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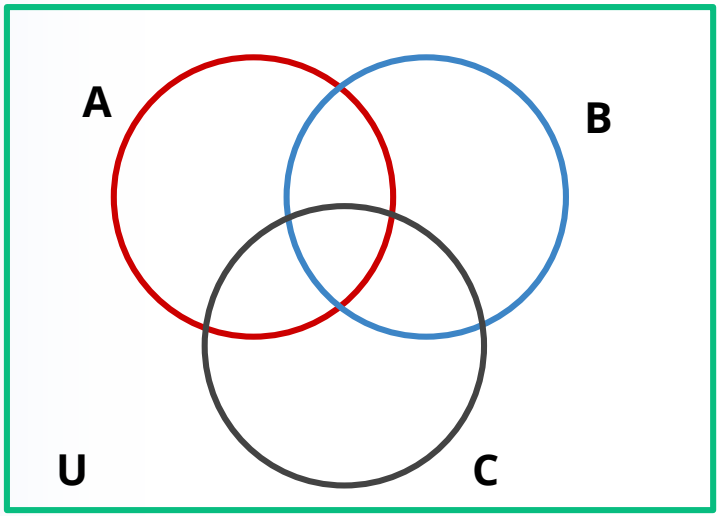
Operations on Sets
(Venn Diagram)

Sets

2



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Sameer Chincholikar

B.Tech, M.Tech - IIT-Roorkee

- **10+** years Teaching experience
- Taught **1 Million+** Students
- **100+** Aspiring Teachers Mentored

sameer_iitr

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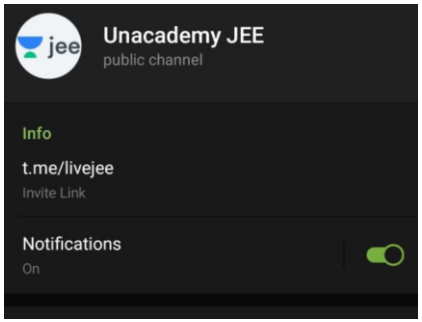

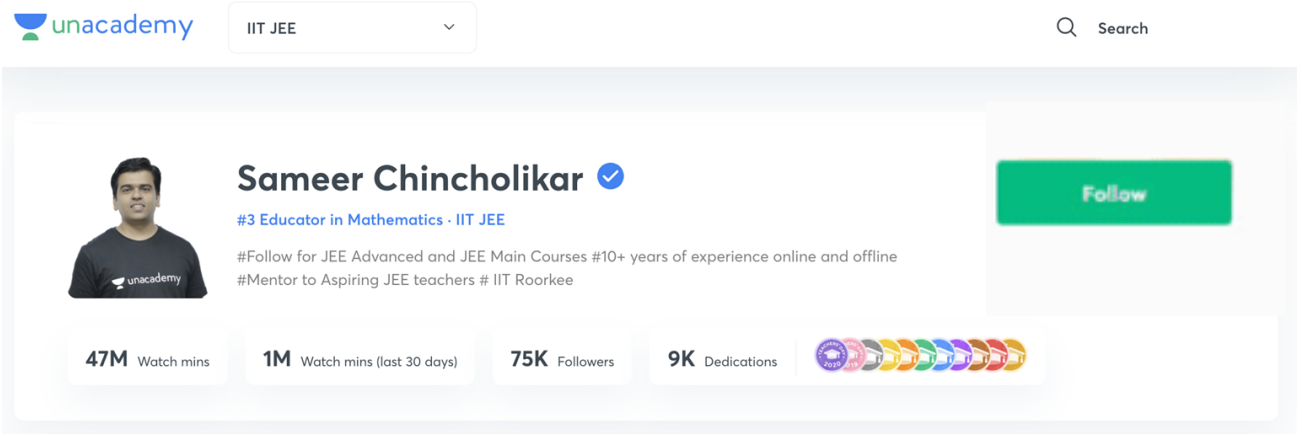

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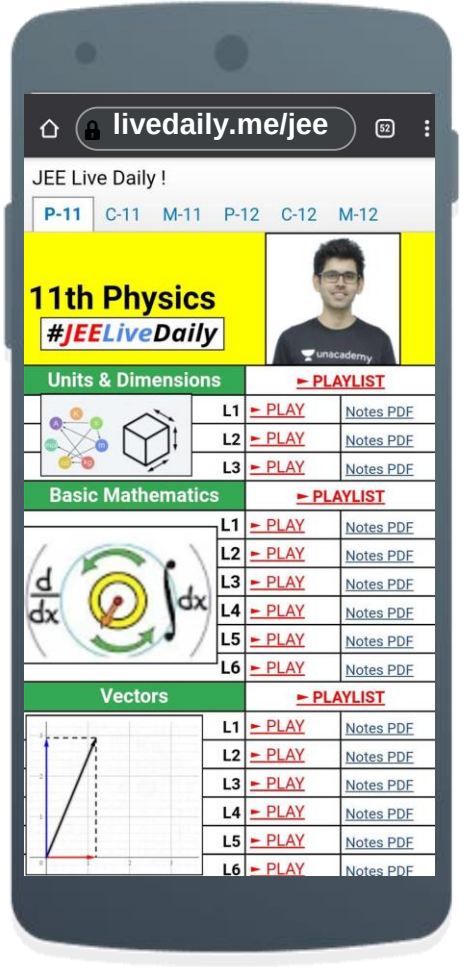

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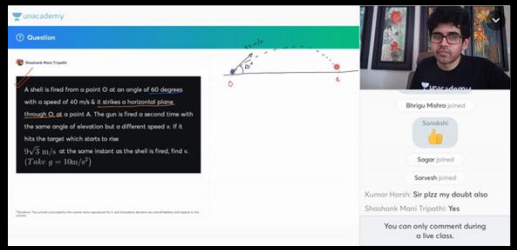

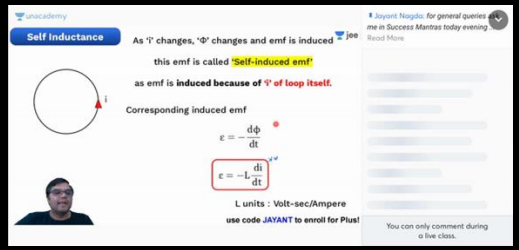

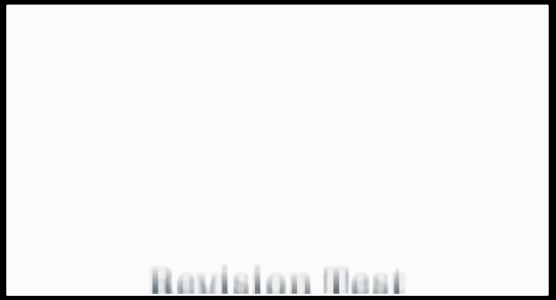

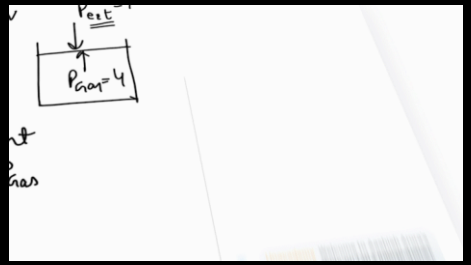

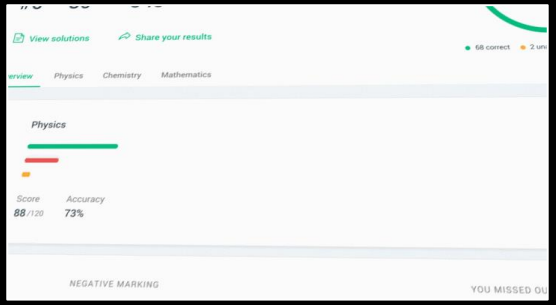

+ LIVE Class Environment

- **LIVE Polls** & **Leaderboard**
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- **LIVE** Interaction

