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Functions

LECTURE 10

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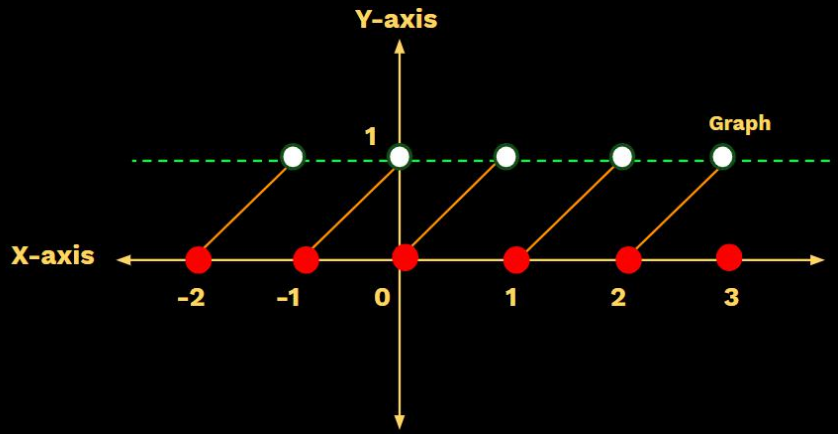

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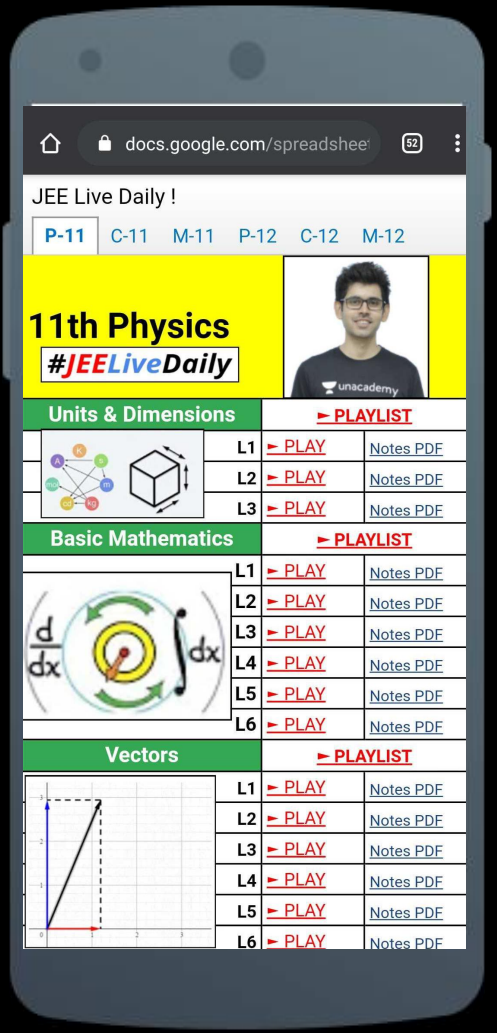

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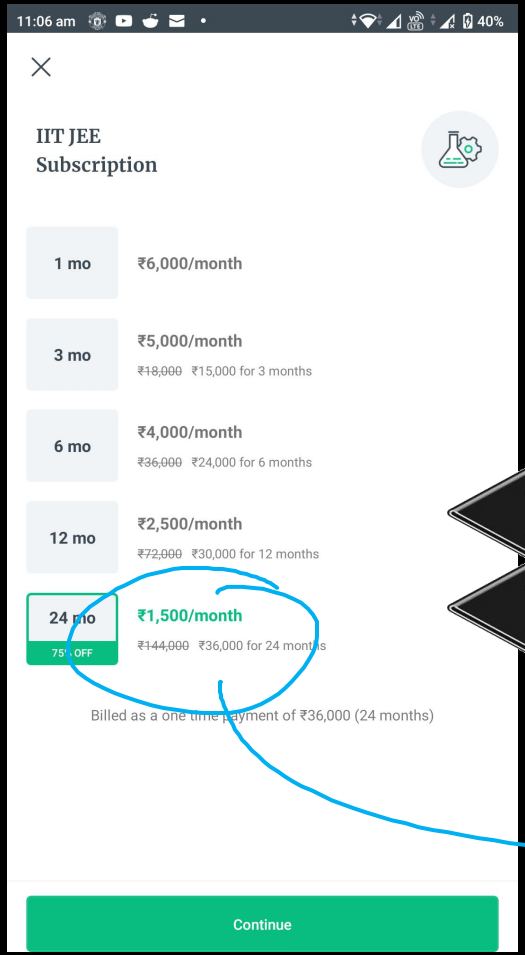

