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Important Formulas and Method of Difference

Sequences & Series

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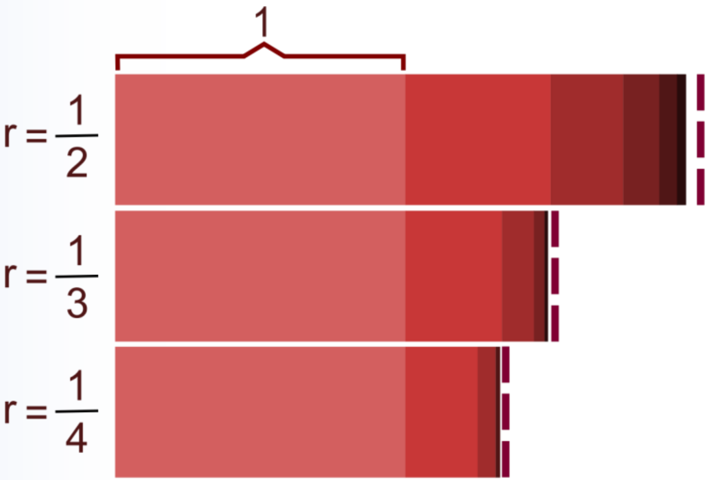

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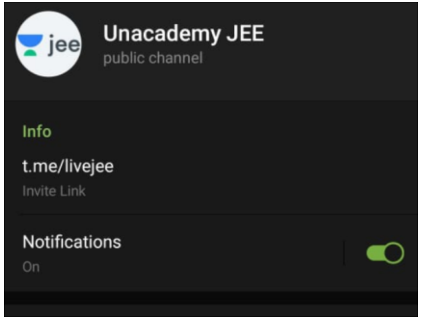

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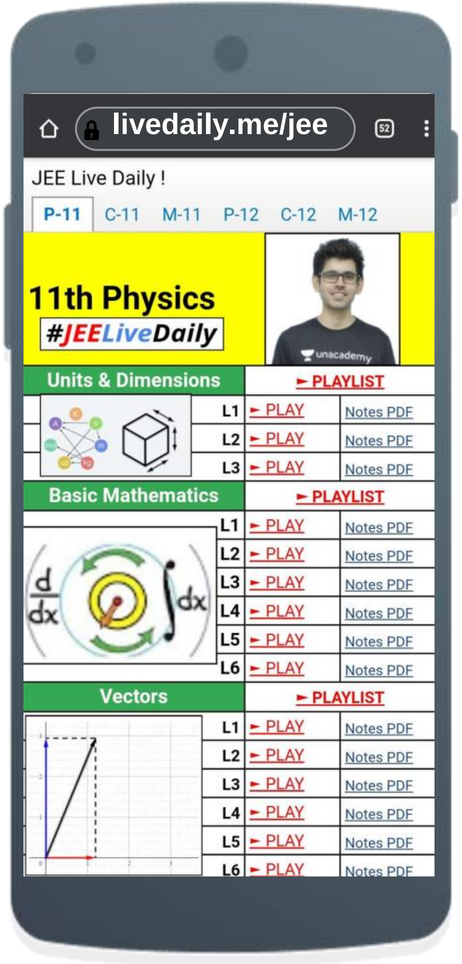

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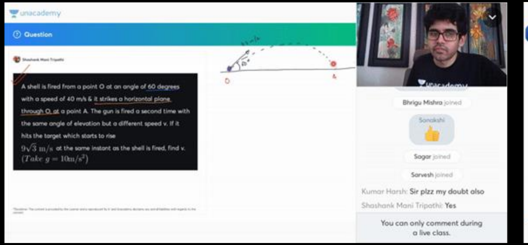

