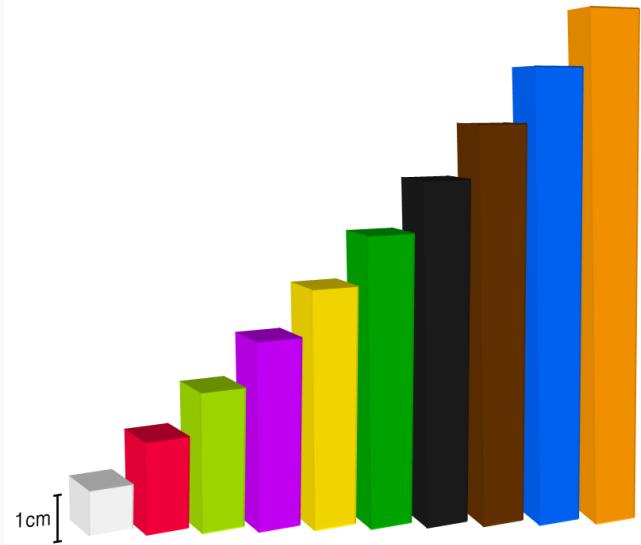


# Arithmetic Progression - 2

Sequences & Series



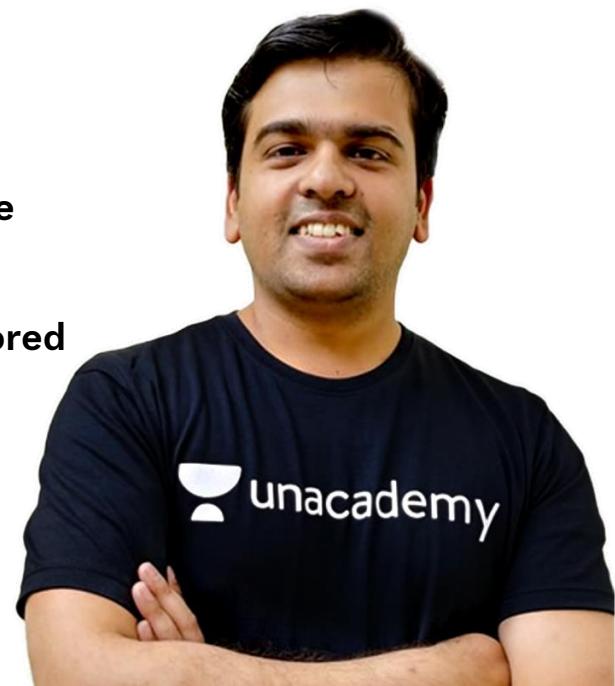
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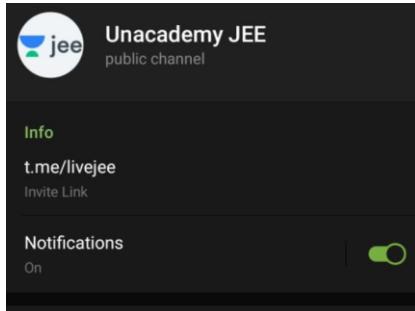
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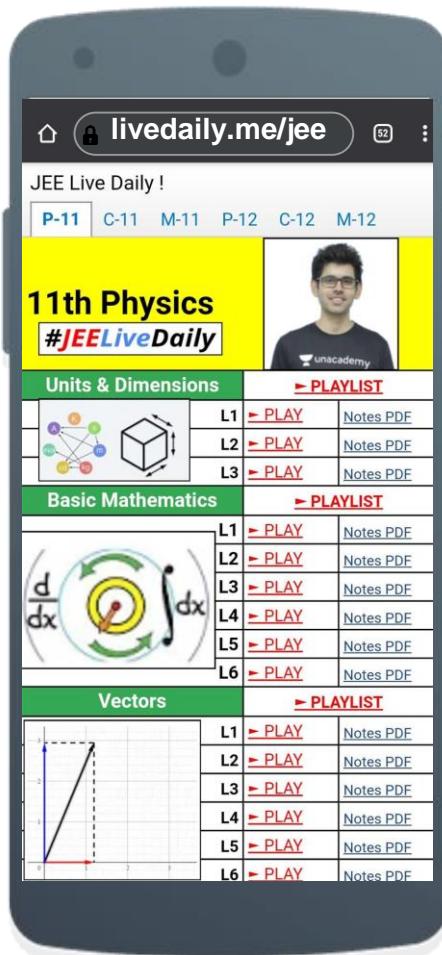
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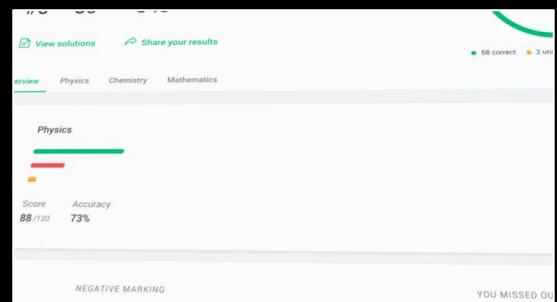
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The collage includes:

- Top Left:** A screenshot of a physics question about a shell being fired from point O at an angle of 60 degrees with a speed of 60 m/s, hitting a horizontal plane at point A. It shows a diagram and a text box with student comments.
- Top Right:** A screenshot of a live class on "Self Inductance". It shows a circular loop with current flowing clockwise, a formula for self-induced emf ( $\epsilon = -L \frac{di}{dt}$ ), and a note about units (Volts-sec/Ampere).
- Bottom:** A screenshot of a handwritten note showing a rectangle with a downward arrow labeled  $P_{ext}$  and a vertical arrow labeled  $P_{grav} = 4$ .

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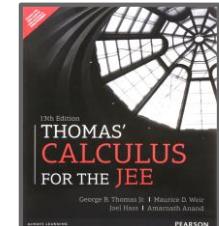
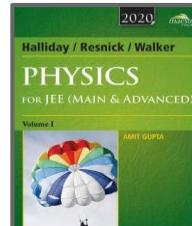
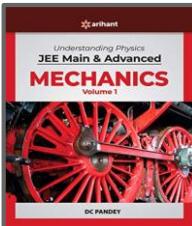
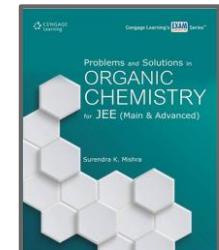
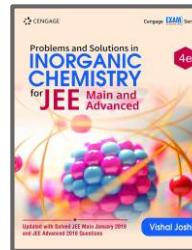
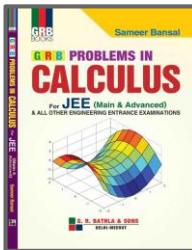
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# LET'S BEGIN!!



# Homework Question





The sum of integers from 1 to 100 that are divisible by 2 or 5 is

A. 2150

~~B. 3050~~

C. 2500

D. None of these

$$A : 2, 4, 6, \dots, 100 ; n(A) = 50$$

$$S_A = \frac{50}{2}(2+100)$$

$$B : 5, 10, 15, \dots, 100 ; n(B) = 20$$

$$S_B = \frac{20}{2}(5+100)$$

$$C : 10, 20, 30, \dots, 100 ; n(C) = 10$$

$$S_C = \frac{10}{2}(10+100)$$

$$S_A + S_B - S_C$$

$$= 50 \times 51 + 10 \times 105 - (550)$$

$$= \boxed{3050}$$





# Important Results





## Important Result !

Sum of first **n** natural numbers

$$1 + 2 + 3 + \dots + n = \frac{n}{2} (2(1) + (n-1)1)$$

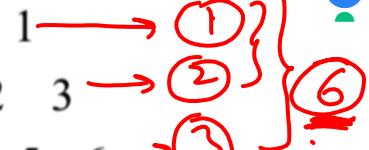
E.g.  $\frac{10(10+1)}{2}$     E.g.  $\frac{9(9+1)}{2}$     |    =  $\boxed{\frac{n(n+1)}{2}}$





If the natural numbers are written as shown

jee



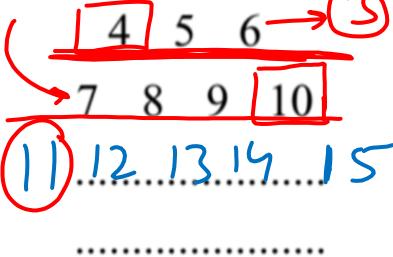
Then, the sum of the terms if the  $n^{\text{th}}$  row is

