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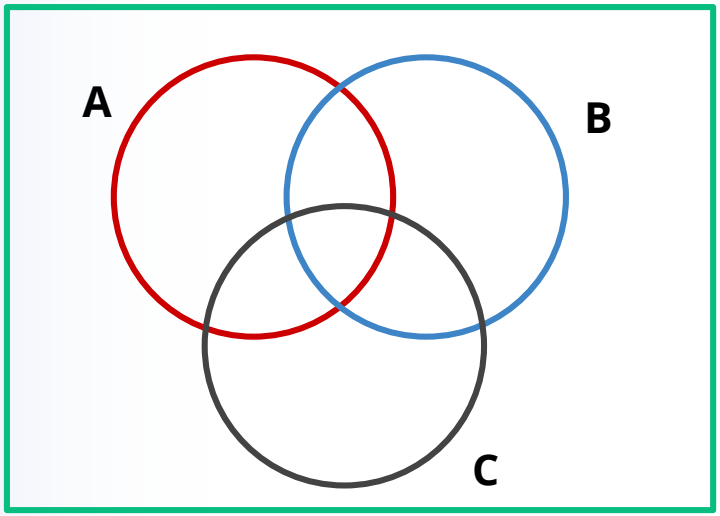
Subsets and Power Sets

Sets 1



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Sameer Chincholikar

B.Tech, M.Tech - IIT-Roorkee

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

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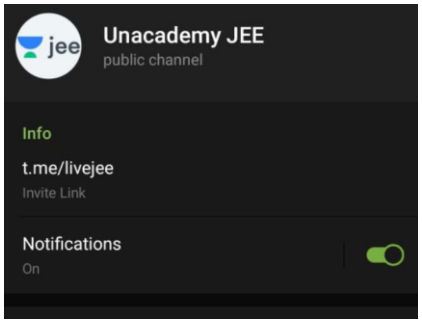