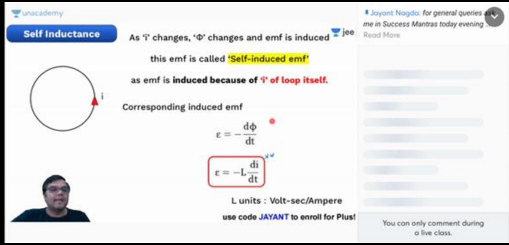

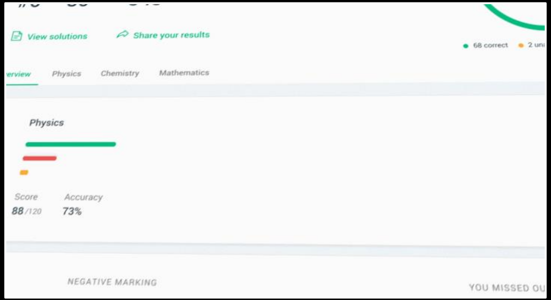

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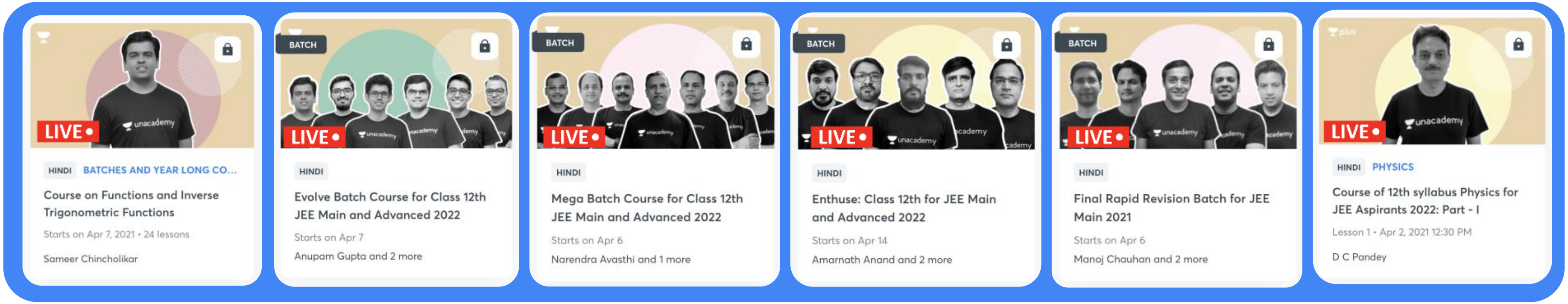

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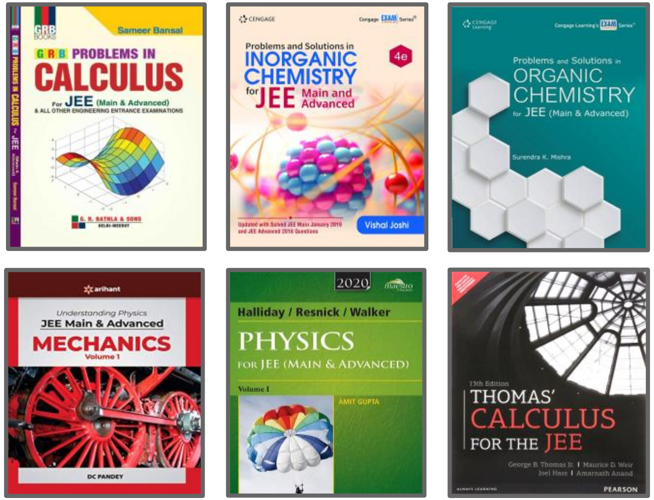

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Manas Pandey 99.69

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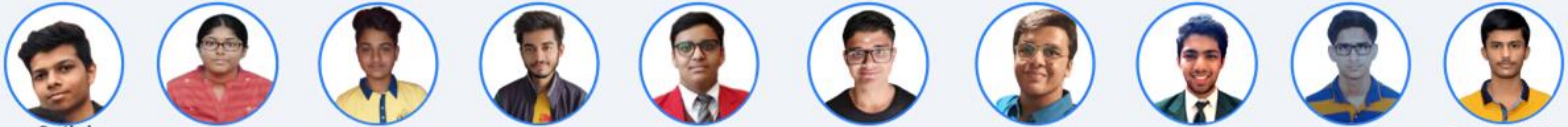