A.  $\frac{n(n^2 - 1)}{2} \rightarrow 0$

B.  $\frac{n(n^2 + 1)}{4} \rightarrow \frac{1}{2}$

C.  $\frac{n(n^2 + 1)}{2} \rightarrow 1$

D. None of these



M-1 : Shortcuts

$$n=1$$

$$n=2$$

$$\underline{M-2} = (\text{No of elements in } n^{\text{th}} \text{ row}) = n$$

Common Diff = 1

first element = ?

$$\begin{aligned}
 & \left( \text{No. of elements used till } (n-1)^{\text{th}} \text{ row} \right) = 1 + 2 + 3 + \dots + (n-1) \\
 & = \frac{(n-1)((n-1)+1)}{2}
 \end{aligned}$$

$$\Rightarrow \left( \text{1st element of } n^{\text{th}} \text{ row} \right) = \left( \frac{n^2 - n}{2} + 1 \right) = \left( \frac{n^2 - n + 2}{2} \right)$$

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

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

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



## Important Result !

### Sum of first $n$ odd natural numbers

$$1 + 3 + 5 + 7 + \dots - n\text{-terms}$$

$$\begin{aligned} a &= 1 & \rightarrow \text{Sum} &= \frac{n}{2} (2(1) + (n-1)(2)) \\ d &= 2 \\ n &= n \end{aligned}$$
$$\begin{aligned} &= \frac{n}{2} (2 + 2n - 2) \\ &= n^2 \end{aligned}$$





The coefficient of  $x^{49}$  in the product  $(x - 1)(x - 3) \dots (x - 99)$  is

A.  $-99^2$

B. 1

C. ~~-2500~~

D. None of these

$$(x-1)(x-3)(x-5) \dots (x-99)$$

No. of brackets: 1, 3, 5,  $\dots$  99

↓

$T_n$

$$T_n = 1 + (n-1)2 = 99$$

$n=50$

Eg:  $(x-1)(x-2)$

$$2 + (-x - 2x) + x^2$$

Eg:  $(\underline{x}-1)(\underline{x}-2)(\underline{x}-3)$

$$x^3 + (-3-2-1)x^2 + x(\underline{\underline{6+3+2}})$$

Sol:

$$x^{49}(-1 - 3 - 5 - \dots - 99)$$

$$x^{49} \left( - \underbrace{(1 + 3 + 5 + \dots + 99)}_{50\text{-terms}} \right)$$

$$x^{49}(-(50)^2)$$



## Important Result !

$$T_n = S_n - S_{n-1}$$

$$S_n = T_1 + T_2 + T_3 + \dots + T_{n-2} + T_{n-1} + T_n$$

$$S_{n-1} = T_1 + T_2 + T_3 + \dots + T_{n-2} + T_{n-1}$$

---

$$S_n - S_{n-1} = T_n$$





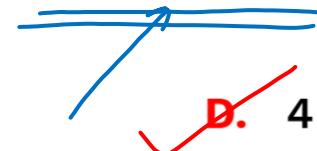
If the sum of  $n$  terms of an AP is given by  $S_n = 3n + 2n^2$ , then the common difference of the AP is

A. 3

B. 2

C. 6

D. 4



M-1 :- Shortcut :-

$$S_2 = T_1 + T_2 = 3(2) + 2(2)^2 = 14$$

$$S_1 = T_1 = 3(1) + 2(1)^2 = 5$$

$$\therefore T_2 = 9 \Rightarrow d = T_2 - T_1 = 9 - 5 = 4$$

Method-2 :

$$S_n = 3n + 2n^2$$

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

$$\therefore T_n = 3(1) + 2(n^2 - (n-1)^2)$$

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

$$\boxed{T_n = 4n+1}$$

$$T_n = 4n + 1$$

$$T_{n-1} = 4(n-1) + 1$$

$$\therefore T_n - T_{n-1} = 4$$

$$\boxed{d = 4}$$







If  $S_n$  denotes the sum of n terms of an A.P., then

$$S_{n+3} - 3S_{n+2} + \cancel{3S_{n+1}} - S_n =$$

A.  $2S_n$

B.  $S_{n+1}$

C.  $3S_n$

✓ D. 0

$$\begin{aligned}
 & S_{n+3} - 3S_{n+2} + 3S_{n+1} - S_n \\
 &= (S_{n+3} - S_{n+2}) \overbrace{- 2S_{n+2} + 2S_{n+1}}^{\text{green bracket}} \\
 &\quad + (S_{n+1} - S_n)
 \end{aligned}$$

