

Formation of Quadratic and Theory of Equations

Quadratic Equations

2



$$\alpha + \beta = \frac{-b}{a}$$



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



$$|\alpha - \beta| = \frac{\sqrt{D}}{|a|}$$



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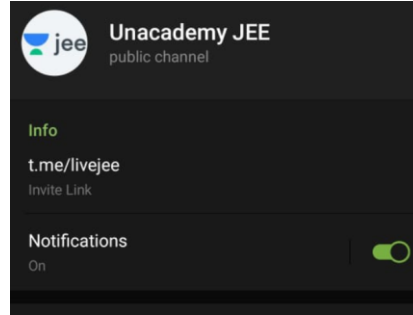
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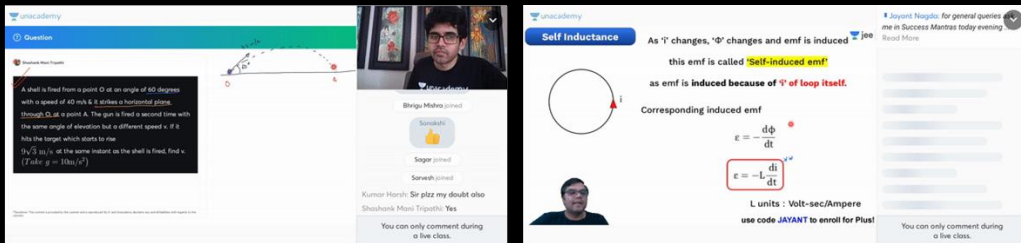
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Questions

A shell is fired from a point O at an angle of 60 degrees with a speed of 40 m/s. It 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 target which starts to rise $(\sqrt{3}/2) \sin(\theta)$ at the same instant as the shell is fired, find v . (Take $g = 10 \text{ m/s}^2$)

Shreyas Mishra joined

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Kumar Harsh: Sir plz my doubt also

Shashank Masi Tripathi: Yes

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Self Inductance

As θ changes, Φ changes and emf is induced

this emf is called **Self-induced emf**

as emf is induced because of θ of loop itself.

Corresponding induced emf

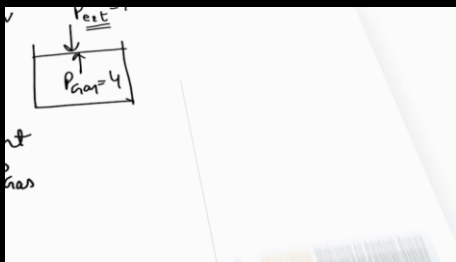
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$$\mathcal{E} = -L \frac{di}{dt}$$

L units: Volt-sec/Ampere

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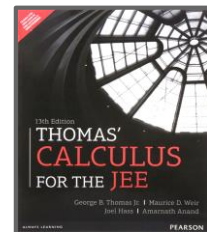
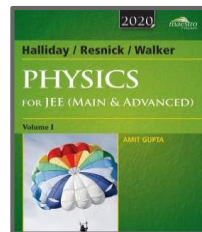
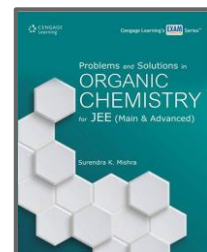
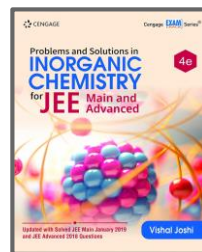
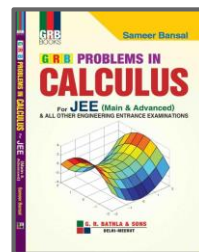
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LET'S BEGIN!!