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Inequalities of AM GM HM

Sequences & Series

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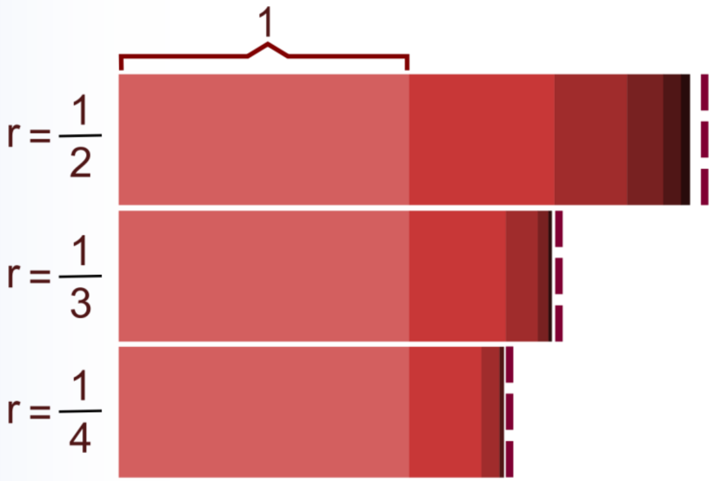

LET'S BEGIN!!

HomeWork Question

If n is positive integer, then show that: $2^{2n+1} > 1 + (2n + 1).2^n$

$$2^{2n+1} > 1 + \underbrace{(2n+1)}2^n$$

$$\left(\frac{2^{2n+1} - 1}{2n+1}\right) > (2)^n$$

$$\frac{1+2+2^2+2^3+\cdots+2^{2n}}{(2n+1)} > \left(1\ 2\ 2^2\ 2^3 \cdots 2^{2n}\right)^{\frac{1}{2n+1}}$$

$$\Rightarrow \frac{\frac{1\left(2^{2n+1}-1\right)}{(2-1)}}{(2n+1)} > \left(2^{1+2+3+\cdots+2n}\right)^{\frac{1}{2n+1}}$$

$$\frac{2^{2n+1}-1}{2n+1} > \left(2^{\frac{\cancel{2}n\,\cancel{(2n+1)}}{\cancel{2}}}\right)^{\frac{1}{\cancel{(2n+1)}}}$$

$$\left(\frac{2^{2n+1}-1}{2n+1}\right) > 2^{n}$$

$$S_n = \Sigma T_n$$

$S_n = \Sigma T_n$

$$S_n = \sum_{n=1}^{n} T_n$$

$$S_n = T_1 + T_2 + T_3 + \cdots + T_n$$

Important Summations

1. $\Sigma(1)$

$$\sum_{r=1}^{n}(1) = \underbrace{1+1+1+\cdots+1}_{n\text{-times}}$$

$$= n$$

Important Summations

2. Σ (n)

$$\sum_{n=1}^{n} (n) = 1 + 2 + 3 + \cdots + n$$

$$= \boxed{\frac{n(n+1)}{2}}$$

Eg

$$\sum_{n=1}^{10} n = \frac{10\times 11}{2} = 55$$

$$\sum_{t=1}^{10} t = 1+2+3+\dots+10$$

$$= \frac{10\times 11}{2} = 55$$

$$\sum_{r=1}^{m} r = \frac{m(m+1)}{2}$$

Eg.

$$\sum_{r=1}^{10} n = 10n$$

Important Summations

3. $\Sigma (n)^2$

$$\sum_{n=1}^{n} (n)^2 = 1^2 + 2^2 + 3^2 + \text{---} + n^2$$

$$= \boxed{\frac{n(n+1)(2n+1)}{6}}$$

$$* \ (n+1)^3 - (n)^3 = \cancel{n^3} + 3n^2 + 3n + 1 - \cancel{n^3}$$

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Now

$$(n+1)^3 - n^3 = 3n^2 + 3n + 1$$

$$\cancel{2^3} - 1^3 = 3(1)^2 + 3(1) + 1$$

$$\cancel{3^3} - \cancel{2^3} = 3(2)^2 + 3(2) + 1$$

$$\cancel{4^3} - \cancel{3^3} = 3(3)^2 + 3(3) + 1$$

$$\vdots \qquad \vdots \qquad\qquad \vdots \qquad \vdots \qquad \vdots$$

$$(n+1)^3 - \cancel{(n)^3} = 3(n)^2 + 3(n) + 1$$

$$(n+1)^3 - 1 = 3\left(\sum n^2\right) + 3\left(\sum n\right) + n$$

$$(n+1)^3 - 1 = 3\left(\sum n^2\right) + 3\left(\frac{n(n+1)}{2}\right) + n$$

$$\Rightarrow (n+1)^3 - \underbrace{(1+n)} - 3\left(\frac{n(n+1)}{2}\right) = 3\left(\sum n^2\right)$$