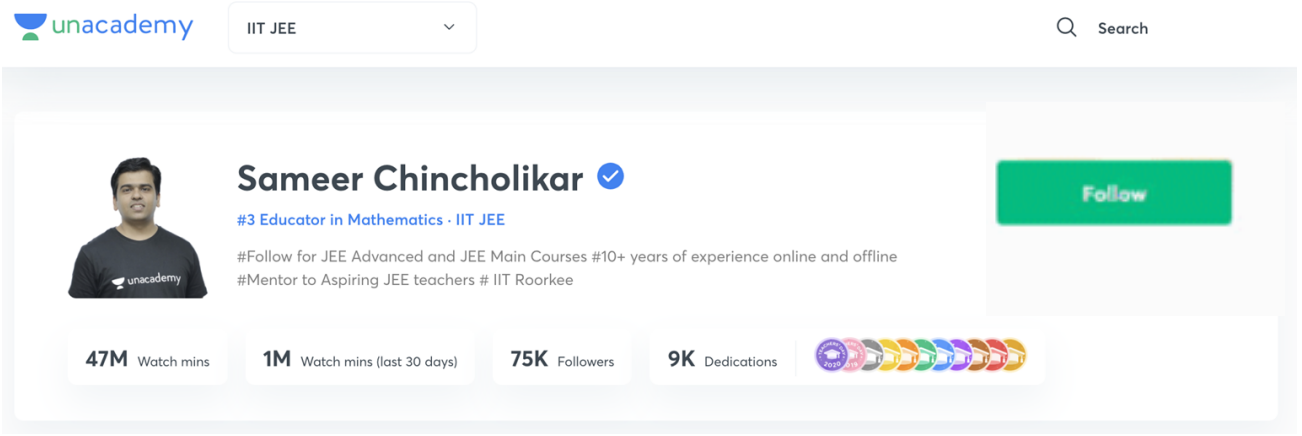

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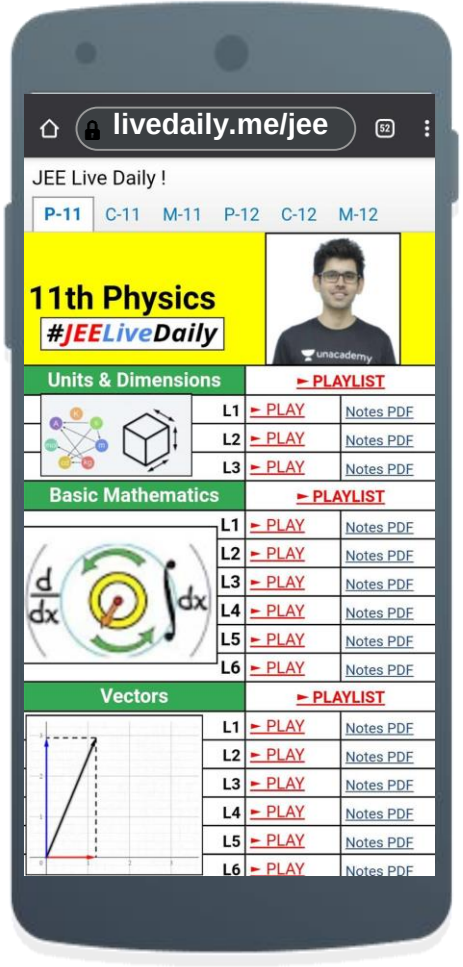

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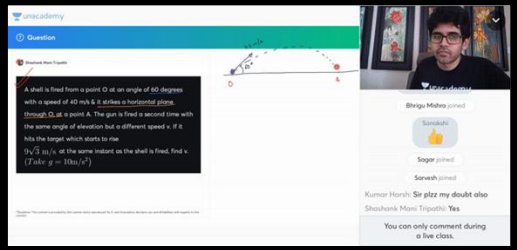

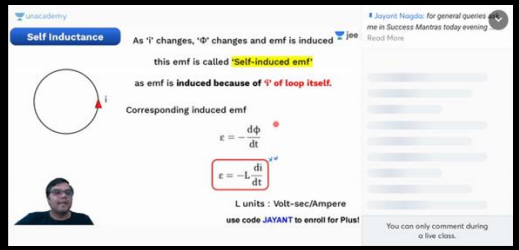

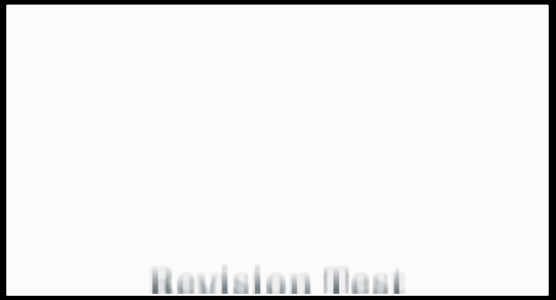

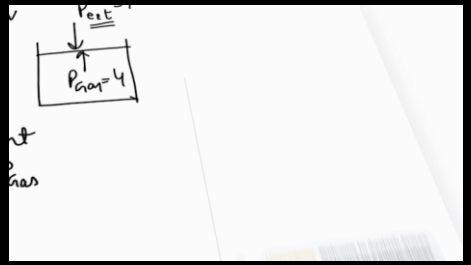

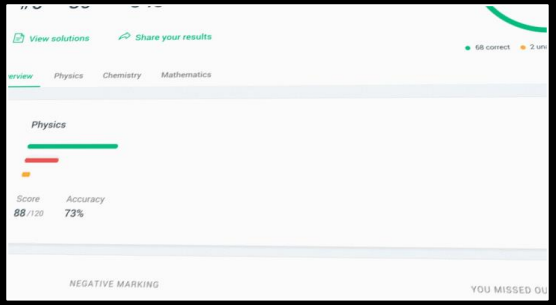

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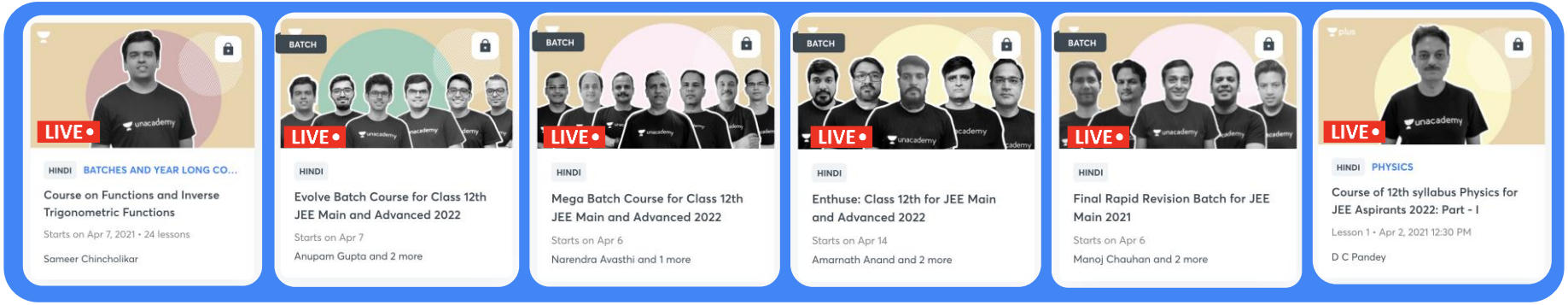