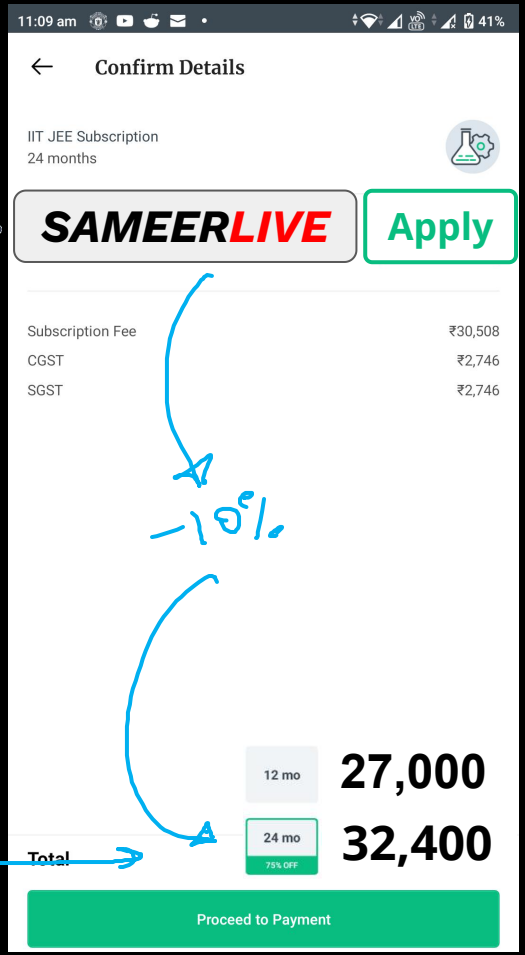

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Functions

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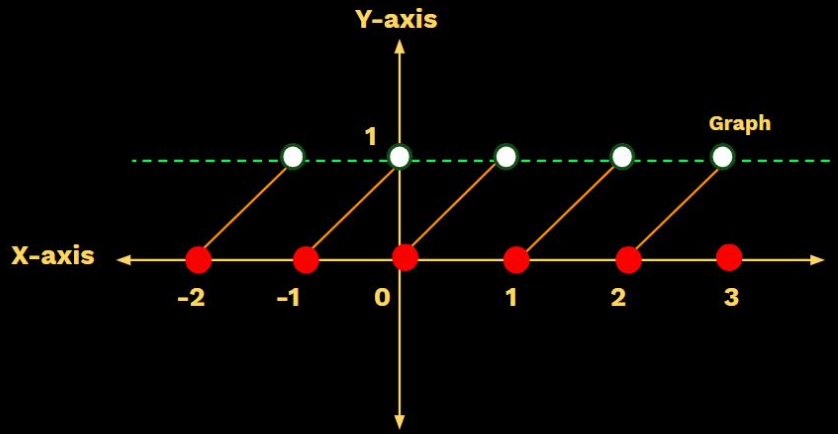
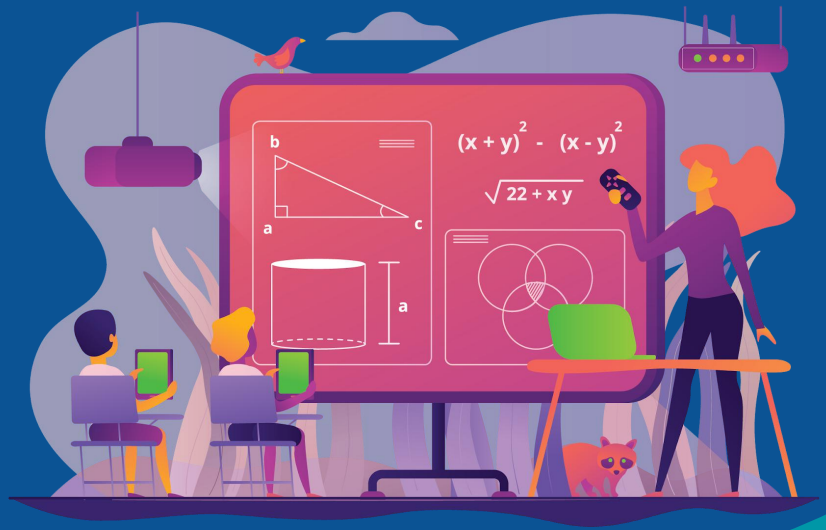


Greatest Integer Function



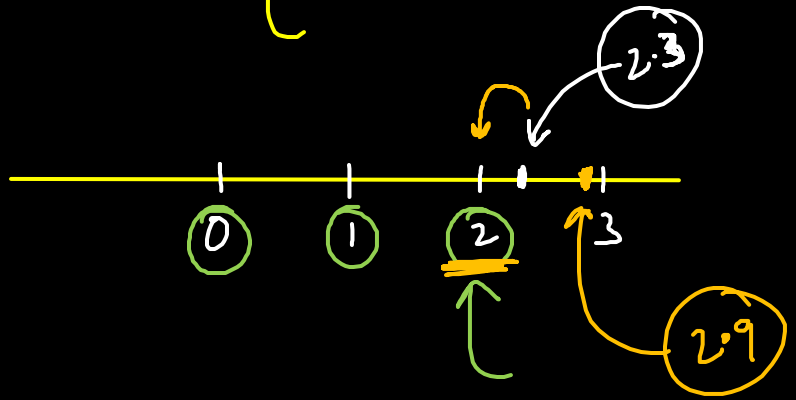
Greatest Integer Function:

Definition: Greatest integer less than or equal to x.

