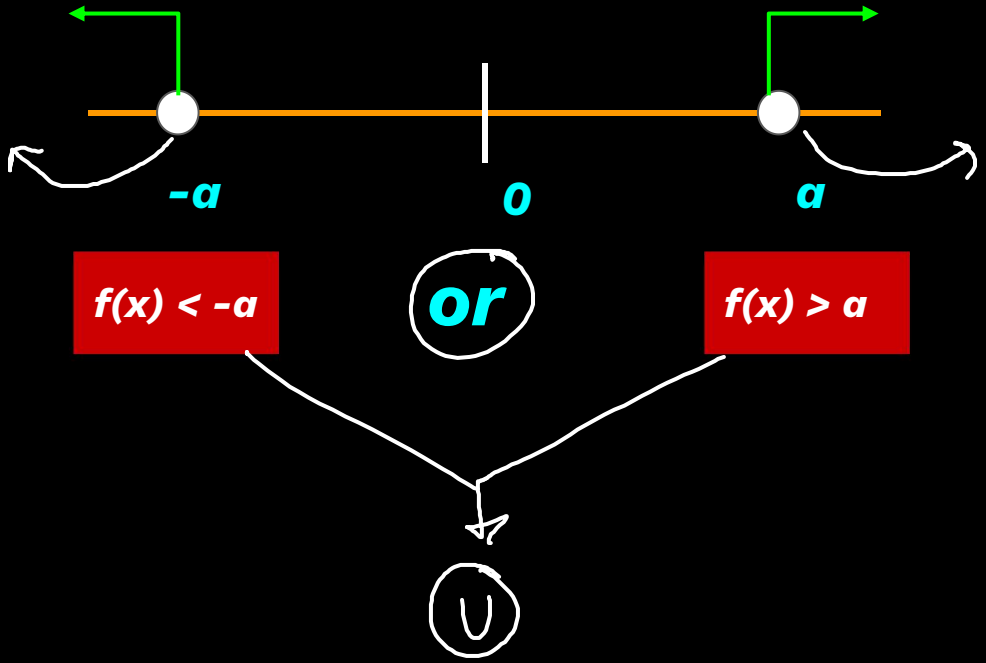
|f(x)| > a



Example

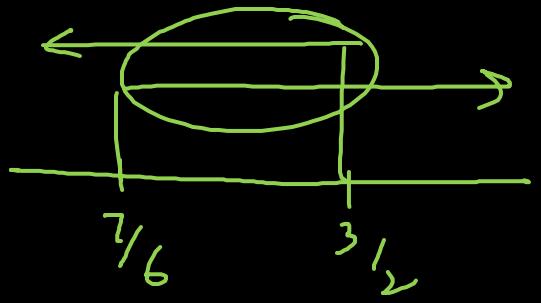
Find $|4 - 3x| \leq 1/2$ then x is equal to:

A. $\left[\frac{7}{6}, \frac{3}{2}\right)$

B. $\left(\frac{7}{6}, \frac{3}{2}\right)$

C. $\left[\frac{7}{6}, \frac{3}{2}\right]$

D. None of these



$x \in \left[\frac{7}{6}, \frac{3}{2}\right]$

$4 - 3x \leq \frac{1}{2}$

$4 - \frac{1}{2} \leq 3x$

$3x \geq \frac{7}{2} \Rightarrow x \geq \frac{7}{6}$

(1) & (2)

$4 - 3x \geq -\frac{1}{2}$

$4 + \frac{1}{2} \geq 3x$

$3x \leq \frac{9}{2}$

$\Rightarrow x \leq \frac{3}{2}$

Example

$$\left|\frac{2x-1}{x-1}\right| > 2$$

A. $(-\infty, -1] \cup [1, \infty)$

B. $(3/4, 1) \cup (1, 2)$

C. $(3/4, \infty)$

D. $(3/4, 1) \cup (1, \infty)$

C-1 :

$$\frac{2x-1}{x-1} > 2$$

$$\frac{2x-1}{x-1} - 2 > 0$$

$$\frac{2x-1-2x+2}{x-1} > 0$$

$$\frac{1}{x-1} > 0$$

$$x - 1 > 0$$

$$x > 1 \quad -(1)$$

C-2 :

$$\frac{2x-1}{x-1} < -2$$

$$\frac{2x-1}{x-1} + 2 < 0$$

$$\frac{2x-1+2x-2}{x-1} < 0$$

$$\frac{4x-3}{x-1} < 0$$

$$x \in \left(\frac{3}{4}, 1\right) \quad -(2)$$

Example The complete set of real 'x' satisfying $||x - 1| - 1| \leq 1$ is:

A. [0, 2] **B.** [-1, 3] **C.** [-1, 1] **D.** [1, 3]

$|x-1| - 1 \geq -1$

$|x-1| \geq 0$

always true

$x \in R$

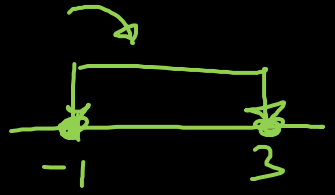
&

$|x-1| - 1 \leq 1$

$|x-1| \leq 2$

$(x-1) \geq -2$ & $(x-1) \leq 2$

$x \geq -1$ $x \leq 3$



Example

$|x^3 - 1| \geq 1(1 - x)$

H.W:

A. $(-\infty, -1] \cup [0, \infty)$

B. $(-\infty, 0] \cup [1, \infty)$

C. $(-\infty, 0) \cup (1, \infty)$

D. $(-\infty, 0) \cup (0, \infty)$

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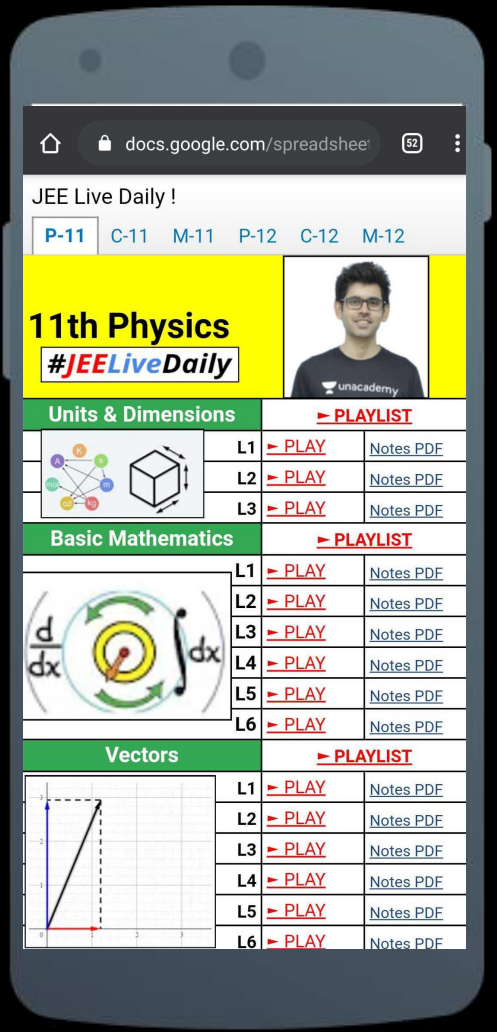

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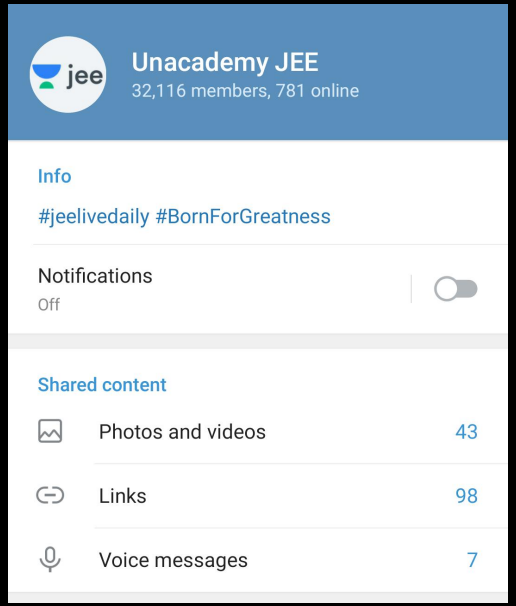