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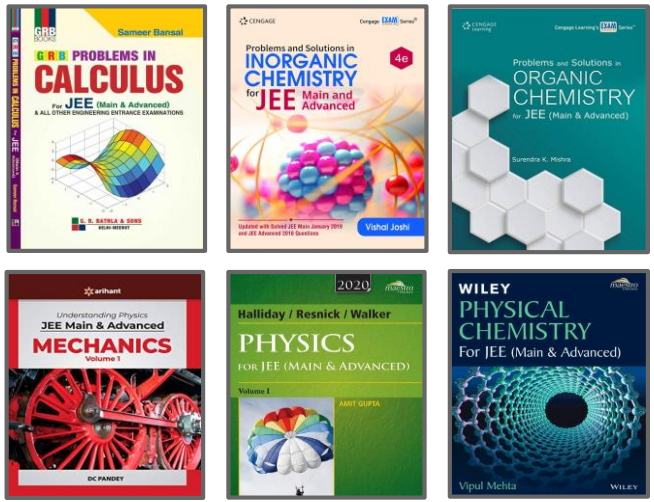

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Adnan
99.95

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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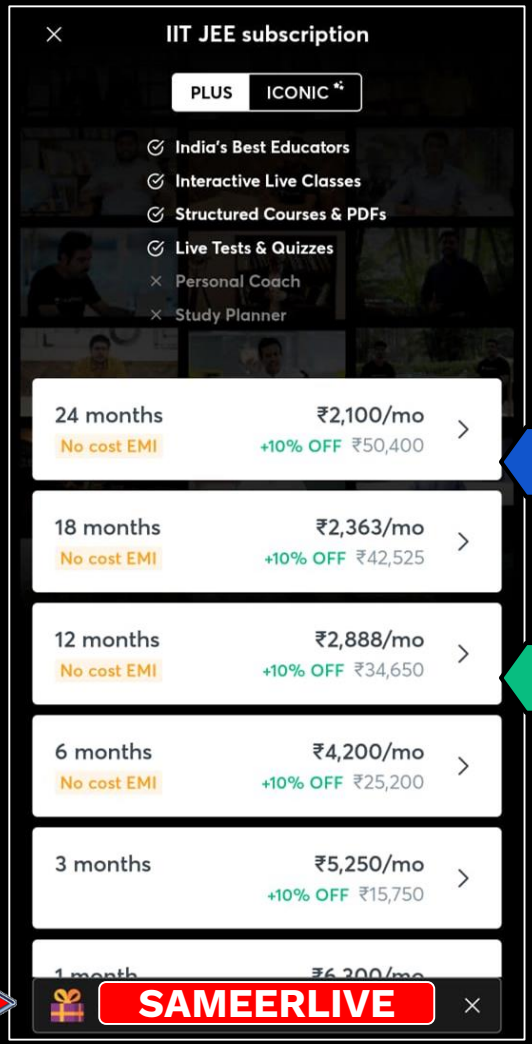

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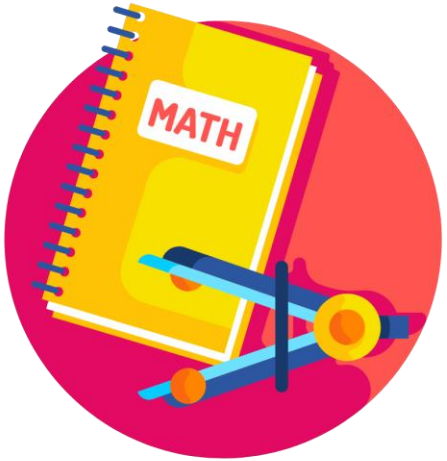
LET'S BEGIN!!

The only way to learn **mathematics** is to do **mathematics**.

PAUL HALMOS



Sets

A set is a **well defined collection of distinct objects.**

Example:

The collection of first five prime natural numbers is a set containing the elements 2, 3, 5, 7, 11.

Representing Sets

1. Roster Form: In this method a set is described by listing elements, separated by commas and enclose them by curly brackets.

Note

While writing the set in roster form, an element is not generally repeated.

Example:

The set of letters of word **MISSISSIPPI** may be written as **{M, I, S, P}.**

Representing Sets

2. Set builder form:

In this we write down a property or rule which gives us all the element of the set.