$$\Rightarrow (n+1)\left[(n+1)^2 - 1 - \frac{3n}{2}\right] = 3\left(\sum n^2\right)$$

$$\Rightarrow (n+1)^2\left[\frac{2n^2+4n+\cancel{2}-\cancel{2}-3n}{2\times 3}\right] = \left(\sum n^2\right)$$

Important Summations

4. $\Sigma (n)^3$

$$\sum_{n=1}^{n} n^3 = 1^3 + 2^3 + 3^3 + \cdots + n^3$$

$$= \left(\frac{n(n+1)}{2}\right)^2$$

$$= \left(\Sigma n\right)^2$$

$$(n+1)^4 - n^4 =$$

Properties of Σ

① $$\sum_{n=1}^{n}(an^2+bn)$$

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

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

$$a\left(\sum n^2\right)+b\left(\sum n\right)$$

Find the sum of the series to n terms whose general term is

$n^2 - 2n + 2$

$$T_n = (n^2 - 2n + 2)$$

$$S_n = \sum_{n=1}^{n} T_n$$

$$= \sum_{n=1}^{n} (n^2 - 2n + 2)$$

$$= \sum n^2 - 2\sum n + 2\sum 1$$

$$= \frac{n(n+1)(2n+1)}{6} - 2\left(\frac{n(n+1)}{2}\right) + 2n$$

Find the **value of the expression**

$$\sum_{i=1}^{n}\sum_{j=1}^{i}\sum_{k=1}^{j}1$$

$$\sum_{i=1}^{n}\sum_{j=1}^{i}\left(\sum_{k=1}^{j}1\right)$$

$$\sum_{i=1}^{n}\left(\sum_{j=1}^{i}j\right)$$

$$\sum_{i=1}^{n}\frac{i(i+1)}{2}$$

$$\frac{1}{2}\left(\sum_{i=1}^{n}i^2+\sum_{i=1}^{n}i\right)$$

$$\frac{1}{2}\left(\frac{n(n+1)(2n+1)}{6}+\frac{n(n+1)}{2}\right)$$

$$\frac{1}{2}\left(\frac{n(n+1)}{2}\right)\left(\frac{2n+1}{3}+1\right)$$

$$\frac{n(n+1)}{2\times 2}\left(\frac{2n+4}{3}\right)$$

$$\boxed{\frac{n(n+1)(n+2)}{6}}$$

Find the sum of **n terms** of the series

1 + (1 + 2) + (1 + 2 + 3) + ...

T_1 T_2 T_3

$$\boxed{S_n = \sum_{r=1}^{n} T_r}$$

$T_1 = 1$

$T_2 = 1 + 2$

$T_3 = 1 + 2 + 3$

$\vdots$

$T_r = 1 + 2 + 3 + - - - + r$

$= \dfrac{r(r+1)}{2}$

Now.

$$S_n = \sum_{r=1}^{n} \frac{r(r+1)}{2}$$

$$= \frac{1}{2}\left[\sum_{r=1}^{n} r^2 + \sum_{r=1}^{n} r\right]$$

$$= \frac{1}{2}\left[\frac{n(n+1)(2n+1)}{6} + \frac{n(n+1)}{2}\right]$$

$$S_n = \frac{n(n+1)(n+2)}{6}$$

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If S_n denote the **sum of the cubes** of the first n natural numbers and s_n denotes the **sum of the first n natural numbers**. Then

$$\sum_{r=1}^{n} \frac{S_r}{s_r}$$ is

A. $\frac{n(n+1)(n+2)}{6}$

B. $\frac{n(n+1)}{2}$

C. $\frac{n^2+3n+2}{6}$

D. None of these

$$S_n = \left(\frac{n(n+1)}{2}\right)^2$$

$$s_n = \left(\frac{n(n+1)}{2}\right)$$

$$\frac{S_n}{s_n} = \frac{n(n+1)}{2}$$

$$\sum_{r=1}^{n} \frac{S_r}{s_r}$$

$$= \sum \frac{r(r+1)}{2}$$

$$= \frac{n(n+1)(n+2)}{6}$$

Find the sum of the series to n terms (where n is even)