+ Performance Analysis

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- **DPPs** & **Quizzes**

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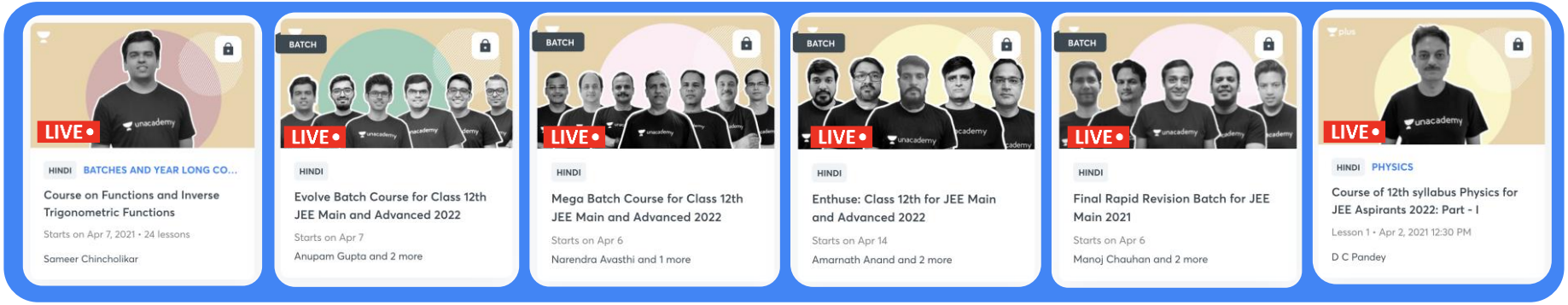

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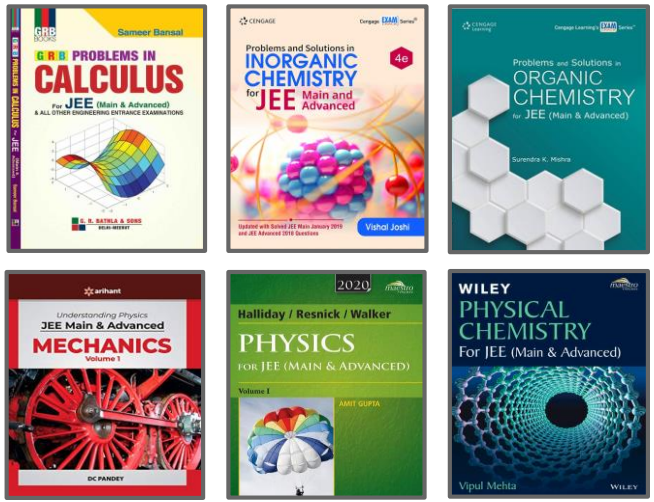