Formation of Quadratic Equation





Formation of Quadratic Equation

A quadratic equation whose roots are α and β , is

i.e. $x^2 - (\text{sum of roots})x + (\text{product of roots}) = 0$

$$(x - \alpha)(x - \beta) = 0$$

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$



If (α, β) are the roots of the quadratic equation $ax^2 + bx + c = 0$ then find the **quadratic equation** whose roots are $(2\alpha, 2\beta)$

$$ax^2 + bx + c = 0 ; (\alpha, \beta) \Rightarrow \begin{cases} \alpha + \beta = -\frac{b}{a} \\ \alpha\beta = \frac{c}{a} \end{cases}$$

New Eqⁿ:

$$\left(\begin{array}{c} \text{Sum of} \\ \text{roots} \end{array} \right) = 2\alpha + 2\beta = 2(\alpha + \beta) = \left(-\frac{2b}{a} \right)$$

$$\left(\begin{array}{c} \text{Prod. of} \\ \text{roots} \end{array} \right) = (2\alpha)(2\beta) = 4(\alpha\beta) = \left(\frac{4c}{a} \right)$$

The new Eqⁿ is.

$$x^2 - \left(-\frac{2b}{a}\right)x + \frac{4c}{a} = 0$$

$$\boxed{ax^2 + 2bx + 4c = 0}$$

M-2 : (α, β) are roots of
 $ax^2 + bx + c = 0$

$$\Rightarrow \boxed{a\alpha^2 + b\alpha + c = 0} \text{ (1)}$$

Now:

$$x = 2\alpha$$

$$\Rightarrow \alpha = \frac{x}{2}$$

$$\Rightarrow a\left(\frac{x}{2}\right)^2 + b\left(\frac{x}{2}\right) + c = 0$$

$$\Rightarrow \boxed{ax^2 + 2bx + 4c = 0}$$



Let α and β , be the roots of the quadratic equation $ax^2 + bx + c = 0$, $c \neq 0$. Find the **quadratic equation** whose roots are

$$\frac{1-\alpha}{\alpha} \text{ and } \frac{1-\beta}{\beta}$$

M-2

$\therefore \alpha$ & β are roots

$$\text{of } ax^2 + bx + c = 0$$

$$\Rightarrow \boxed{a\alpha^2 + b\alpha + c = 0} \quad (1)$$

Now.

$$x = \frac{1-\alpha}{\alpha}$$

$$x = \frac{1}{\alpha} - 1$$

$$\frac{1}{\alpha} = x + 1$$

$$\boxed{\alpha = \frac{1}{x+1}}$$

use in Eqⁿ (1).

$$a\left(\frac{1}{x+1}\right)^2 + b\left(\frac{1}{x+1}\right) + c = 0$$

$$a + b(x+1) + c(x+1)^2 = 0$$

$$cx^2 + (b+2c)x + (a+b+c) = 0$$



If (α, β) are the roots of the quadratic equation $ax^2 + bx + c = 0$ then find the **quadratic equation** whose roots are $\left(\frac{\alpha}{\beta}, \frac{\beta}{\alpha}\right)$

M-1

$$\begin{aligned} \text{Sum} &= \frac{\alpha}{\beta} + \frac{\beta}{\alpha} \\ &= \frac{\alpha^2 + \beta^2}{\alpha\beta} \end{aligned}$$

$$\begin{aligned} &= \frac{(\alpha + \beta)^2 - 2(\alpha\beta)}{\alpha\beta} \\ &= \frac{(-b/a)^2 - 2(c/a)}{(c/a)} \\ &= \boxed{\frac{b^2 - 2ac}{ac}} \end{aligned}$$

Product

$$\begin{aligned} &= \left(\frac{\alpha}{\beta}\right) \left(\frac{\beta}{\alpha}\right) \\ &= 1 \end{aligned}$$