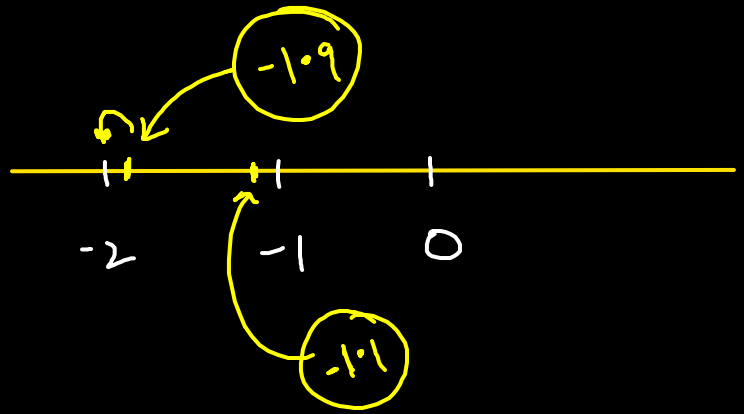
$f(x) = [x]$

Eg: $[2.3] = 2$

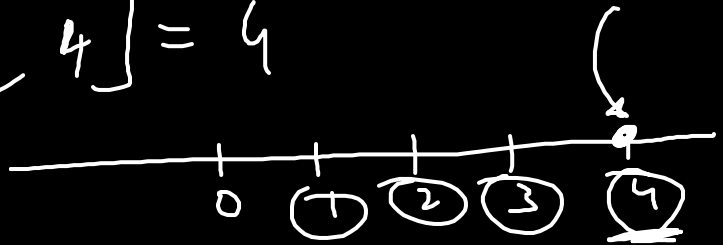
Eg: $[2.9] = 2$

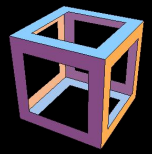


Eg: $[-1.9] = -2$ { Eg: $[-1.1] = -2$



Eg: $[4] = 4$





G.I.F.: Domain and Range

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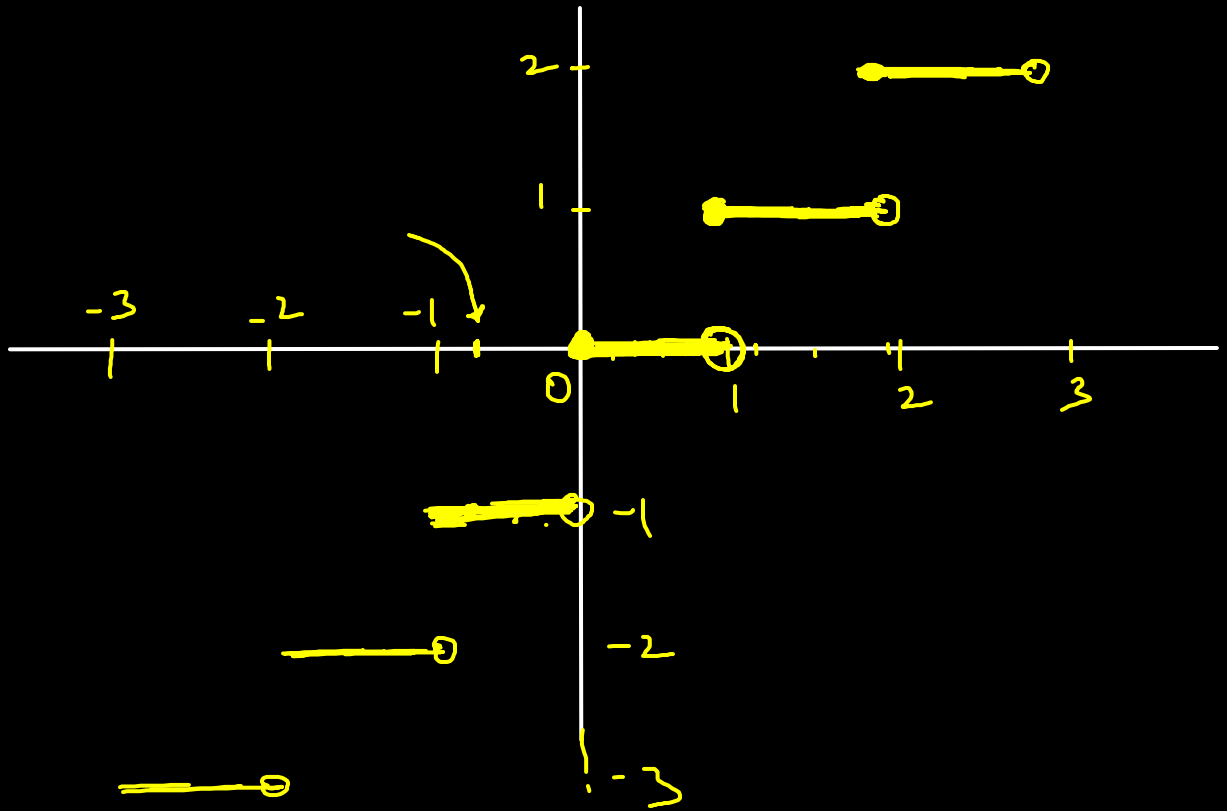
Definition: Greatest integer less than or equal to x.

$f(x) = [x]$

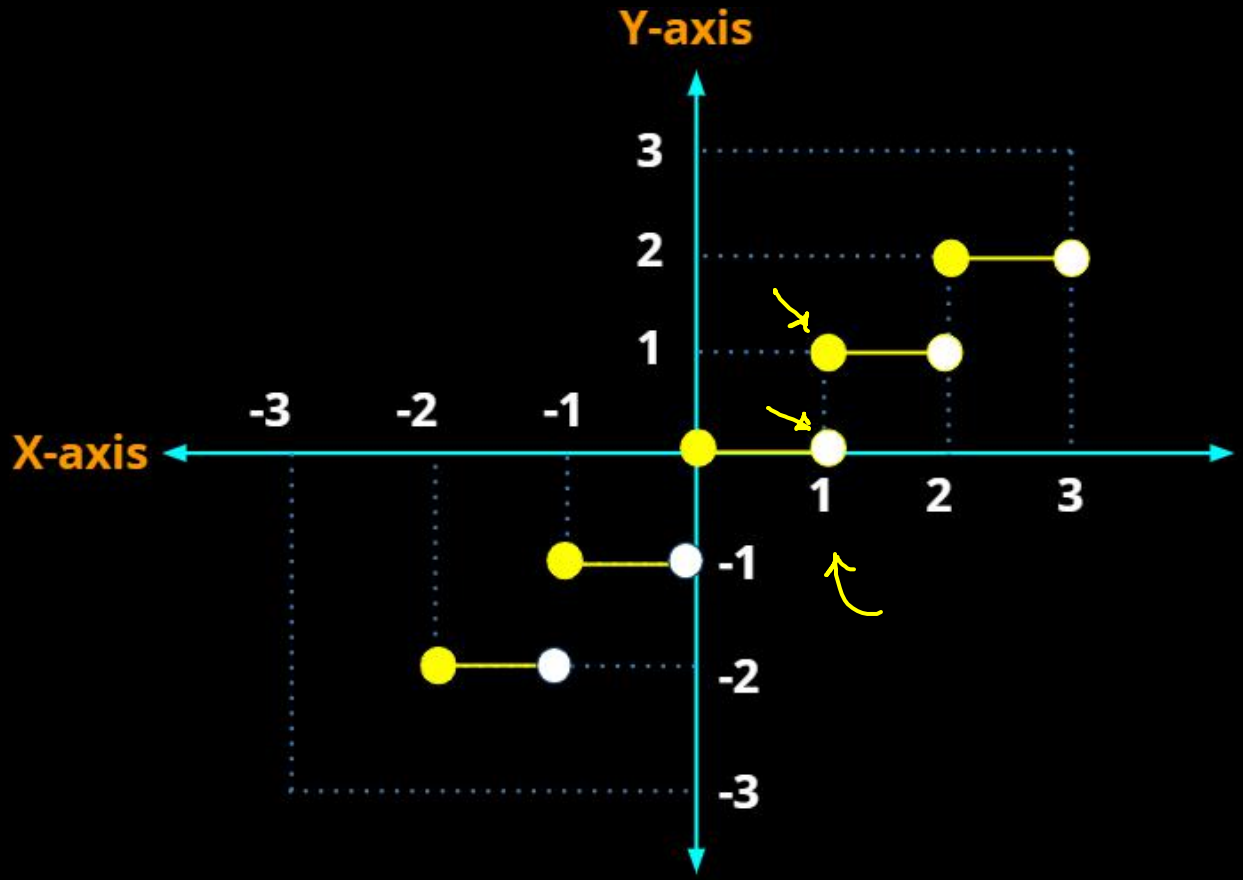
Domain: $X \in R$

Range: Integers

G.I.F.: Graph $[\cdot]$ → Step Function



G.I.F.: Graph



Properties of G.I.F.