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Top Results

Bratin Mondal

100 %ile

Amaiya Singhal
99.97

Adnan
99.95

Ashwin Prasanth
99.94

Tanmay Jain
99.86

Kunal Lalwani
99.81

Utsav Dhanuka
99.75

Aravindan K Sundaram
99.69

Manas Pandey
99.69

Mihir Agarwal
99.63

Akshat Tiwari
99.60

Sarthak Kalankar
99.59

Vaishnovi Arun
99.58

Devashish Tripathi
99.52

Maroof
99.50

Tarun Gupta
99.50

Siddharth Kaushik
99.48

Mihir Kothari
99.39

Sahil
99.38

Vaibhav Dhanuka
99.34

Pratham Kadam
99.29

Shivam Gupta
99.46

Shrish
99.28

Yash Bhaskar
99.10

Subhash Patel
99.02

Ayush Kale
98.85

Ayush Gupta
98.67

Megh Gupta
98.59

Naman Goyal
98.48

MIHIR PRAJAPATI
98.16

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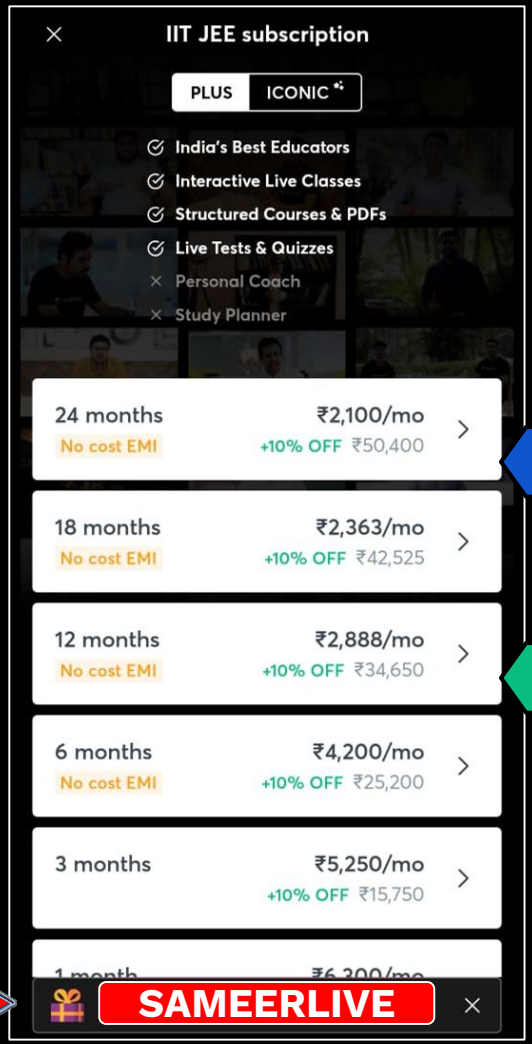
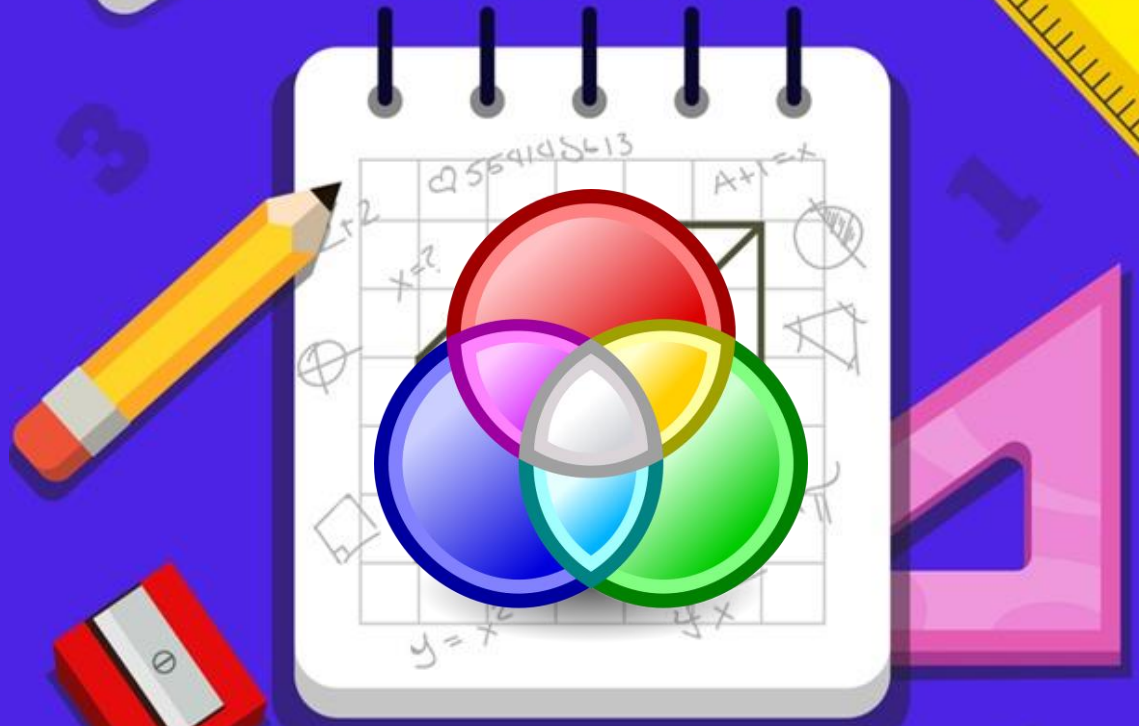


11th / 9, 10

12th / Drop

LET'S BEGIN!!

Venn Diagram



VENN DIAGRAM

Most of the relationships between sets can be represented by means of diagrams which are known as **venn diagrams.**

Example:

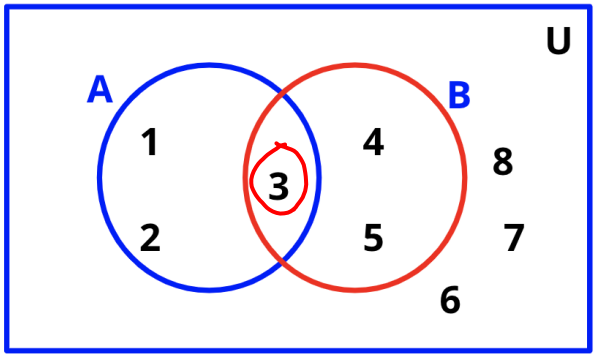
If

A = {1, 2, 3},

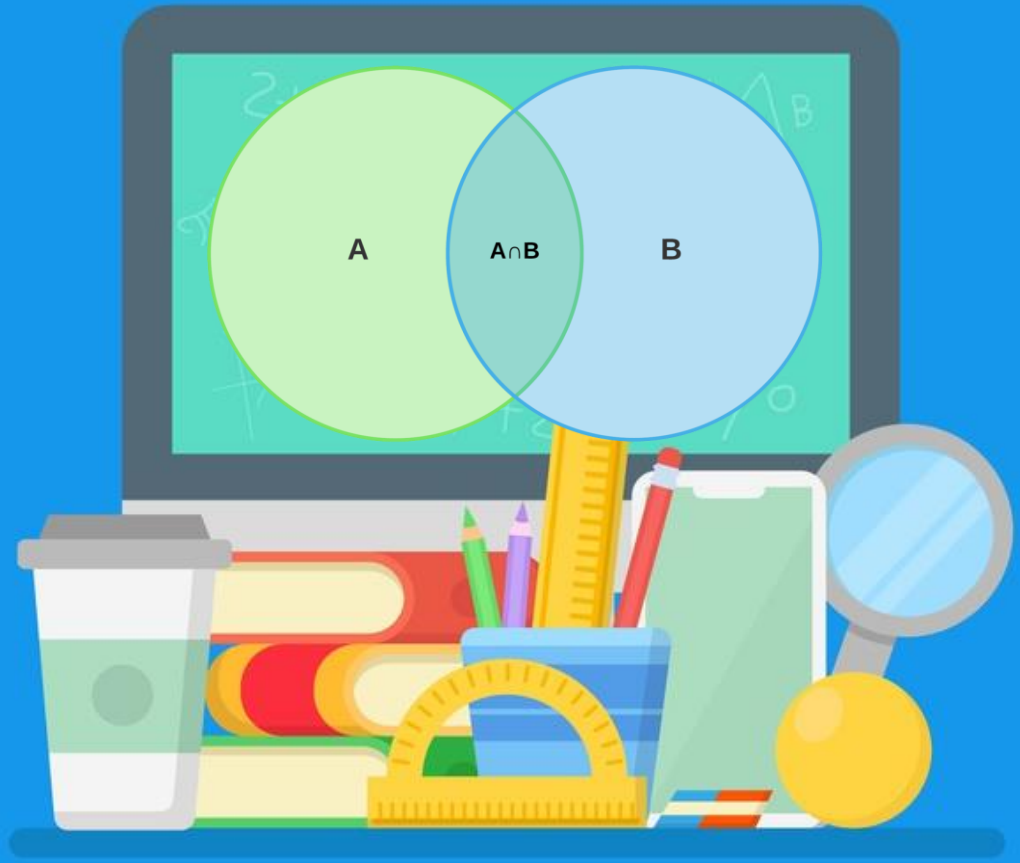
B = {3, 4, 5},

U = {1, 2, 3, 4, 5, 6, 7, 8}

then their venn diagram is



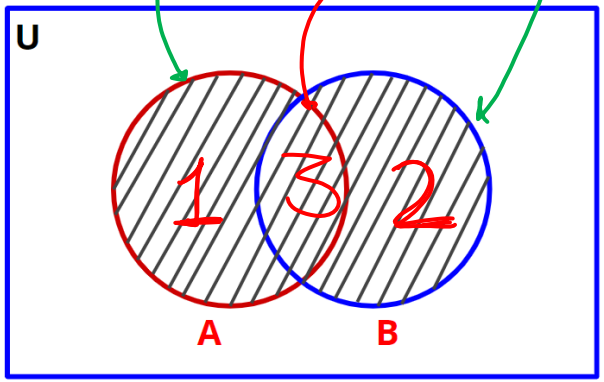
Operation on Sets



Operation on Sets & Venn Diagram

1 **Union of two sets :** $A \cup B = \{x : x \in A \text{ or } x \in B\}$

e.g : **A** = {1, 2, 3}, **B** = {2, 3, 4} then **A ∪ B** = { 1, 2, 3, 4 }

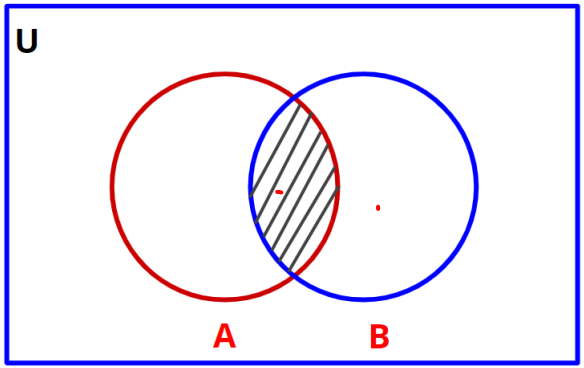


A ∪ B

Operation on Sets & Venn Diagram

2 **Intersection of two sets :** $A \cap B = \{x : x \in A \text{ and } x \in B\}$

e.g : $A = \{1, 2, 3\}$, $B = \{2, 3, 4\}$ then $A \cap B = \{ 2, 3 \}$



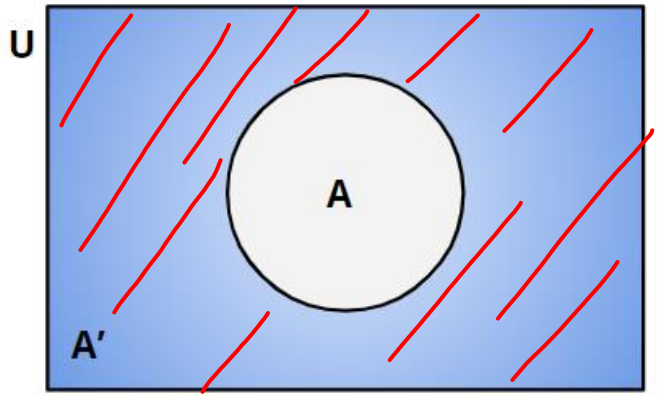
$A \cap B$

Operation on Sets & Venn Diagram

3 **Complement of a set :** $A' = \{x : x \notin A \text{ but } x \in U\}$

e.g : **U** = {1, 2, ...10}, **A** = {1, 2, 3, 4, 5} then **A'** = {6, 7, 8, 9, 10}

A', $\bar{A}$, A^c



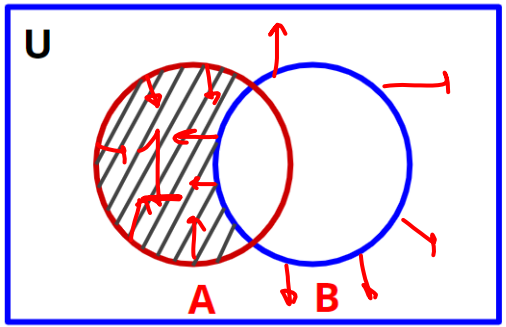
Operation on Sets & Venn Diagram

4 **Difference of two sets :** $A - B = \{x : x \in A \text{ and } x \notin B\}$.

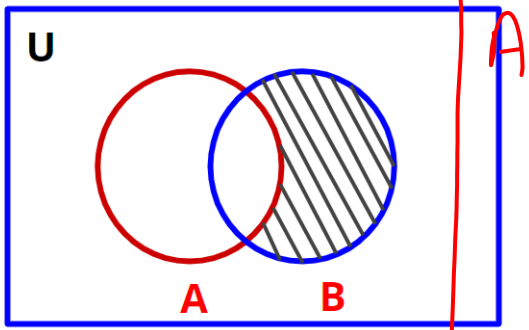
It is also written as $A \cap B'$

e.g : $A = \{1, 2, 3\}$, $B = \{2, 3, 4\}$; $A - B = \{1\}$

Similarly $B - A = B \cap A'$



A — B



B — A

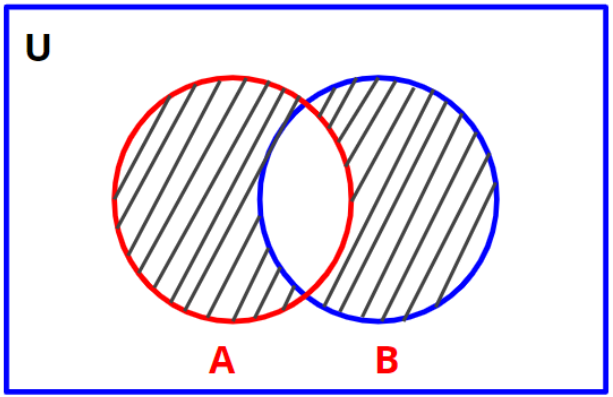
$A - B = A - (A \cap B)$

$= A \cap B'$

Operation on Sets & Venn Diagram

5 **Symmetric difference of two sets :**

It is denoted by $A \Delta B$ and $A \Delta B = (A - B) \cup (B - A)$



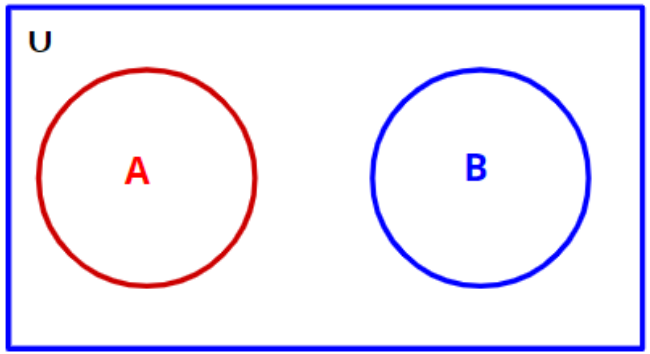
$(A \Delta B) = (A - B) \cup (B - A)$

$A \Delta B = (A \cup B) - (A \cap B)$

Operation on Sets & Venn Diagram

6 **Disjoint sets :** If $A \cap B = \phi$, then A and B are disjoint

e.g : $A = \{1, 2, 3, 4\}$, $B = \{6, 7, 8, 9\}$ then $A \cap B = \phi$



Disjoint

Example

Let **A = {x : x is a prime factor of 240}**

B = {x : x is the sum of any two prime factors of 240}

Then

A. $5 \notin A \cap B$ ✗

B. $7 \in A \cap B$ ✗

C. $8 \in A \cap B$ ✗

D. $8 \in A \cup B$ ✓

$240 = 24 \times 2 \times 5$

$= 3 \times 8 \times 2 \times 5$

$= 2^4 \, 3^1 \, 5^1$

$A = \{2, 3, 5\}$

$B = \{5, 8, 7\}$

$A \cap B = \{5\}$

Example

Let $X = \{(x, y, z) \mid x, y, z \in N,\ x + y + z = 10,\ x < y < z\}$ and $Y = \{(x, y, z) \mid x, y, z \in N,\ y = |x - z|\}$ then $X \cap Y$ is equal to