\therefore Req q^n :

$$x^2 - \left(\frac{b^2 - 2ac}{ac} \right) x + 1 = 0$$

$$\boxed{acx^2 - (b^2 - 2ac)x + ac = 0}$$

M-2 $\therefore \left(\frac{\alpha}{\beta}, \frac{\beta}{\alpha} \right) \equiv \left(\frac{\alpha^2}{\alpha\beta}, \frac{\beta^2}{\alpha\beta} \right)$

$$\equiv \left(\frac{\alpha^2}{(c/a)}, \frac{\beta^2}{(c/a)} \right)$$

Now:

$$x = \frac{\alpha^2}{(c/a)}$$

$$\alpha^2 = \frac{cx}{a}$$

$$\boxed{\alpha = \sqrt{\frac{cx}{a}}}$$

Now,

$$ax^2 + bx + c = 0$$

$$a\left(\sqrt{\frac{cx}{a}}\right)^2 + b\left(\sqrt{\frac{cx}{a}}\right) + c = 0$$

$$\cancel{a} \frac{cx}{\cancel{a}} + c = -b \sqrt{\frac{cx}{a}}$$

$$c^x (x+1)^2 = \frac{b^2 \cancel{x}}{a}$$

$$ac(x^2 + 2x + 1) = b^2 x$$

$$acx^2 + (2ac - b^2)x + (ac) = 0$$



If $\alpha \neq \beta$, but $\alpha^2 = 5\alpha - 3$, $\beta^2 = 5\beta - 3$, then the equation whose roots are α / β and β / α is :

A. $x^2 - 5x - 3 = 0$

B. $3x^2 - 19x + 3 = 0$

C. $3x^2 - 12x - 3 = 0$

D. None of these

$$\begin{cases} \alpha^2 - 5\alpha + 3 = 0 \\ \beta^2 - 5\beta + 3 = 0 \end{cases}$$

$$\Rightarrow \begin{cases} \alpha \text{ \& } \beta \text{ are roots of} \\ x^2 - 5x + 3 = 0 \end{cases}$$

Now.

$$\boxed{\alpha + \beta = 5 ; \alpha\beta = 3}$$

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

$$\text{Prod} = \left(\frac{\alpha}{\beta} \right) \left(\frac{\beta}{\alpha} \right) = 1$$

$$\left(\frac{19}{3} \right)$$



The quadratic equation $x^2 + mx + n = 0$ has roots which are twice those of $x^2 + px + m = 0$ and m, n and $p \neq 0$. Find the value of n/p .

$$\rightarrow x^2 + mx + n = 0, (2\alpha, 2\beta)$$

$$x^2 + px + m = 0, (\alpha, \beta)$$

New Soln $(2\alpha, 2\beta)$

$$x = 2\alpha \Rightarrow \alpha = \frac{x}{2}$$

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

$$\left(\frac{x}{2}\right)^2 + p\left(\frac{x}{2}\right) + m = 0$$

$$x^2 + (2p)x + (4m) = 0$$

①

But Eqⁿ with roots $(2\alpha, 2\beta)$

is $x^2 + mx + n = 0$ — (2)

On comparing Eqⁿ (1) & (2).

$$\begin{aligned} m = 2p &\Rightarrow p = m/2 \\ n = 4m &\Rightarrow n = 4m \end{aligned} \quad \left. \begin{array}{l} \rightarrow \\ \rightarrow \end{array} \right\} \frac{n}{p} = \frac{4m}{m/2} = 8$$



If α, β are the roots of equation, $x^2 - 2x + 3 = 0$, find the **equation whose roots** are $\alpha^3 - 3\alpha^2 + 5\alpha - 2$ and $\beta^3 - \beta^2 + \beta + 5$

$$x^2 - 2x + 3 = 0 ; (\alpha, \beta)$$

$$\begin{cases} \alpha^2 - 2\alpha + 3 = 0 \\ \beta^2 - 2\beta + 3 = 0 \end{cases}$$

$$\boxed{\alpha^3} - 2\alpha^2 + 3\alpha = 0$$

Now.

$$\alpha^3 - 3\alpha^2 + 5\alpha - 2$$

$$(2\alpha^2 - 3\alpha) - 3\alpha^2 + 5\alpha - 2$$

$$- \alpha^2 + 2\alpha - 2$$

$$3 - 2 = 1$$

Now.