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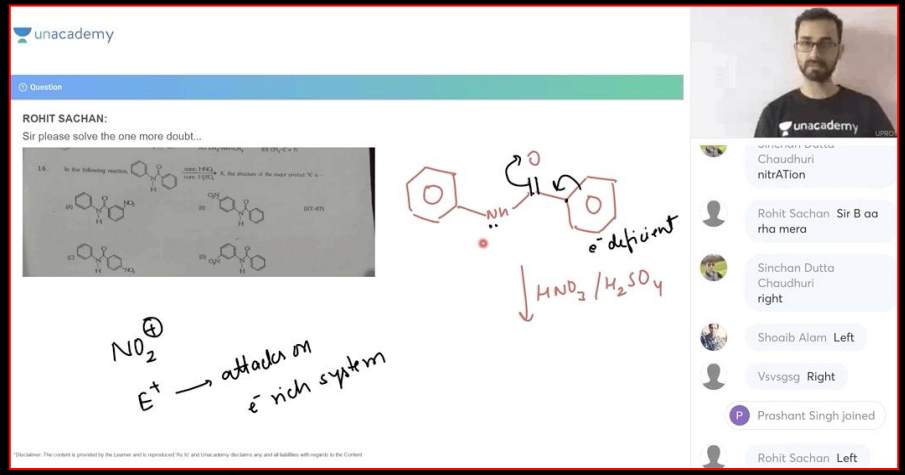

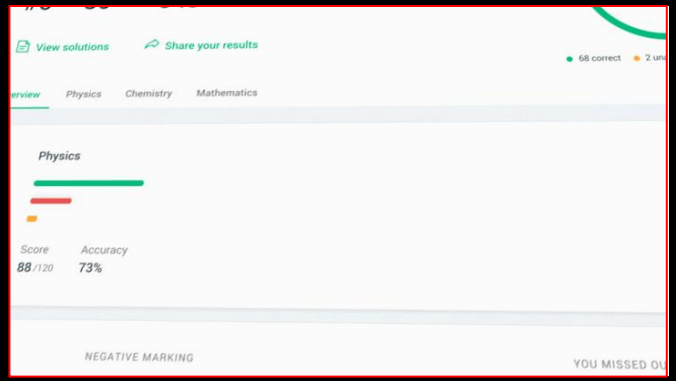

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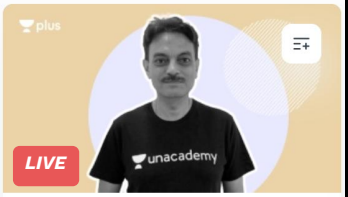

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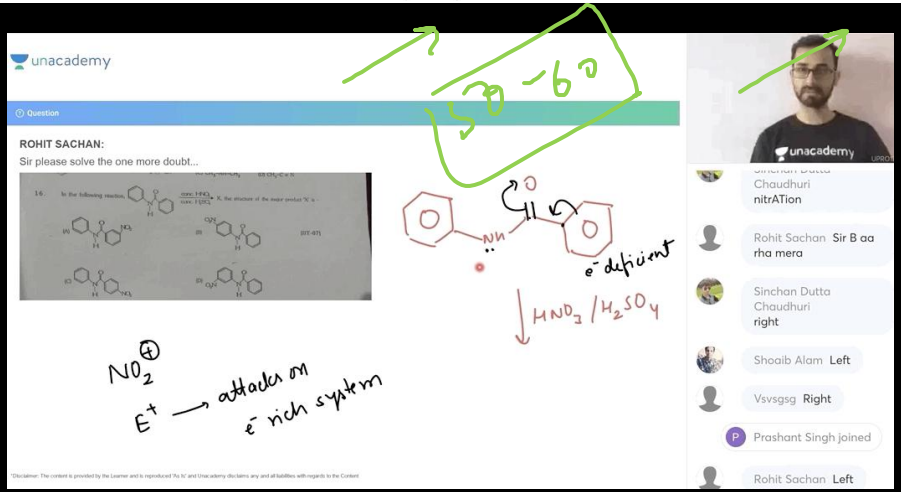