$S_n - S_{n-1} = T_n$
$S_{n+1} - S_n = T_{n+1}$

$$= T_{n+3} - 2(T_{n+2}) + T_{n+1}$$

$$= (T_{n+3} - T_{n+2}) - (T_{n+2} - T_{n+1})$$
$$(d) - (d)$$

$$= 0$$



# Properties of A.P.





## Properties of A.P.

1

The common difference can be zero, positive or negative.





## Properties of A.P.

2

If  $a, b, c$  are in A.P.  $\Rightarrow 2b = a + c$

$$a, b, c \rightarrow A.P.$$
$$(b-a) = (c-b) \Rightarrow 2b = a+c$$

~~Eg:~~

1, 3, 5

$$\frac{1+5}{2} = 3$$



If  $\log_3 2$ ,  $\log_3(2^x - 5)$  and  $\log_3\left(2^x - \frac{7}{2}\right)$

are in arithmetic progression. Determine the value of  $x$

in AP

∴ in AP:

$$2 \cdot \log_3(2^x - 5) = \log_3 2 + \log_3\left(2^x - \frac{7}{2}\right)$$

$$\Rightarrow \log_3(2^x - 5)^2 = \log_3(2(2^x) - 7)$$

$$\Rightarrow (2^x - 5)^2 = 2(2^x) - 7$$

Let:  $2^x = t$

$$(t-5)^2 = 2t - 7$$

$$t^2 - 10t + 25 = 2t - 7$$

$$t^2 - 12t + 32 = 0$$

$$(t-4)(t-8) = 0$$

$$t = 4$$

$$\Rightarrow 2^x = 4$$

$$2^x = 2^2$$

$$\boxed{x = 2}$$

Reject

$$t = 8$$

$$2^x = 8$$

$$2^x = 2^3$$

$$\boxed{x = 3}$$

Accept

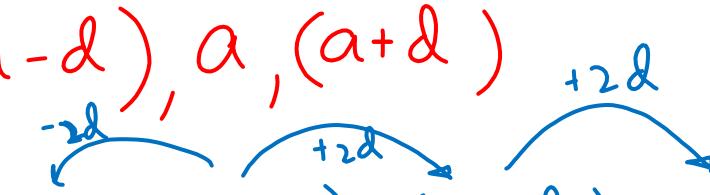
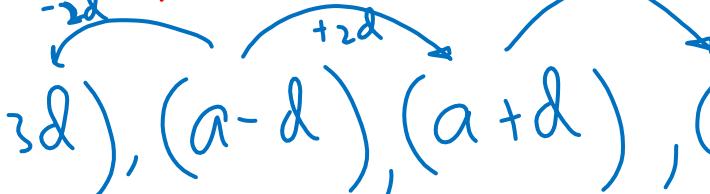




## Properties of A.P.

3

### Considering Numbers in A.P.

- {
- 3 terms:  $(a-d), a, (a+d)$   

  - 4 terms:  $(a-3d), (a-d), (a+d), (a+3d)$   

  - 5 terms:  $(a-2d), (a-d), a, (a+d), (a+2d)$   


The sum of three numbers in A.P. is **27** and the sum of their squares is **293**, find the numbers.

$$\underbrace{(a-d)}_{\text{---}} + \underbrace{a}_{\text{---}} + \underbrace{(a+d)}_{\text{---}} = 27$$

$$\Rightarrow 3a = 27$$

$$a = 9$$

& also:

$$(a-d)^2 + a^2 + (a+d)^2 = 293$$

$$3a^2 + 2d^2 = 293$$

$$3(9)^2 + 2d^2 = 293$$

$$2d^2 = 293 - 243$$

$$2d^2 = 50$$

$$d^2 = 25$$

$$d = \pm 5$$

$$(a-d), (a), (a+d)$$

$$(9-5), 9, (9+5) \Rightarrow [9, 9, 14]$$

$$(9+5), 9, (9-5) \Rightarrow [14, 9, 4]$$



The real numbers  $x_1, x_2, x_3$  satisfying the equation  $x^3 - x^2 + \beta x + \gamma = 0$   
 are in A.P. The intervals in which  $\beta$  and  $\gamma$  lie are