$$\underbrace{\beta^3}_{\downarrow} - \beta^2 + \beta + 5$$

$$(2\beta^2 - 3\beta) - \beta^2 + \beta + 5$$

$$\underbrace{\beta^2 - 2\beta}_{\downarrow} + 5$$

$$-3 + 5 = \textcircled{2}$$

New S_1^1 is.

$$x^2 - (3)x + 2 = 0$$

Theory of Equations (Relation between roots and coefficients)





1. Quadratic Equation

$$\begin{array}{lcl} \sum \alpha = \alpha + \beta = -\frac{b}{a} & \text{--- (1)} & ax^2 + bx + c = 0 \\ \sum \alpha\beta = \alpha\beta = \frac{c}{a} & \text{--- (2)} & \downarrow \\ & & (\alpha, \beta) \end{array}$$



2. Cubic Equation

For: $ax^3 + bx^2 + cx + d = 0$

has three roots: (α, β, γ)

$$ax^3 + bx^2 + cx + d = a \sqrt{(x - \alpha)(x - \beta)(x - \gamma)}$$

$$x^3 + \left(\frac{b}{a}\right)x^2 + \left(\frac{c}{a}\right)x + \left(\frac{d}{a}\right) = x^3 - (\alpha + \beta + \gamma)x^2 + (\alpha\beta + \beta\gamma + \gamma\alpha)x - \alpha\beta\gamma$$

$$\alpha + \beta + \gamma = -\frac{b}{a} \quad \text{--- (1)}$$

$$\alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a} \quad \text{--- (2)}$$

$$\alpha\beta\gamma = -\frac{d}{a} \quad \text{--- (3)}$$

$$\sum \alpha = -\frac{b}{a}$$

$$\sum \alpha\beta = \frac{c}{a}$$

$$\sum \alpha\beta\gamma = -\frac{d}{a}$$



If $2x^3 + mx^2 - 13x + n = 0$ has roots **2 and 3**, then the **value of m and n** are:

A. -10, 50

B. -5, 30

C. 5, 30

D. None of these

$$(\alpha, 2, 3)$$

$$2x^3 + mx^2 - 13x + n = 0$$

$$\alpha + 2 + 3 = -\frac{m}{2}$$

$$2\alpha + 6 + 3\alpha = -\frac{13}{2}$$

$$(\alpha)(2)(3) = -\frac{n}{2}$$

$$\Rightarrow 5\alpha = -\frac{25}{2} \Rightarrow \boxed{\alpha = -\frac{5}{2}}$$

$$\begin{cases} -\frac{5}{2} + 5 = -\frac{m}{2} \\ \frac{5}{2} = -\frac{m}{2} \\ \boxed{m = -5} \end{cases}$$

& $-\frac{5}{2} \times 6 = -\frac{n}{2}$

$$\boxed{n = 30}$$

$$\underline{\underline{M-2}}$$

$$\begin{cases} 2(2)^3 + m(2)^2 - 13(2) + n = 0 \\ 2(3)^3 + m(3)^2 - 13(3) + n = 0 \end{cases}$$

→ solve: $\begin{cases} m = ? \\ n = ? \end{cases}$



3. Equation of degree 'n'

If $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n$ are the roots of the equation;

$$f(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \dots + a_{n-1}x + a_n = 0$$

where a_0, a_1, \dots, a_n are all real & $a_0 \neq 0$ then,

$$a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \dots + a_n = 0$$

has roots, $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n$

$$a_0 x^n + a_1 x^{n-1} + a_2 x^{n-2} + \dots + a_n$$

$$= a_0 (x - \alpha_1)(x - \alpha_2)(x - \alpha_3) \dots (x - \alpha_n)$$

$$x^n + \left(\frac{a_1}{a_0}\right)x^{n-1} + \left(\frac{a_2}{a_0}\right)x^{n-2} + \dots + \left(\frac{a_n}{a_0}\right)$$

$$= x^n - (\alpha_1 + \alpha_2 + \dots + \alpha_n)x^{n-1} + (\sum \alpha_1 \alpha_2) x^{n-2}$$