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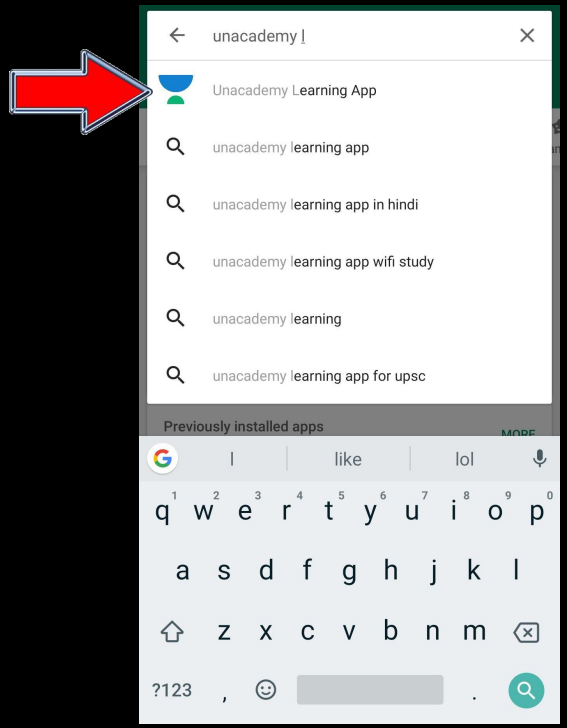
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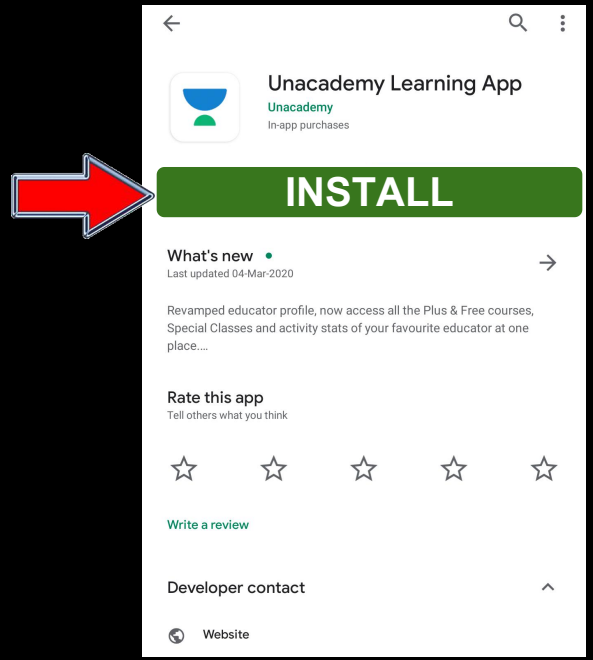
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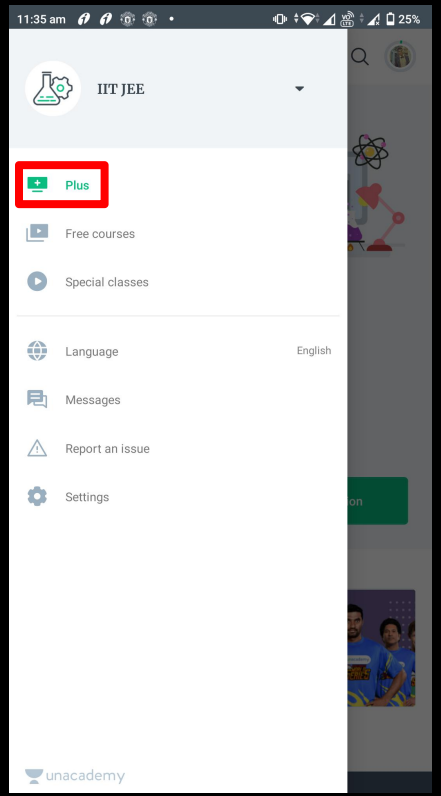

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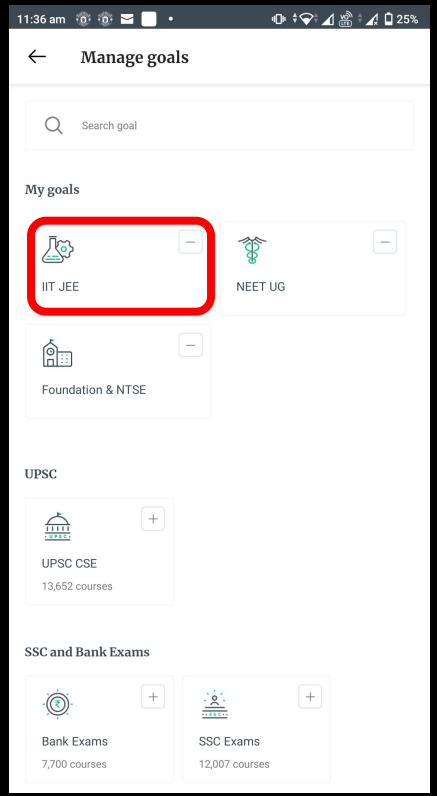