$1^2 + 2.2^2 + 3^2 + 2.4^2 + 5^2 + 2.6^2 + \ldots\ldots$

$$1^2 + 2(2^2) + 3^2 + 2(4)^2 + 5^2 + 2(6)^2 + \cdots + 2\cdot(2m)^2$$

$$\boxed{\underline{\text{Let:}} \quad n = 2m}$$

$$\left[1^2 + 2^2 + 3^2 + \cdots + (2m)^2\right] + \left[2^2 + 4^2 + 6^2 + \cdots + (2m)^2\right]$$

$$= \frac{(2m)(2m+1)(4m+1)}{6}$$

$$+ 2^2\left[1^2+2^2+3^2+ - - - + m^2\right]$$

$$= \frac{(\cancel{2}m)(2m+1)(4m+1)}{\cancel{6}\;3} + \cancel{4}^{\,2}\,\frac{m(m+1)(2m+1)}{3\;\cancel{6}}$$

$$= \frac{m(2m+1)}{3}\left[4m+1 + 2m+2\right]$$

$$= \frac{m(2m+1)(\cancel{2}(2m+1))}{\cancel{2}}$$

$$= \boxed{m(2m+1)^2}$$

$$m \longrightarrow \frac{n}{2}$$

$$= \boxed{\frac{n}{2}(n+1)^2}$$

Method of Difference

Method of Difference

This method helps in finding the general term of a sequence.

1. **If the k^{th} difference of consecutive terms is in A.P.**

T_n : Polynomial of degree $(K+1)$

Method of Difference

This method helps in finding the general term of a sequence.

2. If the k^{th} difference of consecutive terms is in G.P.

$$T_n : a(r)^{n-1} + \left(\text{Polynomial of degree } (K-1)\right)$$

Find the sum to n-terms : **3 + 7 + 13 + 21 + 31 .....**

$$3 + 7 + 13 + 21 + 31$$

$\boxed{K=1}$: 4 6 8 10 $\longrightarrow$ A.P.

T_n = Polynomial of degree two

$$\boxed{T_n = an^2 + bn + c}$$

$$T_1 = a + b + c = 3$$

$$T_2 = 4a + 2b + c = 7$$

$$T_3 = 9a + 3b + c = 13$$

$$3a + b = 4$$

$$5a + b = 6$$

$$2a = 2$$

$$\boxed{a = 1} \Rightarrow \boxed{b = 1} \Rightarrow \boxed{c = 1}$$

$$\Rightarrow \boxed{T_n = n^2 + n + 1}$$

$$S_n = \sum T_n$$

$$= \sum (n^2 + n + 1)$$

$$= \frac{n(n+1)(2n+1)}{6} + \frac{n(n+1)}{2} + n$$

Find the sum to n-terms : **1 + 4 + 10 + 22 + 46 ....**

$1 + 4 + 10 + 22 + 46 + \cdots$

$\boxed{K=1}$: $3 \quad 6 \quad 12 \quad 24 \longrightarrow$ G.P.

$r = 2$

$$\boxed{T_n = a(2)^{n-1} + b}$$

$$\left.\begin{aligned} T_1 &= a+b = 1 \\ T_2 &= 2a+b = 4 \end{aligned}\right\} \rightarrow \boxed{a=3} \Rightarrow \boxed{b=-2}$$

$$\boxed{T_n = 3(2)^{n-1} - 2}$$

$$\therefore S_n = \sum\left(3\cdot 2^{n-1} - 2\right)$$

$$S_n = 3\sum_{n=1}^{n} 2^{n-1} - \sum_{n=1}^{n} 2$$

$$= 3\left(1 + 2^1 + 2^2 + \cdots + 2^{n-1}\right) - 2\sum 1$$

$$= 3\left(\frac{1\left(2^n - 1\right)}{(2-1)}\right) - 2n$$

$$= \boxed{3\cdot 2^n - 3 - 2n}$$

Find the sum to n-terms : **2 + 12 + 36 + 80 + 150 + 252 + 392 ....**

HW

2 + 12 + 36 + 80 + 150 + 252 + 392 + - -

10 24 44 70 102 140

14 20 26 32 38 → A.P.