2. Equation of degree 'n'

If $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n$ are the roots of the equation;

$$f(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \dots + a_{n-1}x + a_n = 0$$

where a_0, a_1, \dots, a_n are all real & $a_0 \neq 0$ then,

$$\Rightarrow \sum \alpha_1 = -\frac{a_1}{a_0}$$



$$\sum \alpha_1 \alpha_2 \alpha_3 = -\frac{a_3}{a_0}$$



$$\Rightarrow \sum \alpha_1 \alpha_2 = +\frac{a_2}{a_0}$$



$$\alpha_1 \alpha_2 \alpha_3 \dots \alpha_n = (-1)^n \frac{a_n}{a_0}$$



If α, β, γ are the roots of the cubic $x^3 + qx + r = 0$ then find the **equation** whose roots are $\alpha + \beta, \beta + \gamma, \gamma + \alpha$.

$$x^3 + qx + r = 0 ; (\alpha, \beta, \gamma)$$

$$(-\gamma, -\alpha, -\beta)$$

$$\boxed{\alpha^3 + q\alpha + r = 0}$$

$$\begin{cases} \alpha + \beta + \gamma = 0 \\ \alpha\beta + \beta\gamma + \gamma\alpha = q \\ \alpha\beta\gamma = -r \end{cases}$$

$$x = -\alpha$$

$$\boxed{x = -\gamma}$$

$$(-x)^3 + q(-x) + r = 0$$

$$-x^3 - qx + r = 0$$

$$x^3 + qx - r = 0$$



If α, β, γ are the roots of the cubic $x^3 + qx + r = 0$ then find the **equation** whose roots are $\alpha\beta, \beta\gamma, \gamma\alpha$.

H.W - 1



If $x^2 - 3x + 2$ is one of the **factors** of the expression $x^4 - px^2 + q$, then:

A. $p = 4, q = 5$

B. $p = 5, q = 4$

C. $p = -5, q = -4$

D. None of these

HW-2



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6:00 - 7:30 PM



Ashwani Sir | Chemistry

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9:00 - 10:30 PM

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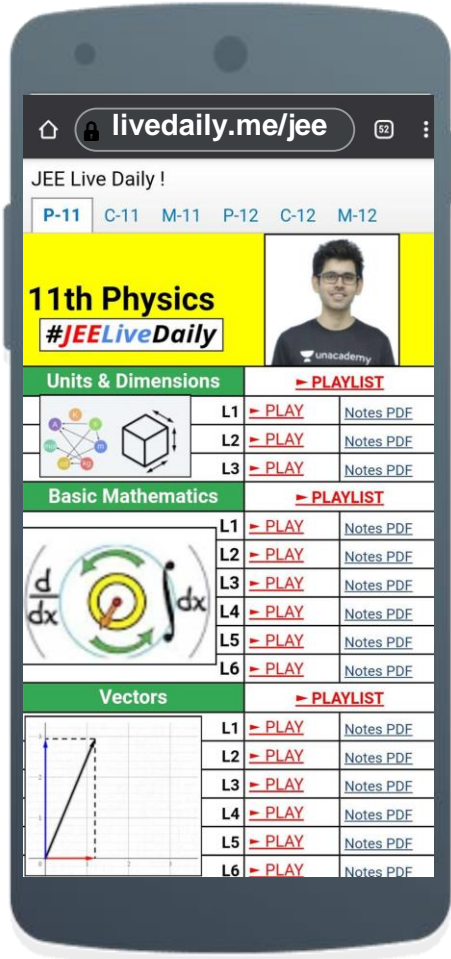
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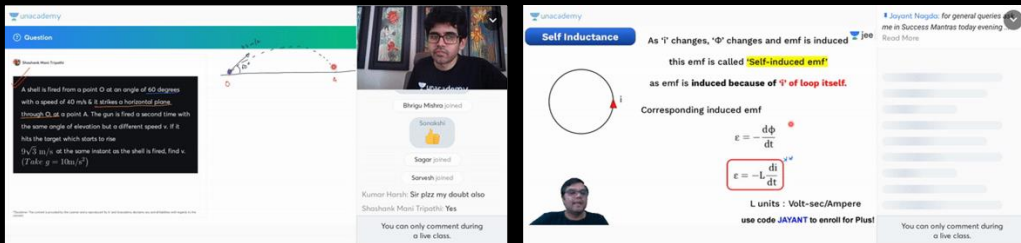
Nishant Sir | Maths