- A.  $(-\infty, \frac{1}{3}], [-\frac{1}{27}, \infty)$
- B.  $(-8, \frac{1}{3}), [-\frac{1}{27}, \infty)$
- C.  $(-\infty, \frac{1}{3}], (-\frac{1}{27}, \infty)$
- D. None of these

$$x_1 \rightarrow a-d$$

$$x_2 \rightarrow a$$

$$x_3 \rightarrow a+d$$

$$\left\{ \begin{array}{l} \text{(i)} \quad x_1 + x_2 + x_3 = 1 \\ \text{(ii)} \quad x_1 x_2 + x_2 x_3 + x_3 x_1 = \beta \\ \text{(iii)} \quad x_1 x_2 x_3 = -\gamma \end{array} \right.$$

$$\text{(i)} \quad 3a = 1 \Rightarrow a = \frac{1}{3}$$

$$\begin{aligned} \text{(ii)} \quad & (a^2 - ad) + (a^2 + ad) + (a^2 - d^2) = \beta \\ \text{(iii)} \quad & a(a^2 - d^2) = -\gamma \end{aligned}$$

using Eg ② :-

$$\beta = 3a^2 - d^2$$

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

$$\beta = \frac{1}{3} - d^2$$

$$\beta = \left(-\infty, \frac{1}{3}\right]$$

Eg ③ :-

$$\gamma = a(d^2 - a^2)$$

$$\gamma = \frac{1}{3}\left(d^2 - \frac{1}{9}\right)$$

$$\gamma \in \left[-\frac{1}{27}, \infty\right)$$



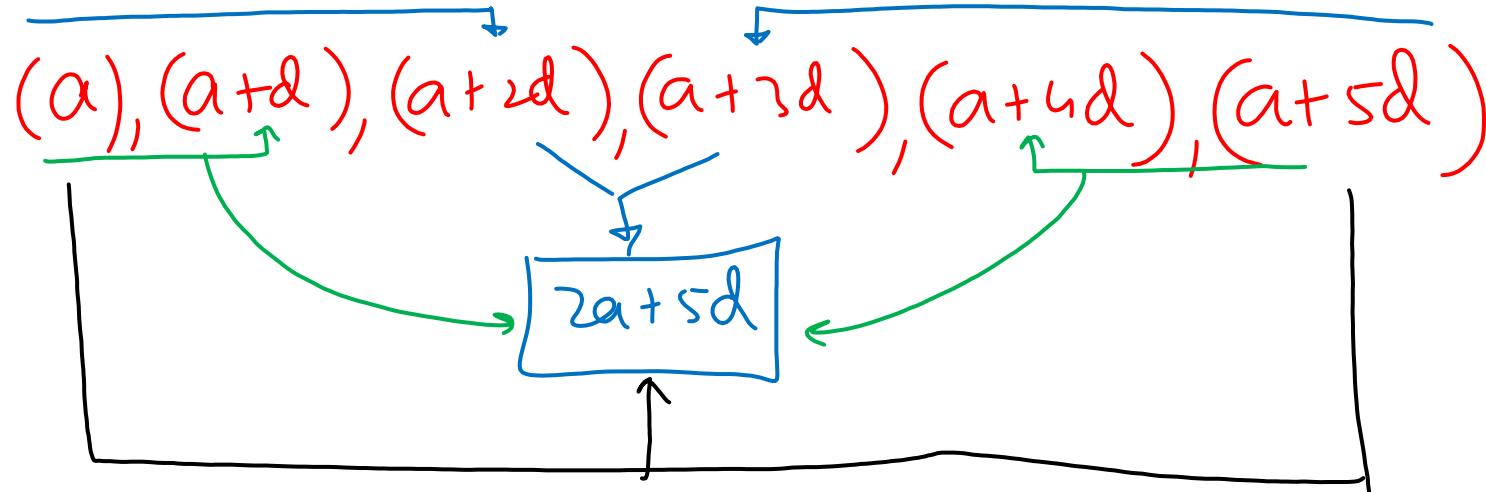




## Properties of A.P.

4

The sum of the terms of an A.P. equidistant from the beginning & end is constant and equal to the sum of first & last terms.