A. {(2, 3, 5)}

B. {1, 4, 5}

C. {5, 1, 4}

D. none of these

$x + y + z = 10$

$x = 1;\ y = 2;\ z = 7$

$x = 1;\ y = 3;\ z = 6$

$x = 1,\ y = 4;\ z = 5$

$x = 2;\ y = 3;\ z = 5$

$$X = \{(1,2,7), (1,3,6), (1,4,5), (2,3,5)\}$$

$$Y = \{(x,y,z) : y = |x-z|, \ x,y,z \in N\}$$

$$X \cap Y = \{(1,4,5), (2,3,5)\}$$

Example

If $U = \{x : x^5 - 6x^4 + 11x^3 - 6x^2 = 0\}$,
$A = \{x : x^2 - 5x + 6 = 0\}$ and $B = \{x : x^2 - 3x + 2 = 0\}$
what is $(A \cap B)'$ equal to?

A. {1, 3} **B.** {1, 2, 3} **C.** {0, 1, 3} **D.** {0, 1, 2, 3}

$$x^5 - 6x^4 + 11x^3 - 6x^2 = 0$$

$$x^2(x^3 - 6x^2 + 11x - 6) = 0$$

$x = 0$ $= 0$

$x^3 - 6x^2 + 11x - 6 = 0$

$x^2(x-1) - 5x(x-1) + 6(x-1) = 0$

$(x-1)(x^2 - 5x + 6) = 0$

$(x-1)(x-2)(x-3) = 0$

$U = \{0, 1, 2, 3\}$

$A = \{2, 3\}$

$B = \{1, 2\}$

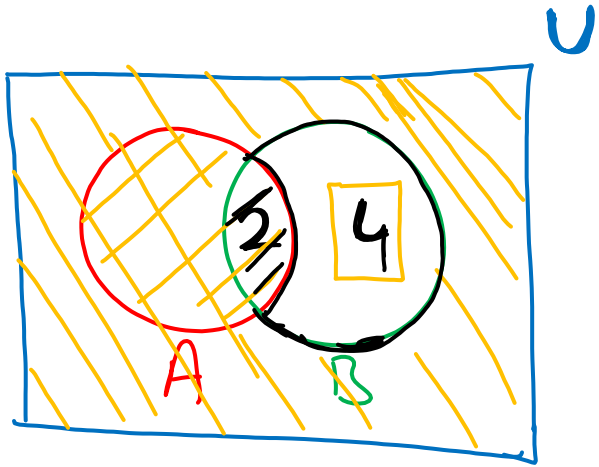
$A \cap B = \{2\}$

$(A \cap B)' = \{0, 1, 3\}$

Example

Let U be a Universal set and **n(U) = 12**.
If **A, B ⊆ U** are such that **n(B) = 6** and **n(A ∩ B) = 2**
then **n(A U B')** is equal to

A. 6 **B.** 10 **C.** 7 **D.** 8



$n(A \cup B') = 12 - 4$

$= 8$

Example

Find A - (A - B) if A = {5, 9, 13, 17, 21} and B = {3, 6, 9, 12, 15, 18, 21, 24}

$(A - B) = \{5, 13, 17\}$

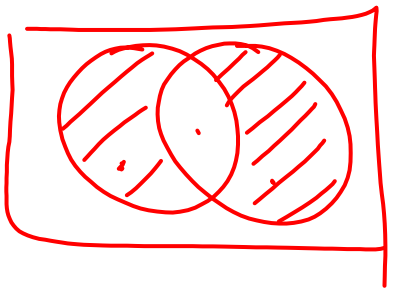
$A - (A - B) = \{9, 21\}$

Example

Let **P(X)** denote the power set of a set X. For any two sets **A** and **B**, if **P(A) = P(B),** then

A. AUB= AΔB **B.** A=B **C.** A∩B = ø **D.** AΔB = ø

A Δ B



A = B

A ∩ B has all values

$A \Delta B = (A \cup B) - (A \cap B)$

$= A - A = \phi$

Example

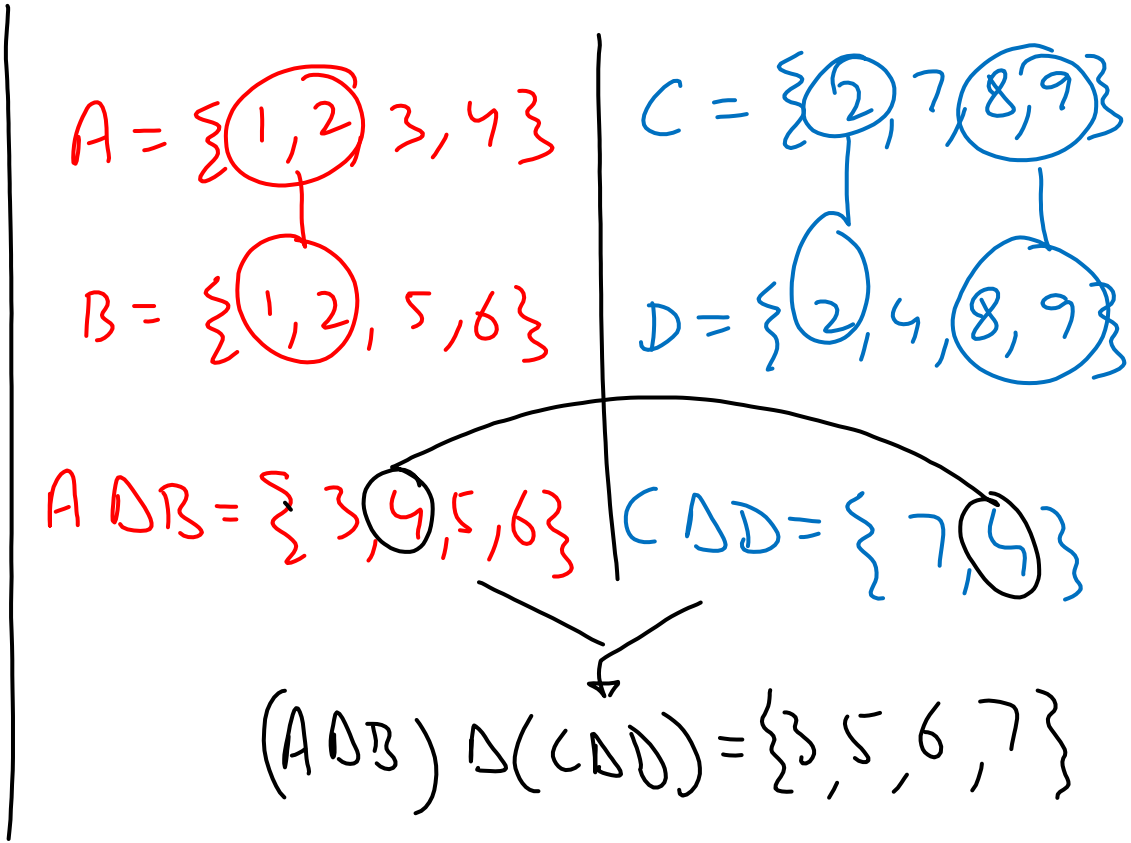
If **A = {1, 2, 3, 4}, B = {1, 2, 5, 6}, C = {2, 7, 8, 9}** and **D = {2, 4, 8, 9}**, then **(A Δ B) Δ (C Δ D) =**