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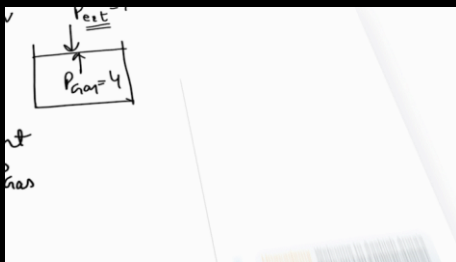
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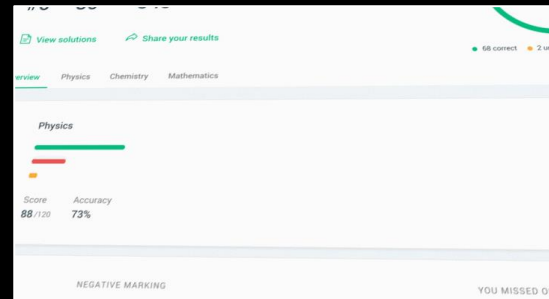
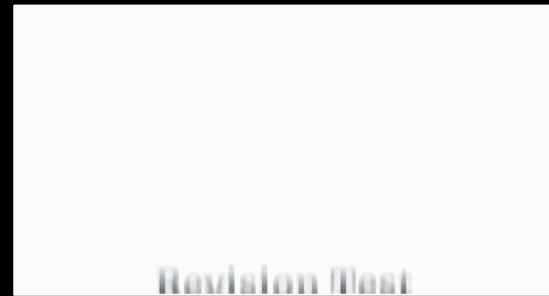


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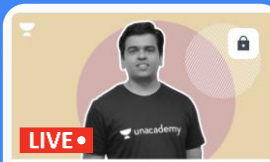


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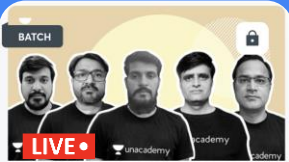
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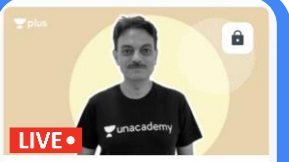
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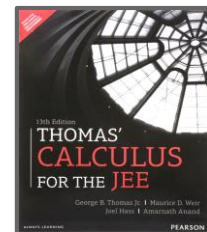
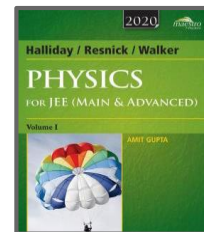
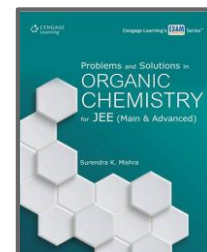
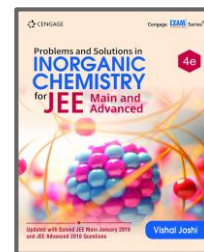
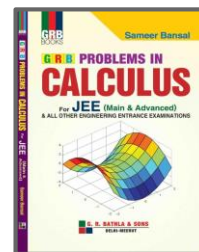
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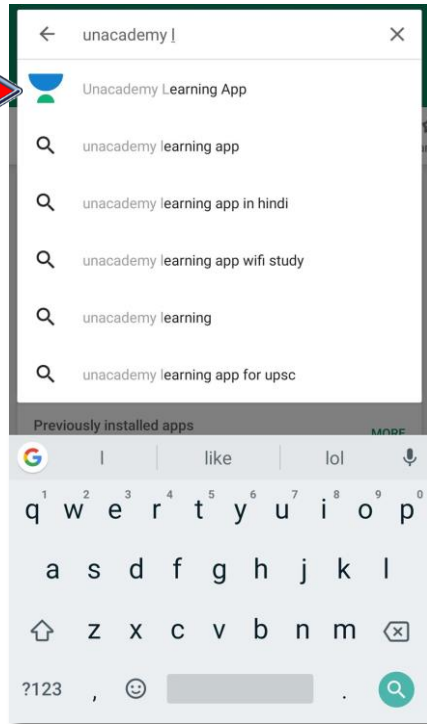