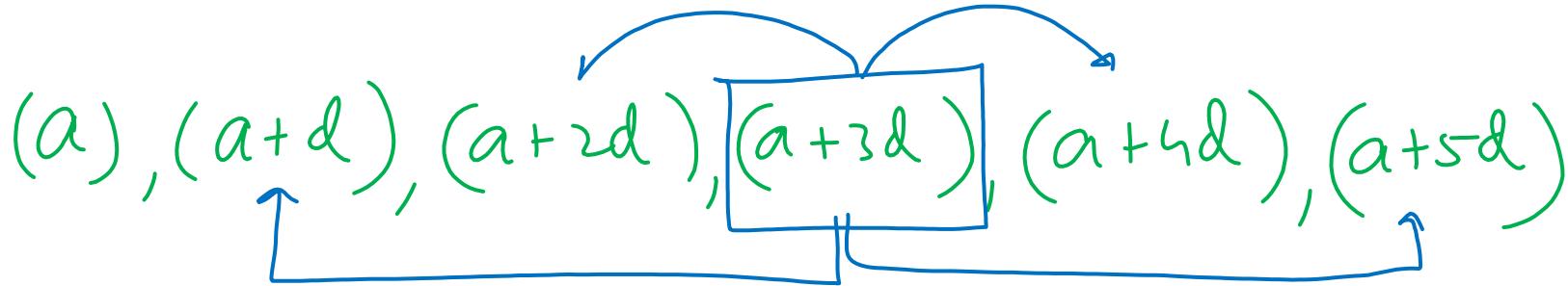




## Properties of A.P.

5

Every term of an AP is average of terms equidistant from it.



$$(T_k - nd) \leftarrow T_k \rightarrow (T_k + nd)$$



- If  $\sum_{j=1}^{21} a_j = 693$ , where  $a_1, a_2, \dots, a_{21}$ , are in A.P., then  $\sum_{i=0}^{10} a_{2i+1}$  is
- A. 361      B. 396      C. 363      D. Data insufficient

MW-1







## Properties of A.P.

6

If each term of an A.P. is increased, decreased, multiplied or divided by the same non zero number, then the resulting sequence is also an A.P..

~~Eg:~~  $2, 4, 6, 8, 10 \rightarrow \text{A.P.}$

$$4, 8, 12, 16, 20 \rightarrow \text{A.P.}$$

$$1, 2, 3, 4, 5 \rightarrow \text{A.P.}$$

$$3, 5, 7, 9, 11 \rightarrow \text{A.P.}$$





If  $\frac{b+c-a}{a}$ ,  $\frac{c+a-b}{b}$ ,  $\frac{a+b-c}{c}$  are in AP, Then show that

$\frac{1}{a}$ ,  $\frac{1}{b}$ ,  $\frac{1}{c}$  are also in AP.

$$\left( \frac{b+c-a}{a} \right), \left( \frac{c+a-b}{b} \right), \left( \frac{a+b-c}{c} \right) \rightarrow A.P.$$

+ 2

+ 2

+ 2

$$\left( \frac{b+c-a}{a} + 2 \right); \left( \frac{c+a-b}{b} + 2 \right); \left( \frac{a+b-c}{c} + 2 \right)$$

→ A.P.

$$\left( \frac{a+b+c}{a} \right), \left( \frac{a+b+c}{b} \right); \left( \frac{a+b+c}{c} \right)$$

$$\boxed{\div (a+b+c)}$$

→ A.P.