A = {x : P(x)}

where P(x) is the property by which $x \in A$ and colon (:) stands for ' such that '

Eg: $A = \{x : x \in \text{Natural No.}, x \leq 5\}$

Example

Express set **A = {x^3 : x < 5, x is a whole number}** in **roster form**

$A = \{0, 1, 8, 27, 64\}$

Example Express set **B = {2, 5, 10, 17, 26}** in **set builder form**

$$B = \{ x : x = n^2 + 1 \; ; \; n \in \mathbf{N} ; \; n \leq 5 \}$$

$$B = \{ (n^2 + 1) ; \; n \in N ; \; n \leq 5 \}$$

Example

Express set C = $\left\{\frac{1}{9}, \frac{1}{25}, \frac{1}{49}, \frac{1}{81}\right\}$ in set builder form

$$C = \left\{ \frac{1}{(2n+1)^2} \; ; \; n \in N ; \; n \leq 4 \right\}$$

Example

The number of elements in the set $A = \{ (a, b) : 2a^2 + 3b^2 = 35 , a, b \in Z \}$, where Z is the set of all integers, is:

A. 2 **B.** 4 **C.** 8 **D.** None

$2a^2 + 3b^2 = 35$

$b = 0 ; \ 2a^2 = 35$ X

$b = \pm 1 ; \ 2a^2 = 32$

$a^2 = 16$

$a = \pm 4$

$b = \pm 2 ; \ 2a^2 = 23$ X

$b = \pm 3 ; \ 2a^2 = 8$

$a^2 = 4$

$a = \pm 2$

Types of Sets

1. Null set or empty set :
A set having no element in it. It is denoted by ϕ or {}.

Example:
A = { x : 0 < x < 1; x ϵ Integers }

= { }

= ϕ

Types of Sets

2. Singleton set:
A set consisting of a single element is called a singleton set.

Example:
A = { x : 0 < x < 2; x ϵ Integers }

= { 1 }

Types of Sets

3. Finite set: A set which has countable number of elements is called a finite set.
Example: Set of prime numbers less than 10.

Order of a finite set: The number of elements in a finite set A is called the order of this set and denoted by O(A) or n(A). It is also called **cardinal number of the set.**

e.g : A = {a, b, c, d} ⇒ n(A) = 4

Types of Sets

4. Infinite set:

A set which has an infinite number of elements is called an infinite set.

$N : \{1, 2, 3, \ldots\}$

$W : \{0, 1, 2, 3 \ldots\}$

$Z : \{\ldots -2, -1, 0, 1, 2, \}$

$---$

R : Real Nos

Q : Rational Nos

Example

Which of the following sets is **empty** ?

A. $\{x \in R \mid x^2 = 9 \text{ and } 2x = 6\}$ → Singleton

B. $\{x \in R \mid x^2 = 9 \text{ and } 2x = 4\}$ → null ✓

C. $\{x \in R \mid x + 4 = 4\}$ → $x = 0$

D. $\{x \in R \mid 2x + 1 = 3\}$ → $x = 1$

Example

Which of the following is **not null set** ?

A. Set of odd natural numbers divisible by 2
B. Set of even prime numbers
C. {x : x is a natural number, x < 5 and x > 7}
D. {y : y is a point common to any two parallel lines}

Example

Which of the following is **a singleton set** ?

A. $\{x : |x| < 1, x \in I\}$

B. $\{x : |x| = 5, x \in I\}$ → finite

C. $\{x : x^2 = 1, x \in I\}$ → finite

D. $\{x : x^2 + x + 1 = 0, x \in R\}$ → null set

Example

Consider the following sets

A = The set of lines which are parallel to the X-axis.

B = The set of letters in the English alphabet. and

C = The set of animals living on the earth.

Which of these is **finite or infinite set** ?

A. Finite set → B, Infinite set → A, C

B. Finite set → B, C, Infinite set → A

C. Finite set → A, C, Infinite set → B

D. None of the above

Types of Sets

5. Equal sets

Two sets A and B are said to be equal if every element of A is member of B, and every element of B is a member of A.

$A = \{1, 2, 3\}$

$B = \{3, 2, 1\}$

$\Rightarrow A = B$

Types of Sets

6. Equivalent sets

Two finite sets A and B are equivalent if their number of elements are same i.e. n(A) = n(B)

e.g. A = {1, 3, 5, 7} , B = {a, b, c, d} n(A) = 4 and n(B) = 4

⇒ **A** and **B** are equivalent sets

Types of Sets

7. Universal Set:

A set consisting of all possible elements which occur in the discussion is called a universal set and is denoted by U.