Properties of Greatest Integer Function:

1. $[x + n] = [x] + n$ (n is integer)

; $[2.7 + 10] = [2.7] + 10 = 2 + 10 = 12$

$[12.7] \rightarrow 12$

2. $[x + [x]] = [x] + [x] = 2[x]$

I

3

$[x] + [-x] =$

$\begin{cases} -1, & \text{if } x \notin I \\ 0, & \text{if } x \in I \end{cases}$

$[4] + [-4] = 0$

$4 + (-4)$

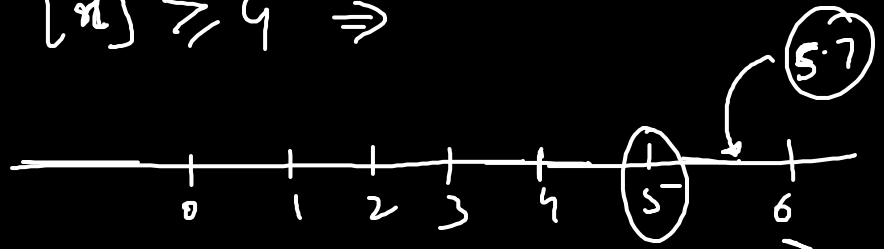
$[2.6] + [-2.6] = -1$

$2 + (-3)$

4 Inequalities:

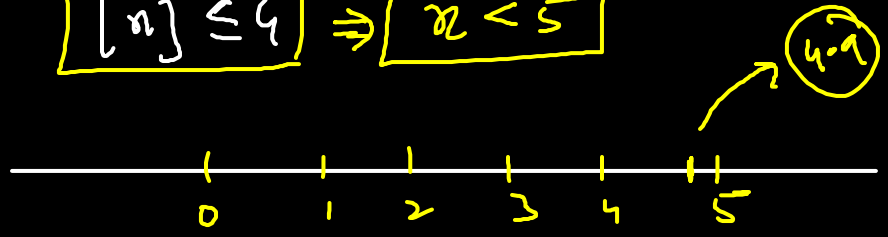
a $[x] \geq n \Rightarrow x \geq n$, where $n \in I$

$[x] \geq 4 \Rightarrow$



b $[x] \leq n \Rightarrow$ ~~$x \leq n, n \in I$~~ $\Rightarrow x < (n+1)$

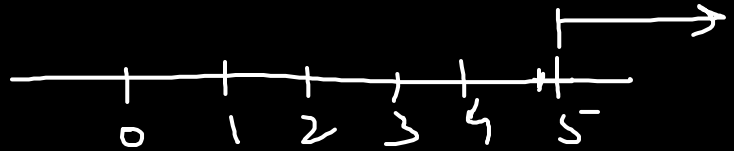
$[n] \leq 4 \Rightarrow x < 5$



4 Inequalities:

c $[x] > n \Rightarrow x \geq n+1,\ n \in I$

Eg: $[x] > 4 \Rightarrow x \geq 5$



d $[x] < n \Rightarrow x < n,\ n \in I$

$[x] < 4 \Rightarrow \boxed{x < 4}$

Example

The number of solutions of: $[x] + [-x] = x^2 - 5x + 5$

A. 2 **B.** 3 **C.** 4 **D.** 0 ✓

$[x] + [-x] = -1$

when $x \notin I$

$-1 = x^2 - 5x + 5$

$x^2 - 5x + 6 = 0$

$x = 2, 3$

ignore

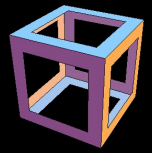
$[x] + [-x] = 0$

when $x \in I$

ignore

$x^2 - 5x + 5 = 0$

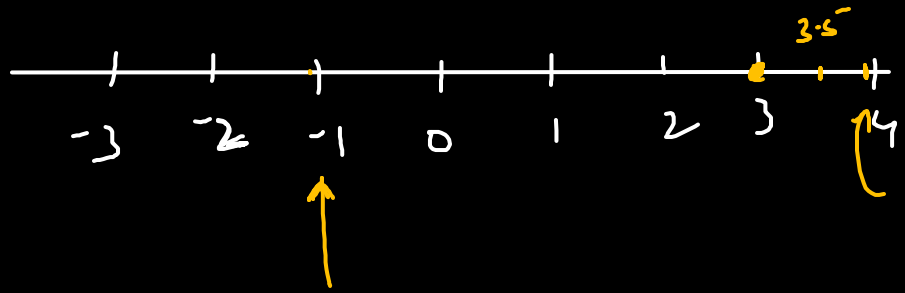
$x = \frac{5 \pm \sqrt{25 - 20}}{2}$



Example

Solve for x: $-2 < [-x] < 3.5$

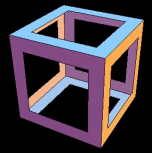
A. (-4, 1] **B.** (3.5, 2) **C.** [-3, 2) **D.** None



$-1 \le t < 4$

$-1 \le (-x) < 4$

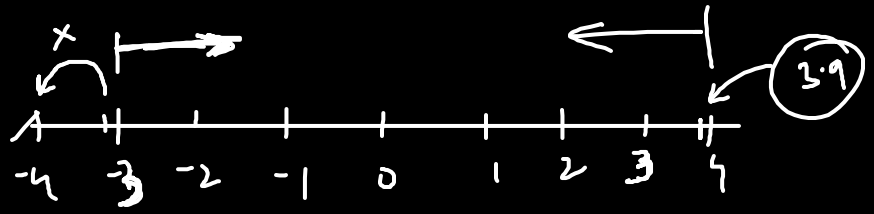
$1 \ge x > -4$



Example

Solve for x: $-3 \leq [2x + 4] \leq 3$

A. $\left[\frac{-7}{2}, \frac{-1}{2}\right]$ **B.** $\left[-4, \frac{-1}{2}\right]$ **C.** $\left[\frac{-7}{2}, 0\right)$ **D.** $[-4, 0)$