$\boxed{K=2}$:

$3 \longrightarrow T$

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Namo Sir | Physics

6:00 - 7:30 PM

Ashwani Sir | Chemistry

7:30 - 9:00 PM

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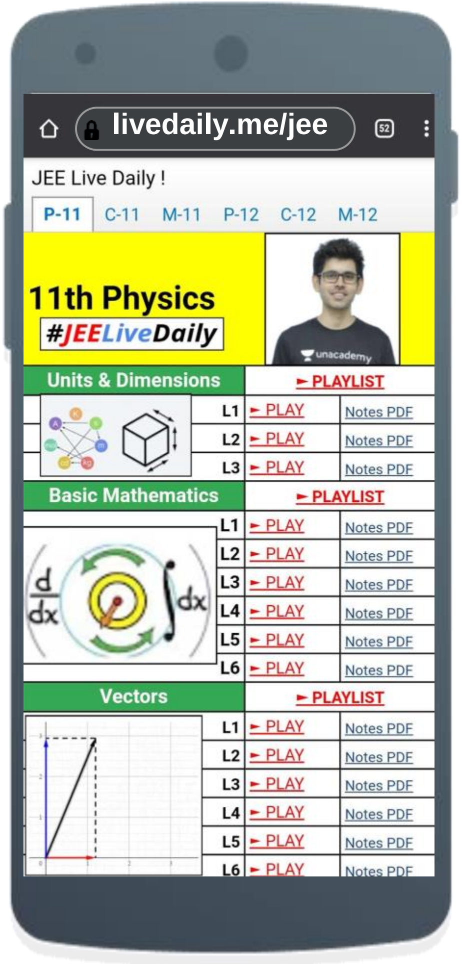

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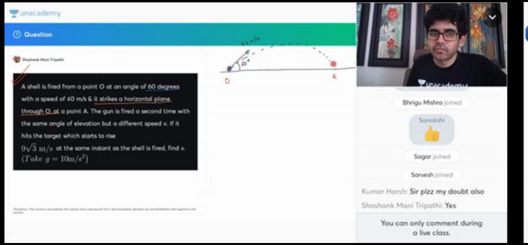