A. {3, 4, 5, 6, 7}

B. {3, 4, 5, 7}

C. {3, 5, 7, 8}

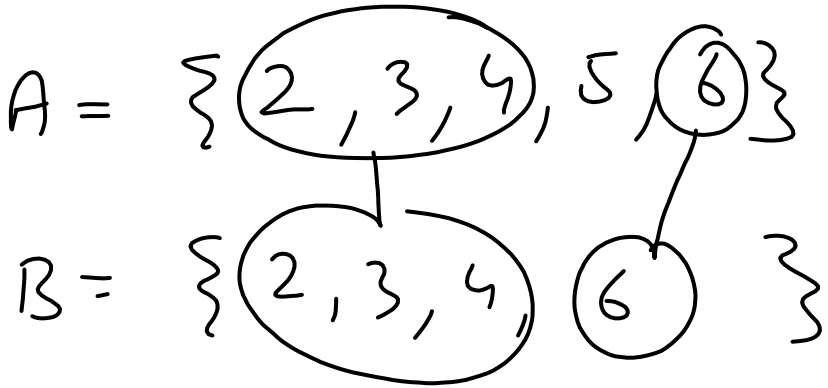
D. {3, 5, 6, 7} ✓



Example

Let **S = {1, 2, 3, 4, 5, 6, 7, 8, 9}** and **A = {2, 3, 4, 5, 6}.** Then the number of subsets B of S such that **A Δ B = {5}** is

A. 1 **B.** 2 **C.** 3 **D.** 4

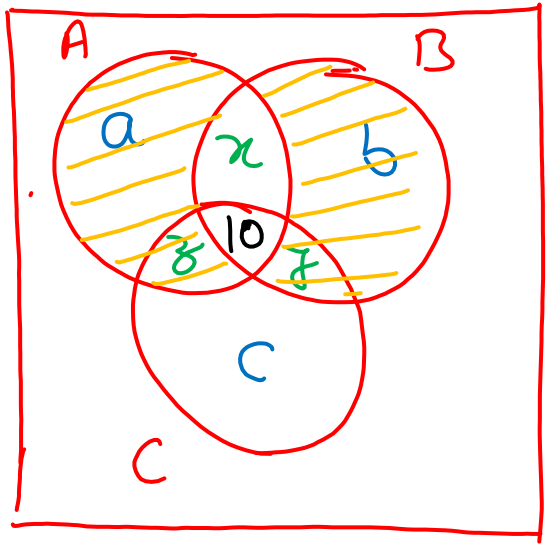


$A \Delta B = \{5\}$

Example

A, B, C are three finite sets such that **A ∩ B ∩ C** has 10 elements. If the sets **A Δ B, B Δ C** and **C Δ A** have **100, 150** and **200** elements, respectively, then the number of elements in **A U B U C** is

A. 450 **B.** 225 **C.** 235 **D.** 215



$n(A \Delta B) = a + z + b + y = 100$

$n(B \Delta C) = x + b + c + z = 150$

$n(C \Delta A) = a + x + c + y = 200$

$+ \quad 2(a + b + c + x + y + z) = 450$

$$[a+b+c+x+y+z] = 225$$

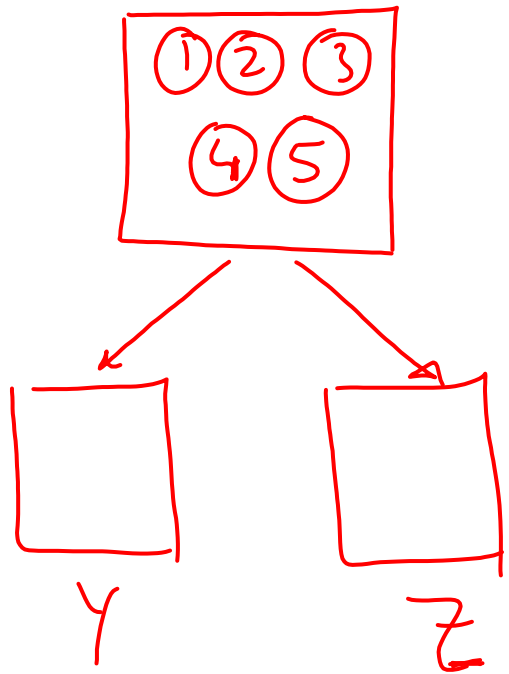
$$+10 \qquad +10$$

$$n(A \cup B \cup C) = 235$$

Example

Let **X = {1, 2, 3, 4, 5}.** The number of different **ordered** pairs **(Y, Z)** that can be formed such that **Y ⊆ X, Z ⊆ X** and **Y ∩ Z** is empty is

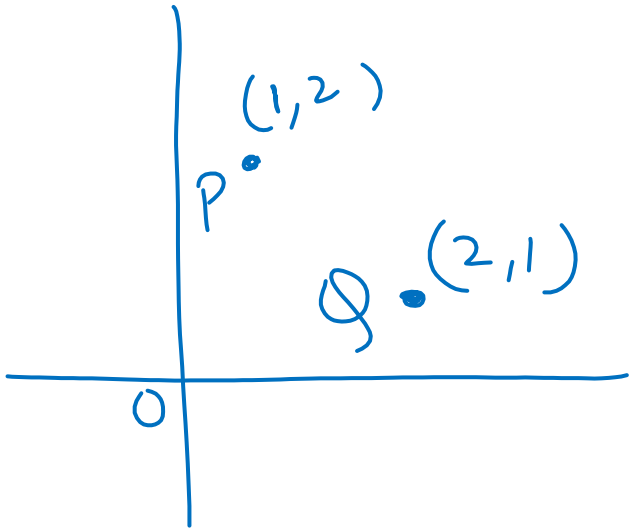
A. 5^2 B. 3^5 C. 2^5 D. 5^3



$3 \times 3 \times 3 \times 3 \times 3 = 3^5$

Eg: $Y = \{1\}$, $Z = \{2, 4\}$

Eg: $Y = \{2, 4\}$, $Z = \{1\}$


(1,2)
P
(2,1)
Q
O

Example

Let **S = {1, 2, 3, 4}.** The total number of unordered pairs of disjoint subsets of S is equal to