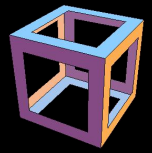


$$-7 \leq 2x < 0$$

$$\boxed{-\frac{7}{2} \leq x < 0}$$

$$-3 \leq t < 4$$

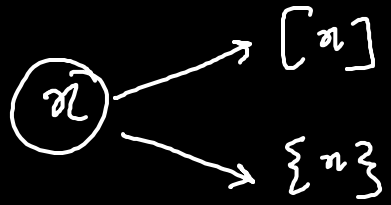
$$-3 \leq 2x + 4 < 4$$

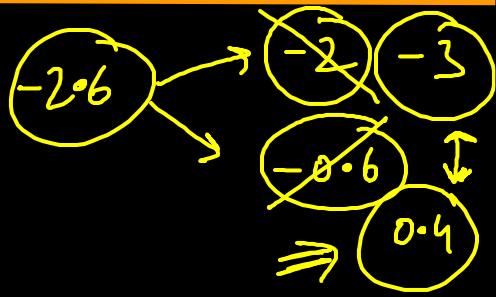


Fractional Part Function

Fractional Part Function: $\{\cdot\}$

Definition: $x = [x] + \{x\}$ *





$f(x) = \{x\} = x - [x]$

Eg: $\{-1.9\}$

$= -1.9 - [-1.9]$

$= -1.9 - (-2)$

$= 0.1$ ✓

Eg: 2.6 → 2, 0.6

$\{2.6\} = 0.6$

$\{3.6\} = 0.6$

$\{9.6\} = 0.6$

F.P.F.: Domain and Range

$x = 4 \rightarrow [x] = 4$

$\{x\} = 0$

Definition:

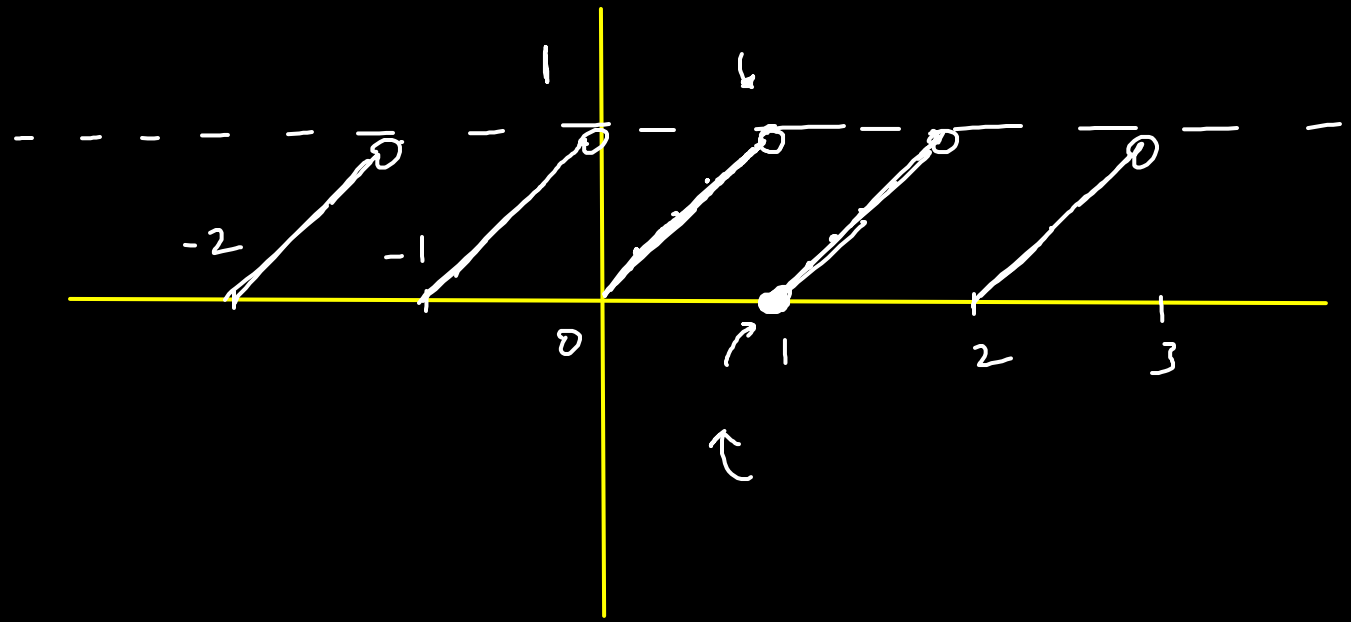
$f(x) = \{x\} = x - [x]$

Domain: R

Range: [0, 1)