$$\frac{1}{a}, \frac{1}{b}, \frac{1}{c} \rightarrow \text{A.P.}$$





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11<sup>th</sup>



Namo Sir | Physics

6:00 - 7:30 PM



Ashwani Sir | Chemistry

7:30 - 9:00 PM



Sameer Sir | Maths

9:00 - 10:30 PM

12<sup>th</sup>



Jayant Sir | Physics

1:30 - 3:00 PM



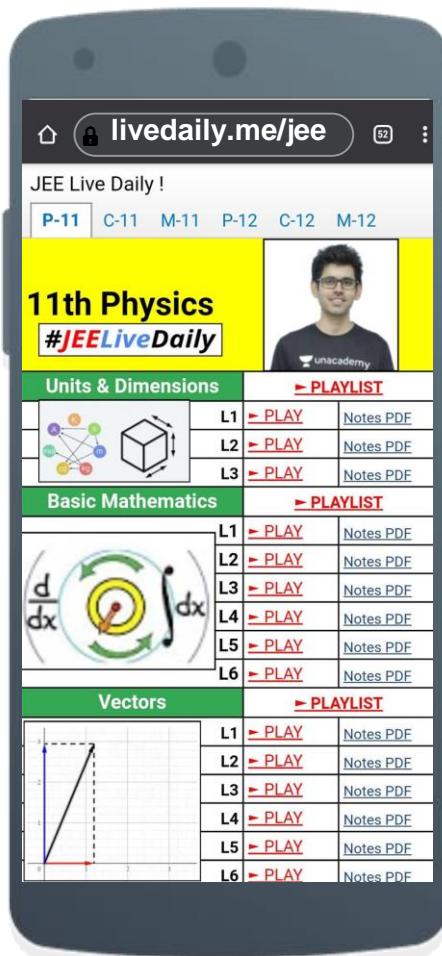
Anupam Sir | Chemistry

3:00 - 4:30 PM



Nishant Sir | Maths

4:30 - 6:00 PM



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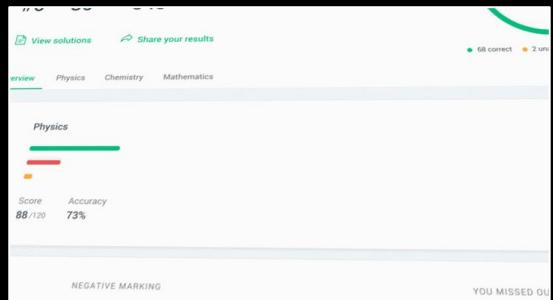
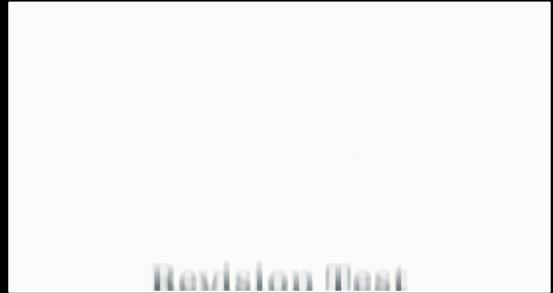
A shell is fired from a point O at an angle of 60 degrees with a speed of 10 m/s and strikes a horizontal plane through O at a point A. The gun is fired a second time with the same angle of elevation but a different speed v. If it hits the same point A, then the value of v is to be found. (Take  $g = 10 \text{ m/s}^2$ )

As 'I' changes, 'Φ' changes and emf is induced  
this emf is called **'Self-induced emf'**  
as emf is induced because of **'Φ' of loop itself.**