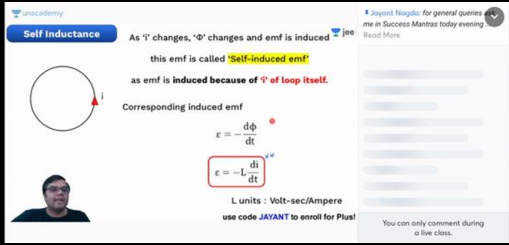

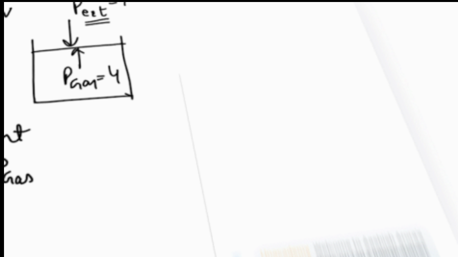

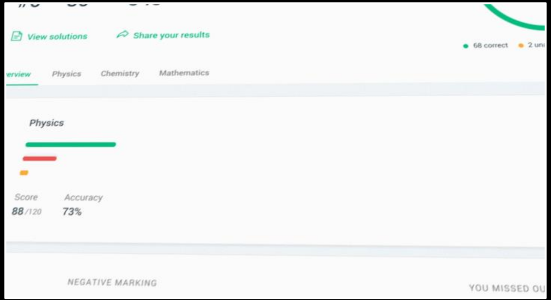

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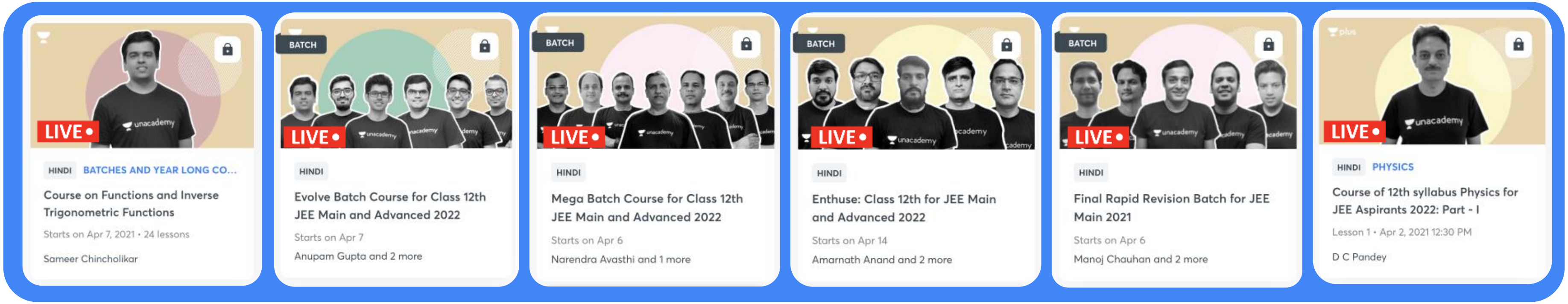

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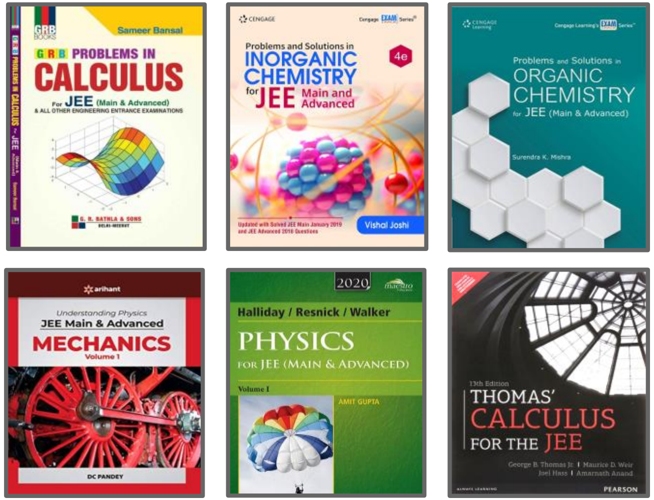