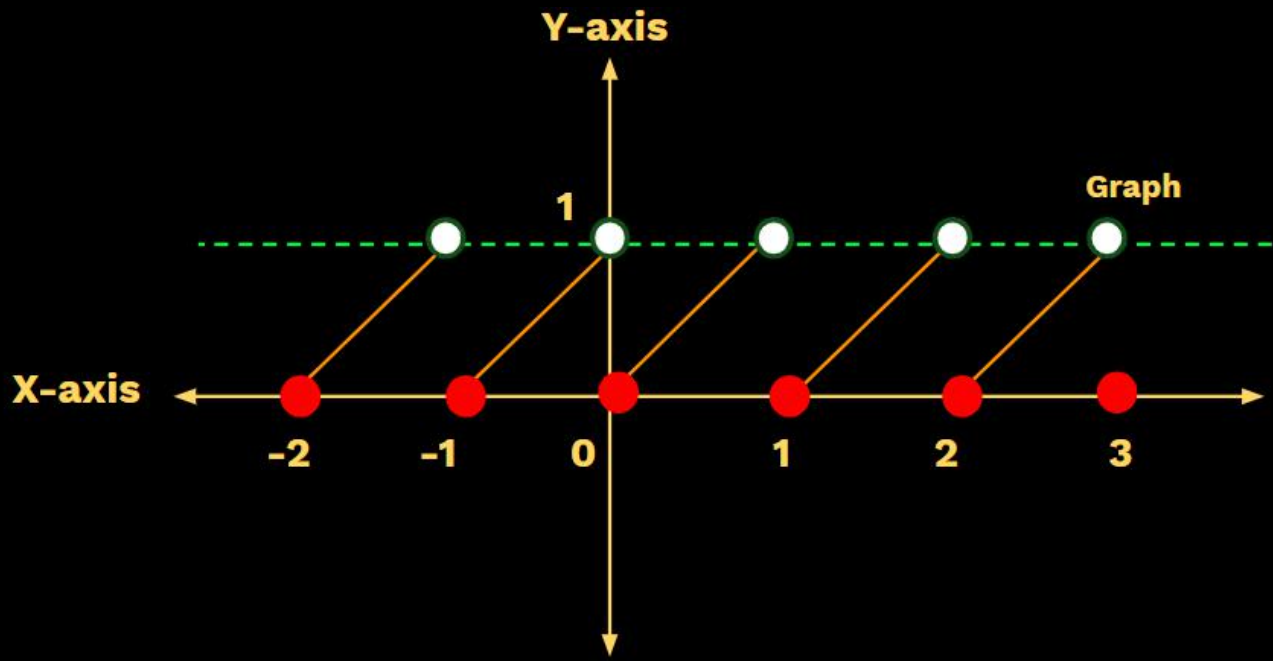
F.P.F.: Graph

$\{x\} = x - [x]$ ①



$y \in [0, 1)$

F.P.F.: Graph



Example

Solve for x: ***3[x] + 2{x} + 2x = 1***

A. $\frac{3}{4}$ ***B.*** $\frac{1}{4}$ ***C.*** $\frac{2}{3}$ ***D.*** $\frac{1}{2}$

$$3[x] + 2\{x\} + 2x = 1$$

$$3[x] + 2\{x\} + 2([x] + \{x\}) = 1$$

$$5[x] + 4\{x\} = 1$$

$5[x] + 4\{x\} = 1$

$$\{x\} = \left(\frac{1 - 5[x]}{4}\right) \quad (1)$$

$\because x = [x] + \{x\}$

$= 0 + \frac{1}{4}$

$= \frac{1}{4}$

$\therefore \boxed{\{x\} \in [0, 1)}$ ✓

If $[x] = 0 \longrightarrow \{x\} = \frac{1}{4}$ ✓

$[x] = 1 \longrightarrow \{x\} = -1$ ✗

$[x] = -1 \longrightarrow \{x\} = 3/2$ ✗

Example

Following equation has: $x = 4\{x\} - [x]$.

A. Two integral solutions

B. One integral and one non-integral solutions

C. Two non-integral solutions

D. No solutions

$$[n] + \{n\} = 4\{n\} - [n]$$

$$2[n] = 3\{n\}$$

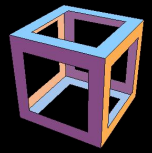
$$\{n\} = \frac{2}{3}[n] \quad \text{— (1)}$$

$\therefore \{n\} \in [0, 1)$

$n = [n] + \{n\}$

$[n] = 0 \rightarrow \{n\} = 0 \rightarrow 0$

$[n] = 1 \rightarrow \{n\} = 2/3 \rightarrow 5/3$



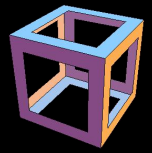
HomeWork Questions

Example

If $y = 3[x] + 2 = 2[x + 4]$. Find the value of: $[x + y]$.

A. 26 **B.** 20 **C.** 14 **D.** None

Hw-1

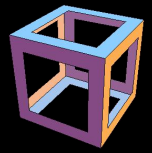


Example

y = [2x - 1] = 3[x - 6]. Find the possible values of ***[3x + y]***.

A. 84 ***B.*** 85 ***C.*** 103 ***D.*** 104

HW-2



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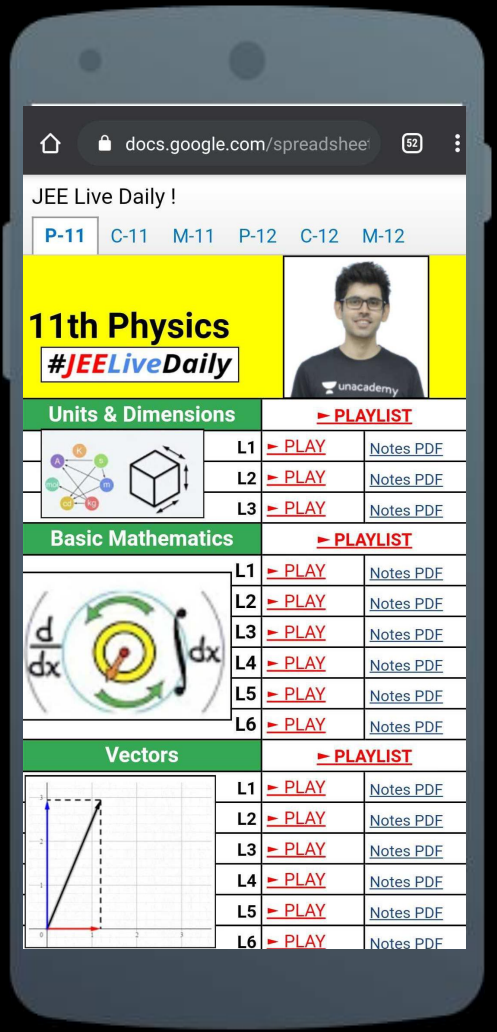

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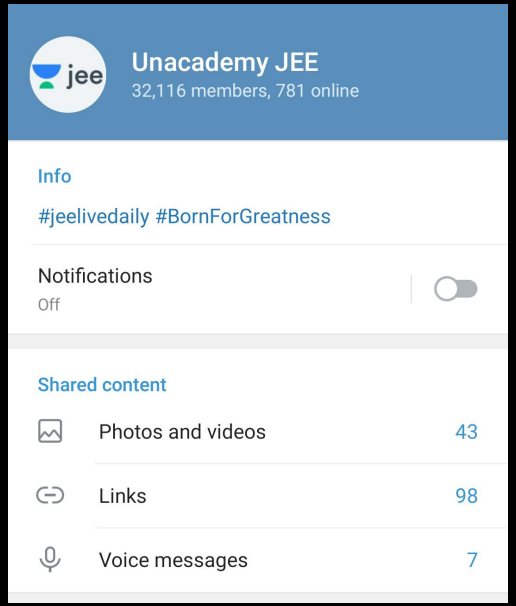