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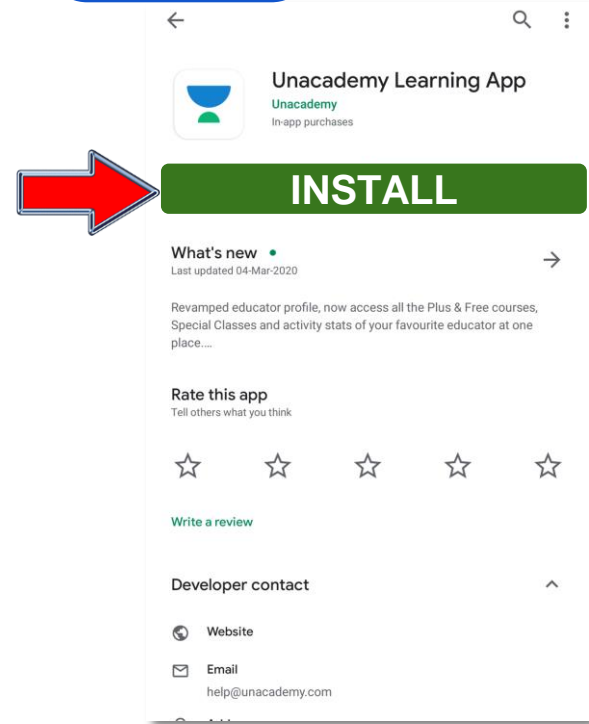


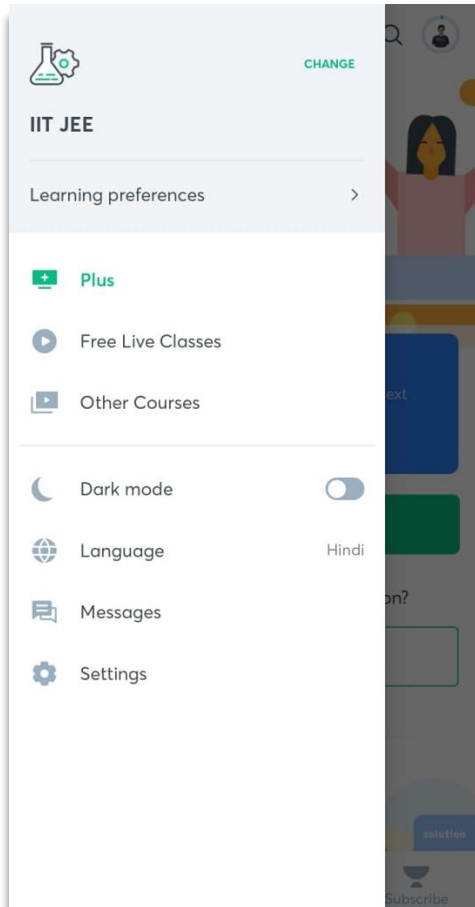
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