A. 25 **B.** 34 **C.** 42 **D.** 41

HW

Daily | TIMETABLE

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11th

Namo Sir | Physics

6:00 - 7:30 PM

Ashwani Sir | Chemistry

7:30 - 9:00 PM

Sameer Sir | Maths

9:00 - 10:30 PM

12th

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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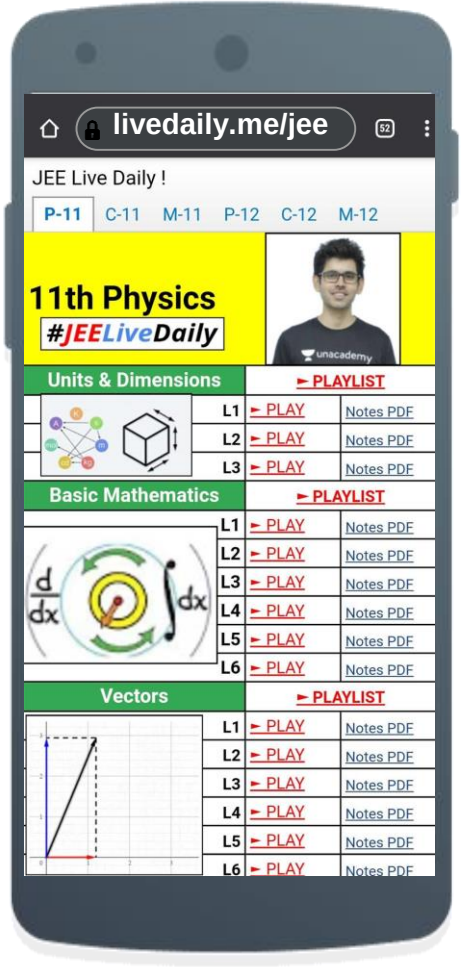

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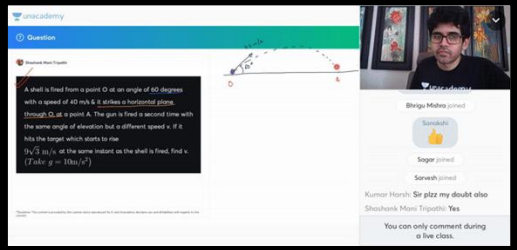

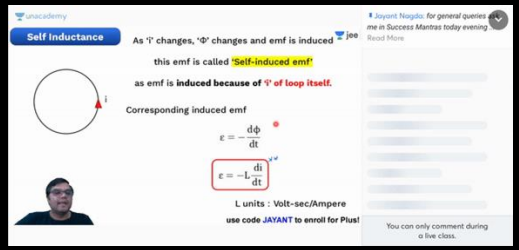

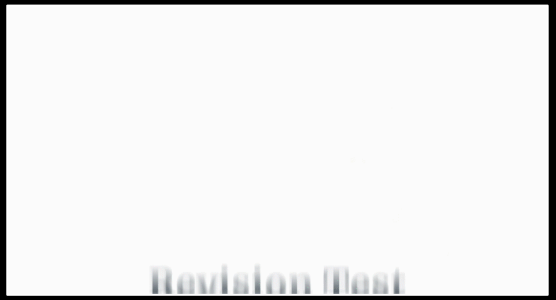

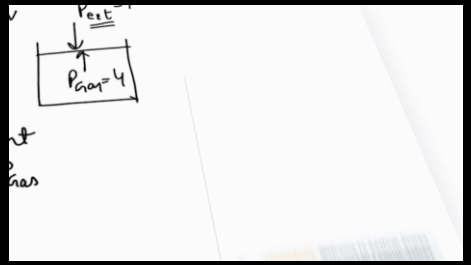

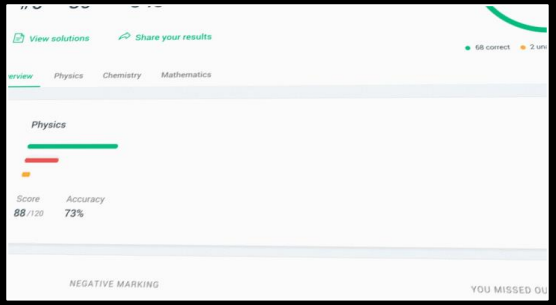

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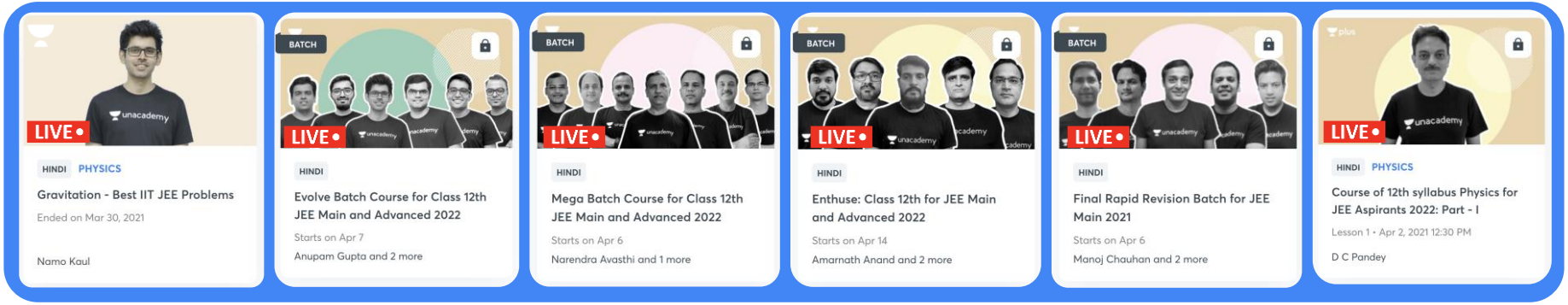