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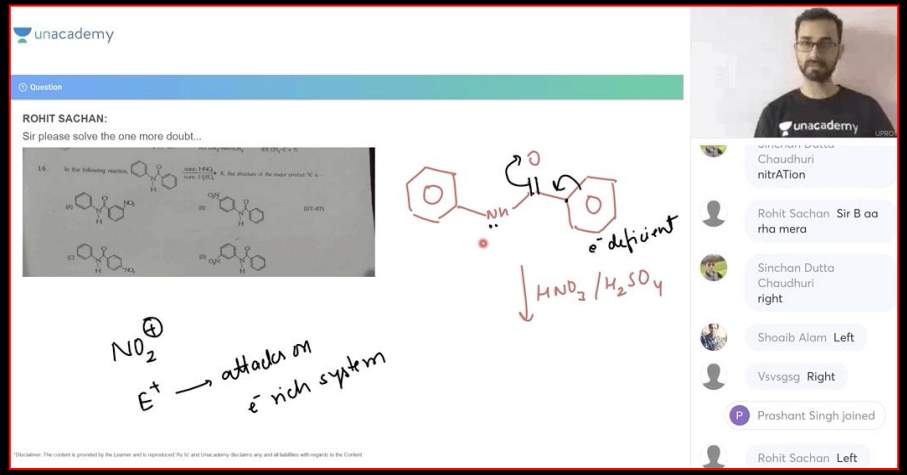

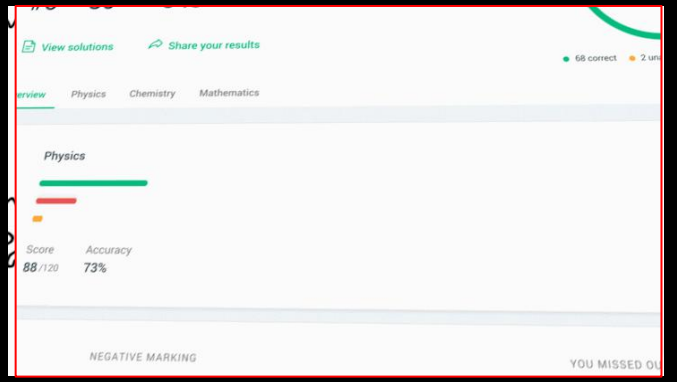

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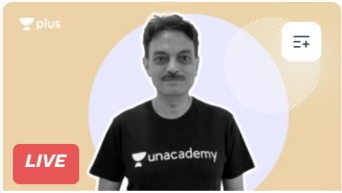

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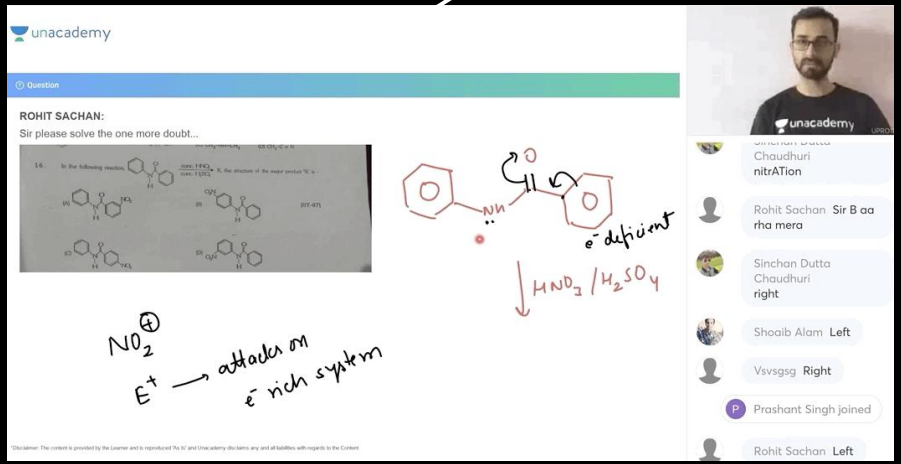

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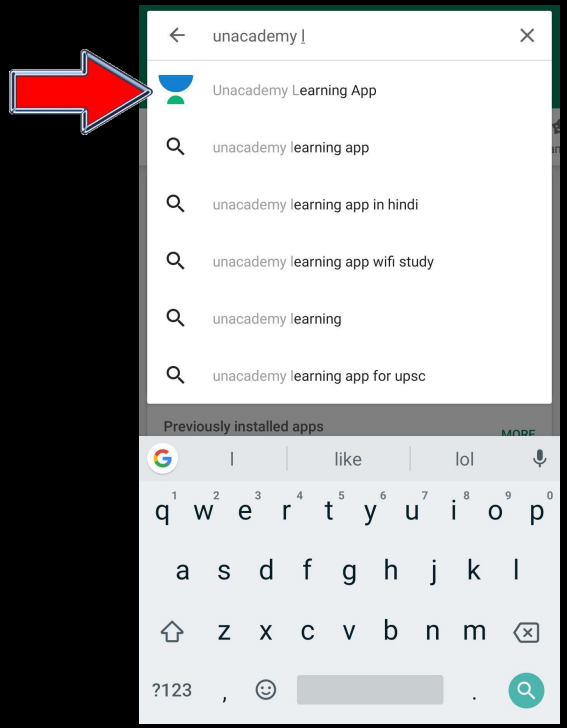
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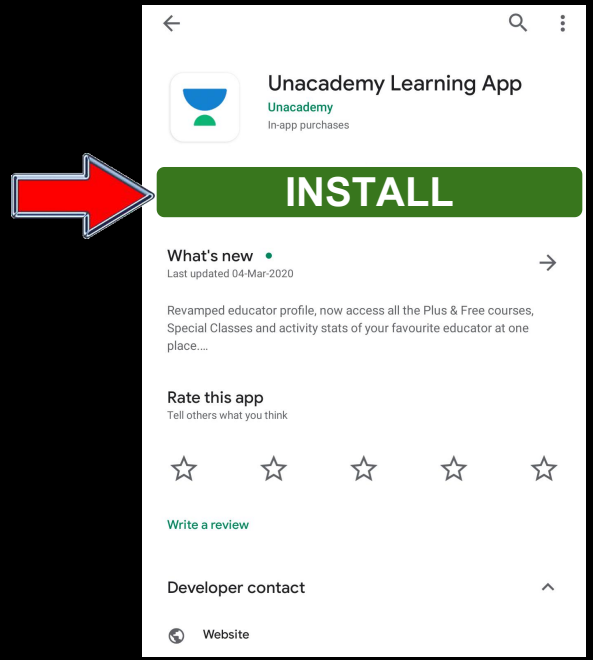
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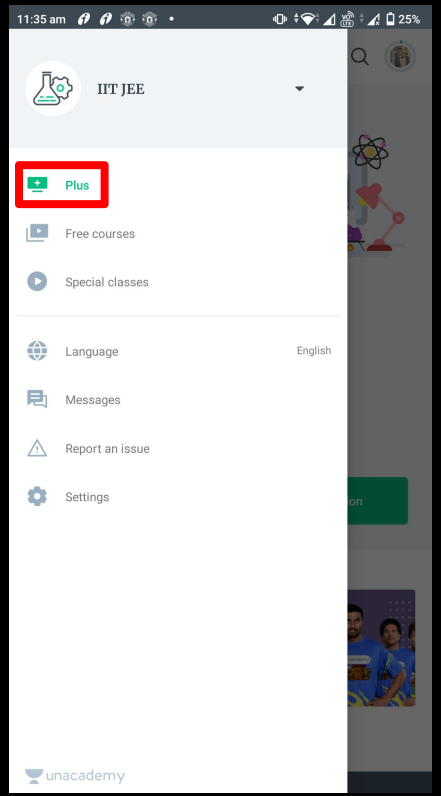