Corresponding induced emf

$$e = -L \frac{di}{dt}$$

L units : Volt-sec/Ampere  
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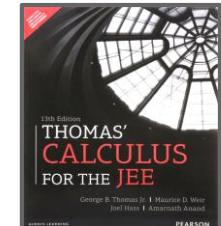
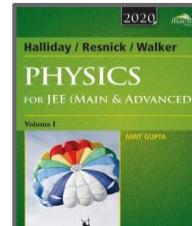
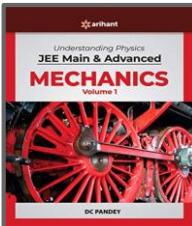
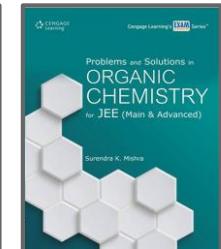
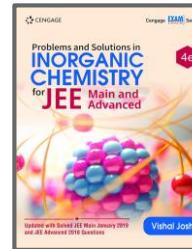
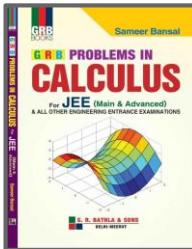
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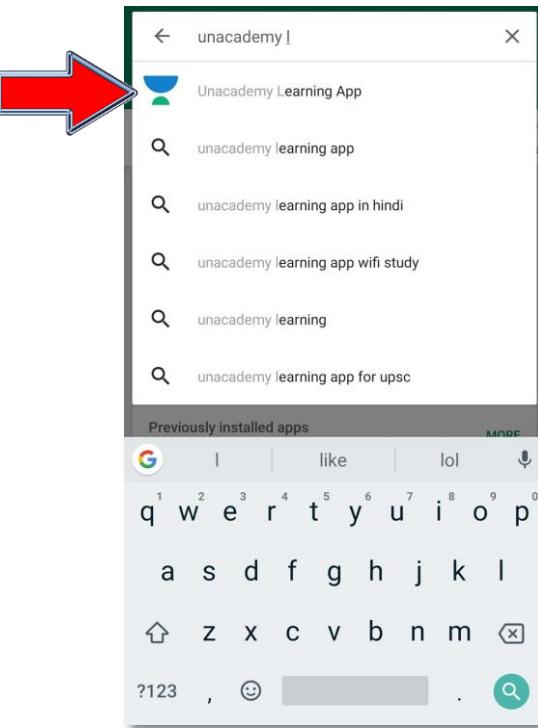


Naman Goyal  
98.48

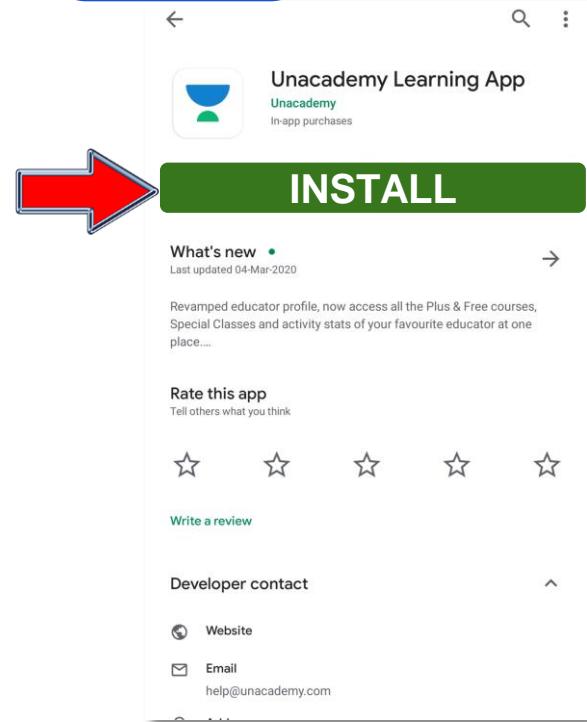


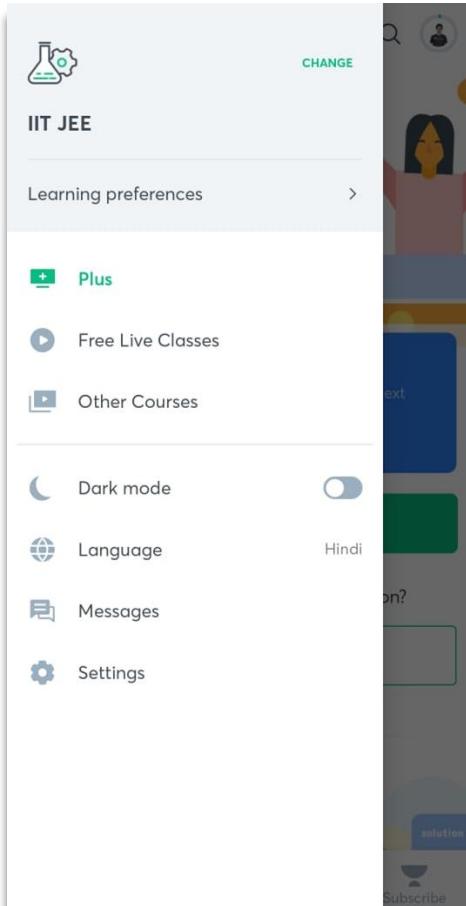
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