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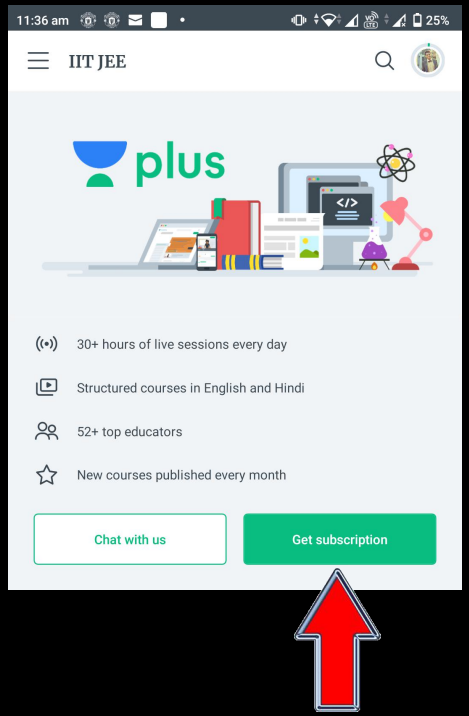

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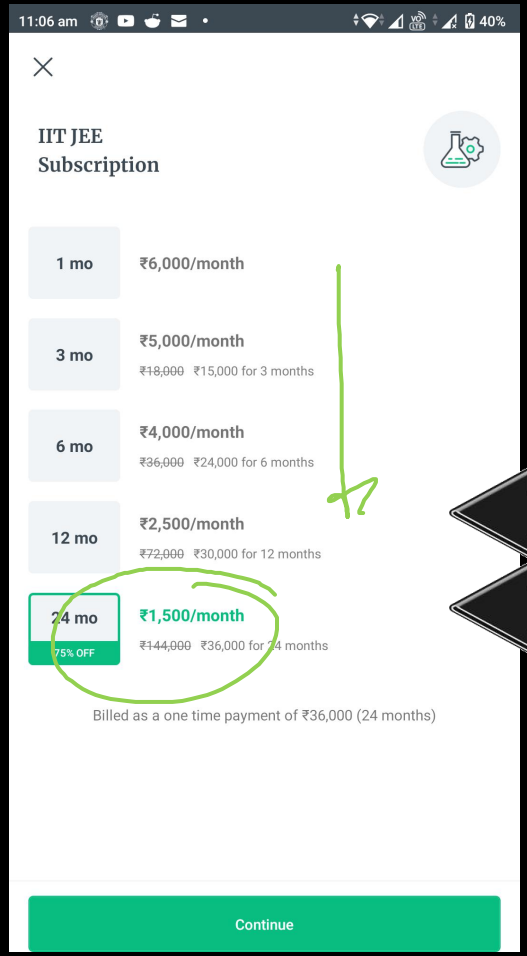

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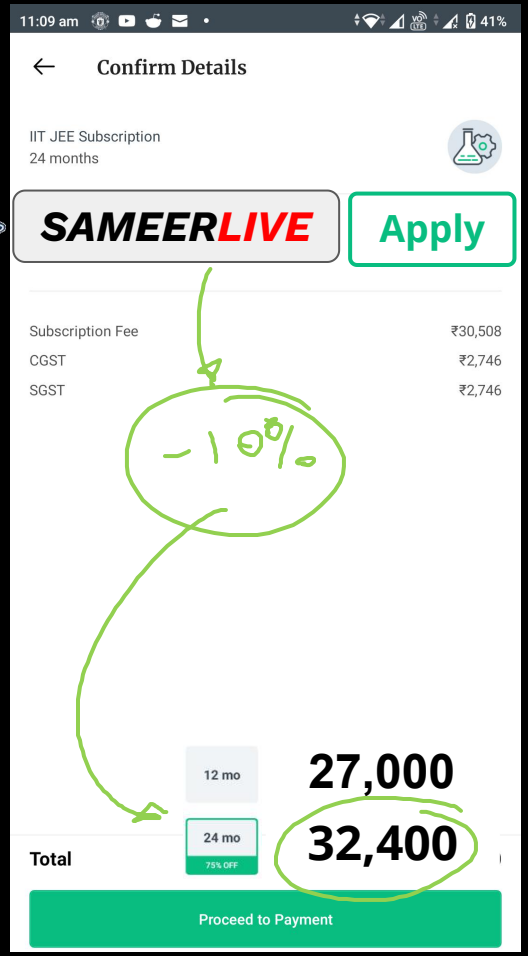

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