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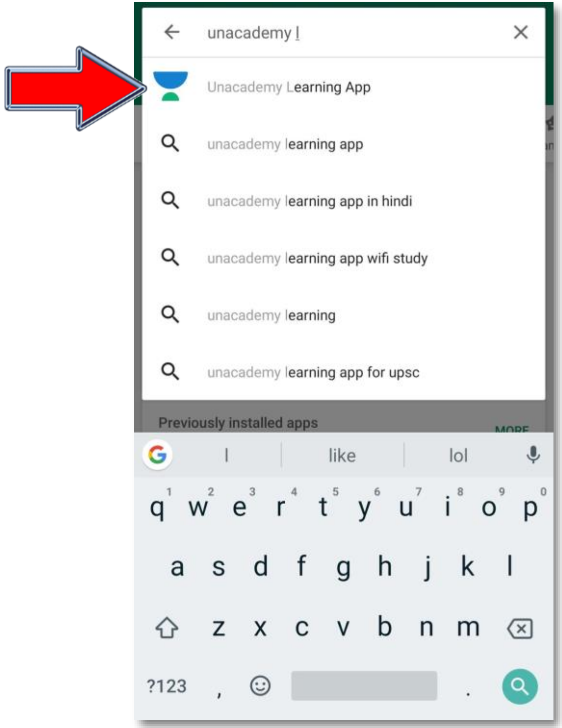
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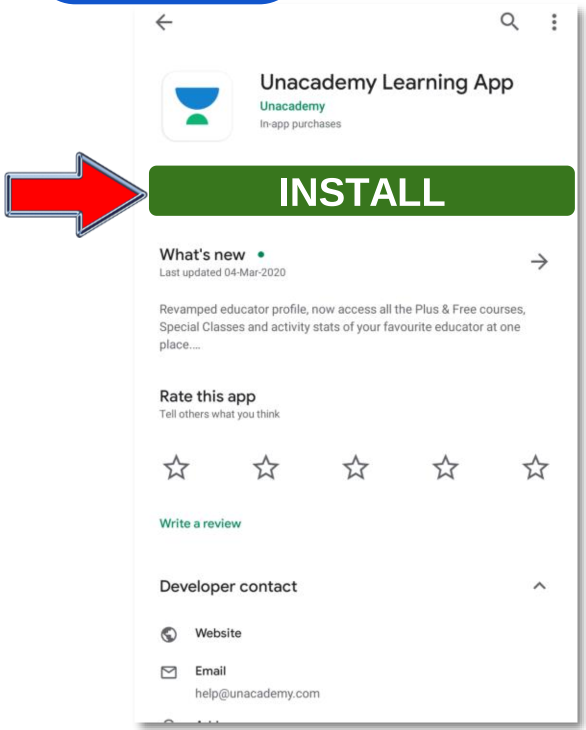
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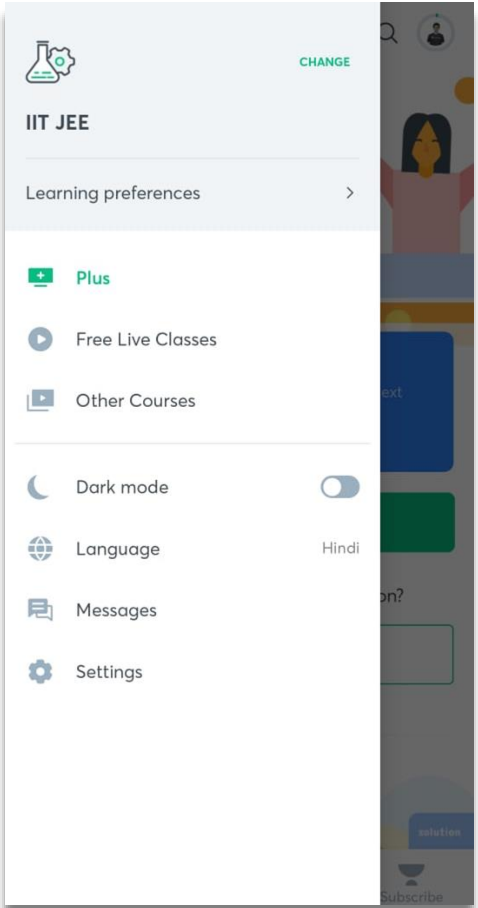
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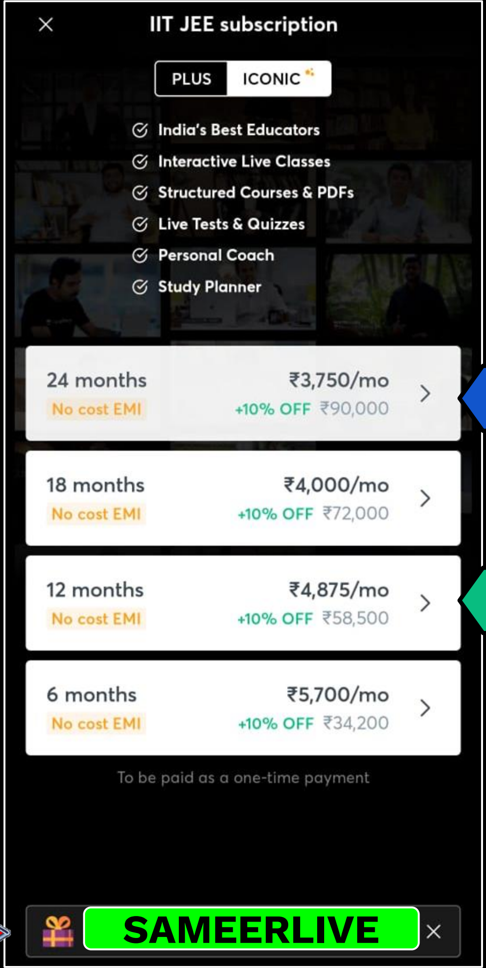

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