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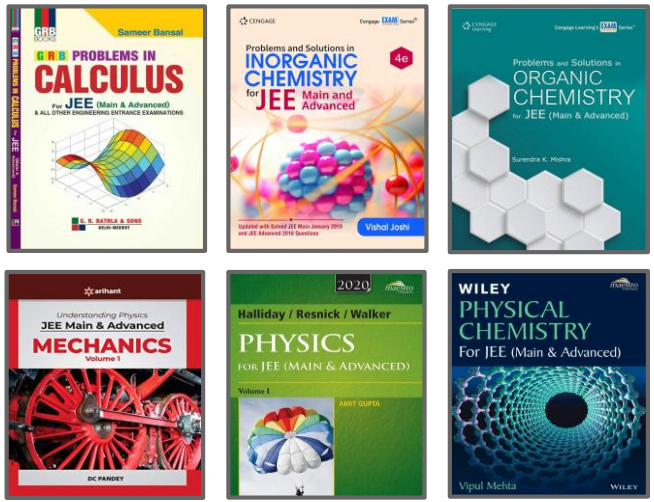
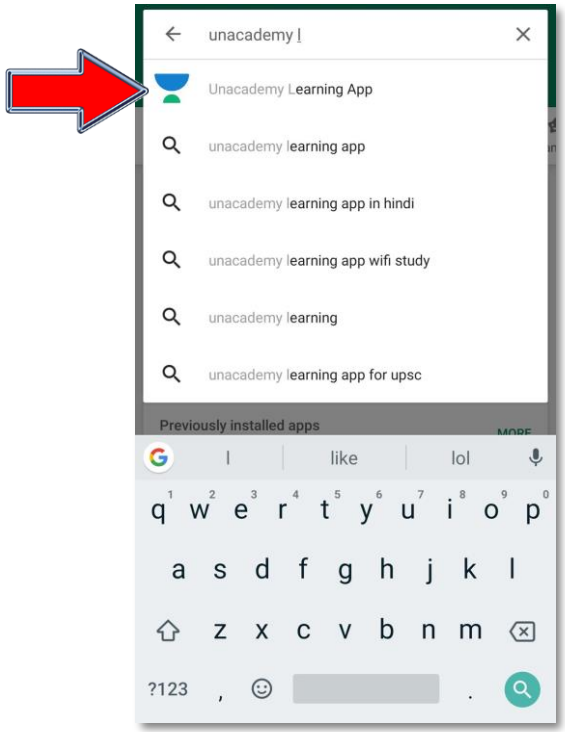


Step 1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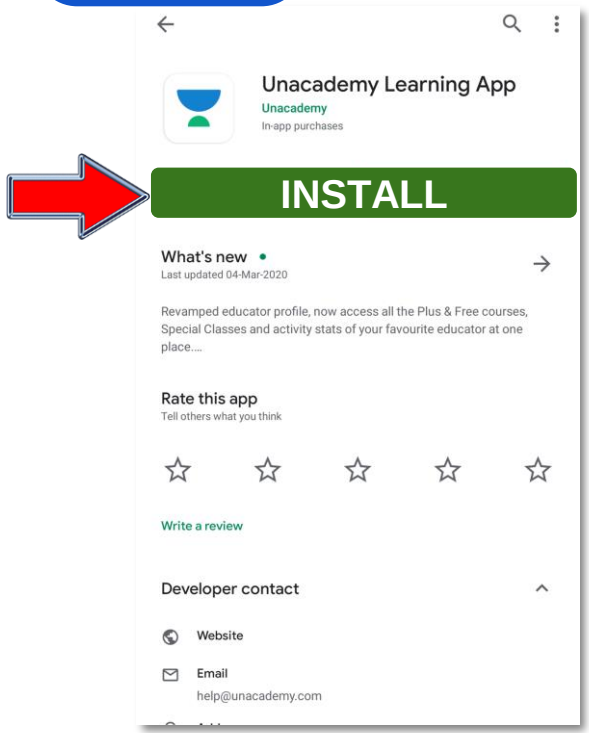
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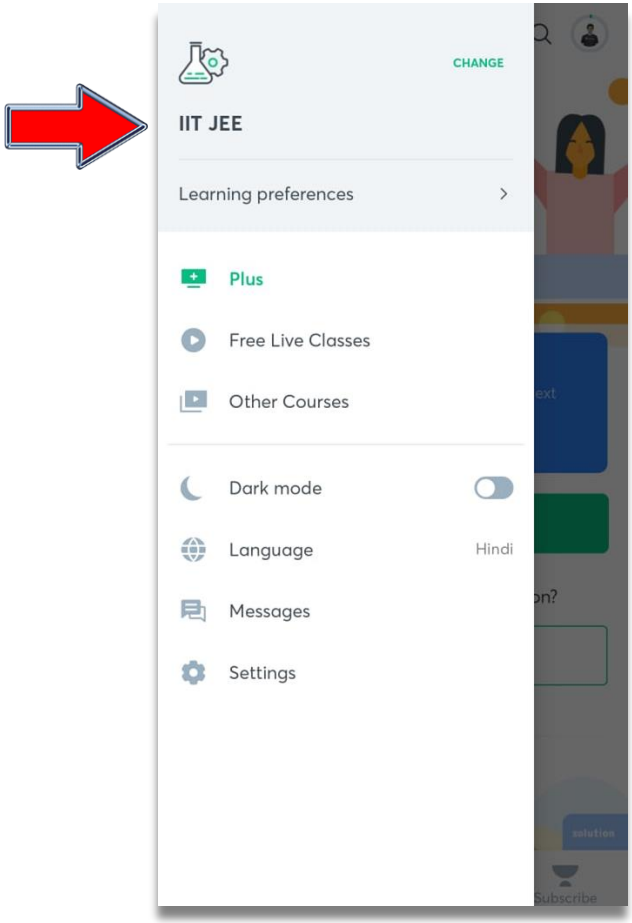
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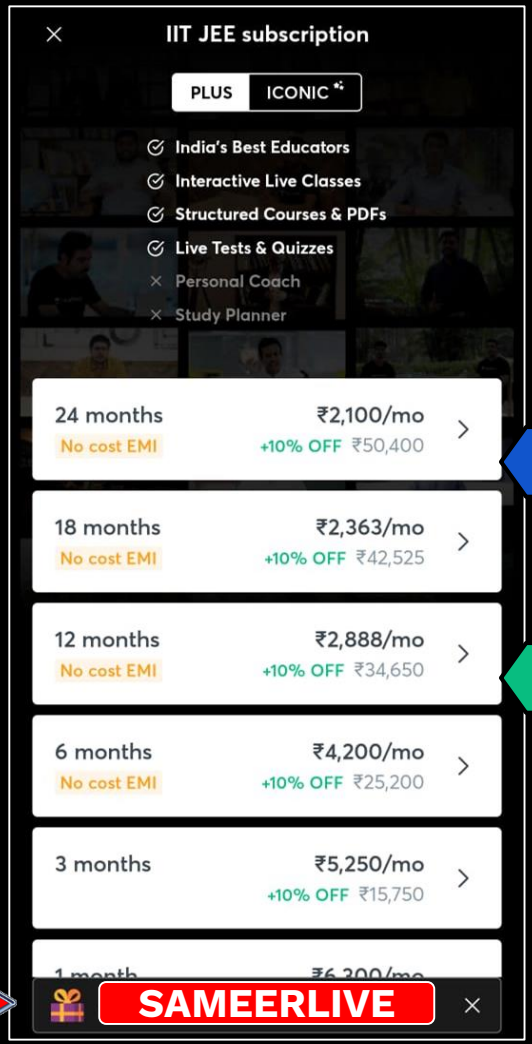

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