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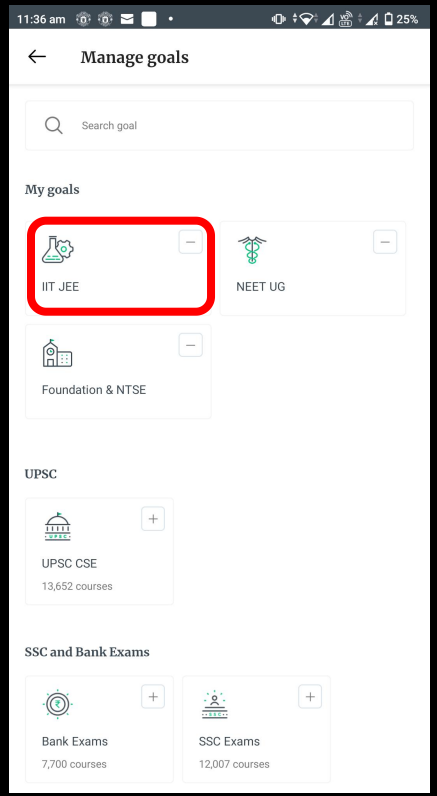

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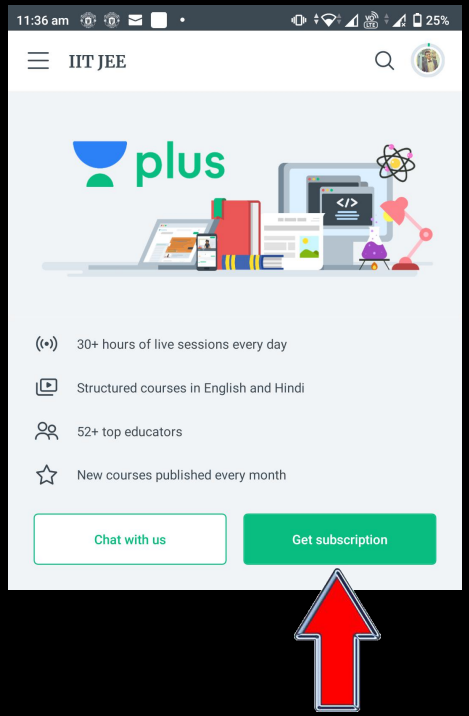

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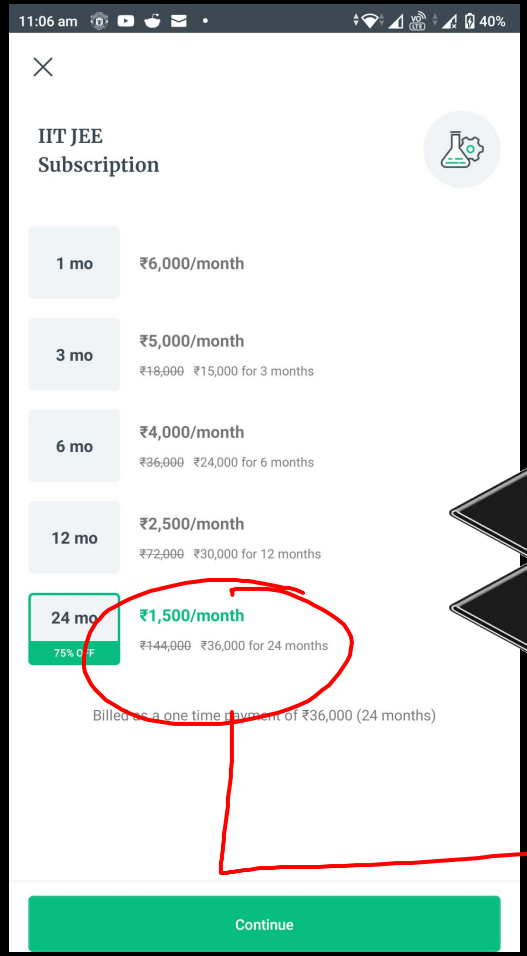
Step 6



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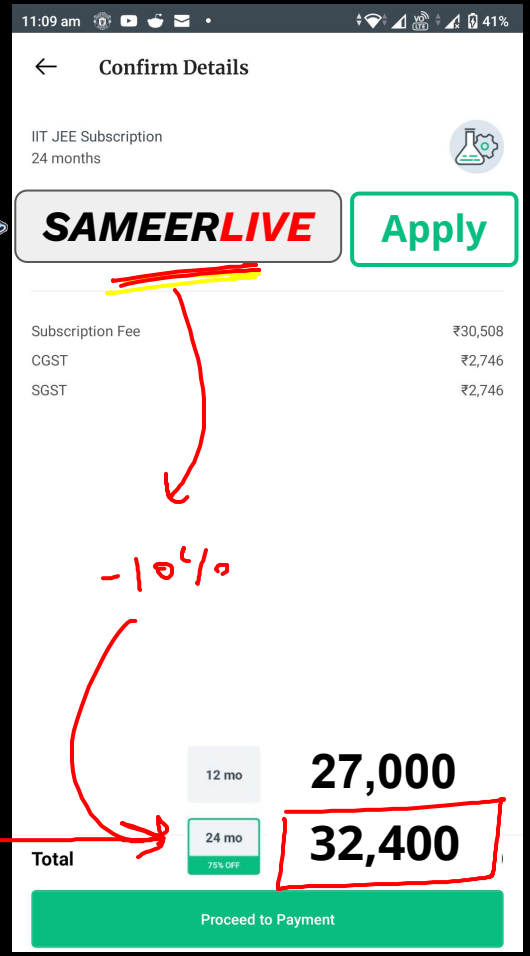

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