Example:

If A = {1, 2, 3} , B = {2, 4, 5, 6},

C = {1, 3, 5, 7} then

U = {1, 2, 3, 4, 5, 6, 7} can be taken as the universal set.

Subset and Superset

Let A and B be two sets. If every element of A is an element B then A is called a subset of B and B is called superset of A. We write it as $A \subseteq B$.

$A \subset B$; $B \supset A$

e.g : A = {1, 2, 3, 4} and

B = {1, 2, 3, 4, 5, 6, 7, 8} $\Rightarrow$ **$A \subset B$**

If A is not a subset of B then we write $A \not\subseteq B$

Proper Subset

If A is a subset of B but A ≠ B then A is a proper subset of B and we write A ⊂ B. Set A is not proper subset of A so this is improper subset of A.

Example:

Write the proper subsets of A = { 1, 2, 3 }

$1 \in A$; $4 \notin A$

$\{\}, \{1\}, \{2\}, \{3\}, \{1,2\}, \{2,3\}, \{3,1\},$

$\{1,2,3\}$

$\{1,2\} \subset A$

Example

Let **A = {1, 2, {3, 4}, 5}**. Which of the following statements are correct.

A. $\{3, 4\} \subset A$ **B.** $\{3, 4\} \in A$ **C.** $\{\{3, 4\}\} \subset A$ **D.** $\{1, 2, 3\} \subset A$

$A = \{1, 2, \{3, 4\}, 5\}$

$3 \in A$ X

$\{3, 4\} \in A$

Important Results

1. Every set is a subset of itself
2. Empty set, ϕ, is a subset of every set
3. $A \subseteq B$ and $B \subseteq A \Leftrightarrow A = B$
4. ϕ is proper subset of every set except itself.

Important Results

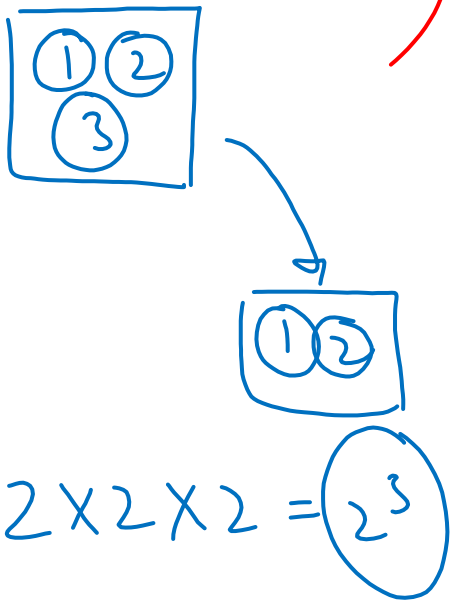
5 The total number of subsets of a finite set containing n elements is 2^n

$A = \{1, 2, 3\}$

Subsets:

$\{\}, \{1\}, \{2\}, \{3\}$

$\{1,2\}, \{2,3\}, \{3,1\}, \{1,2,3\}$



Important Results

6 Number of proper subsets of a set having n elements is $2^n - 1$

Example

If **A = {x : x = 4n + 1, 2 ≤ n ≤ 5}**, then number of subsets of A is -

A. 16
B. 15
C. 4
D. None of these

$n = 2, 3, 4, 5$

$n(A) = 4$

$2^4 \rightarrow$ Subsets

Example

Let **A = {a, b , c, d}** and **B = {a, b, c}**. Then the number of sets X contained in A and not contained in B is

A. 8 **B.** 6 **C.** 16 **D.** 12

M-1 :

$n(A) = 4$; $n(B) = 3$

$n(A) = 4$ → subset 2^4 → 16

$n(B) = 3$ → subset 2^3 → 8

16 − 8 = 8

M-2 : $2 \times 2 \times 2 \times 1 = 8$

Example

Two finite sets have **m** and **n** elements. The number of subsets of the first set is **112** more than that of the second set. The values of **m** and **n** are respectively,

A. 4, 7 **B.** 7, 4 **C.** 4 , 4 **D.** 7, 7

$$2^m - 2^n = 112$$

$$2^n(2^{m-n} - 1) = 4 \times 28$$

$$= 2^4 \times 7$$

$$= 2^4(2^3 - 1)$$

$n = 4$

$m - n = 3$

$m = 7$

Power Set

Let A be any set. The **set of all subsets** of A is called power set of A & is denoted by P(A)

Example

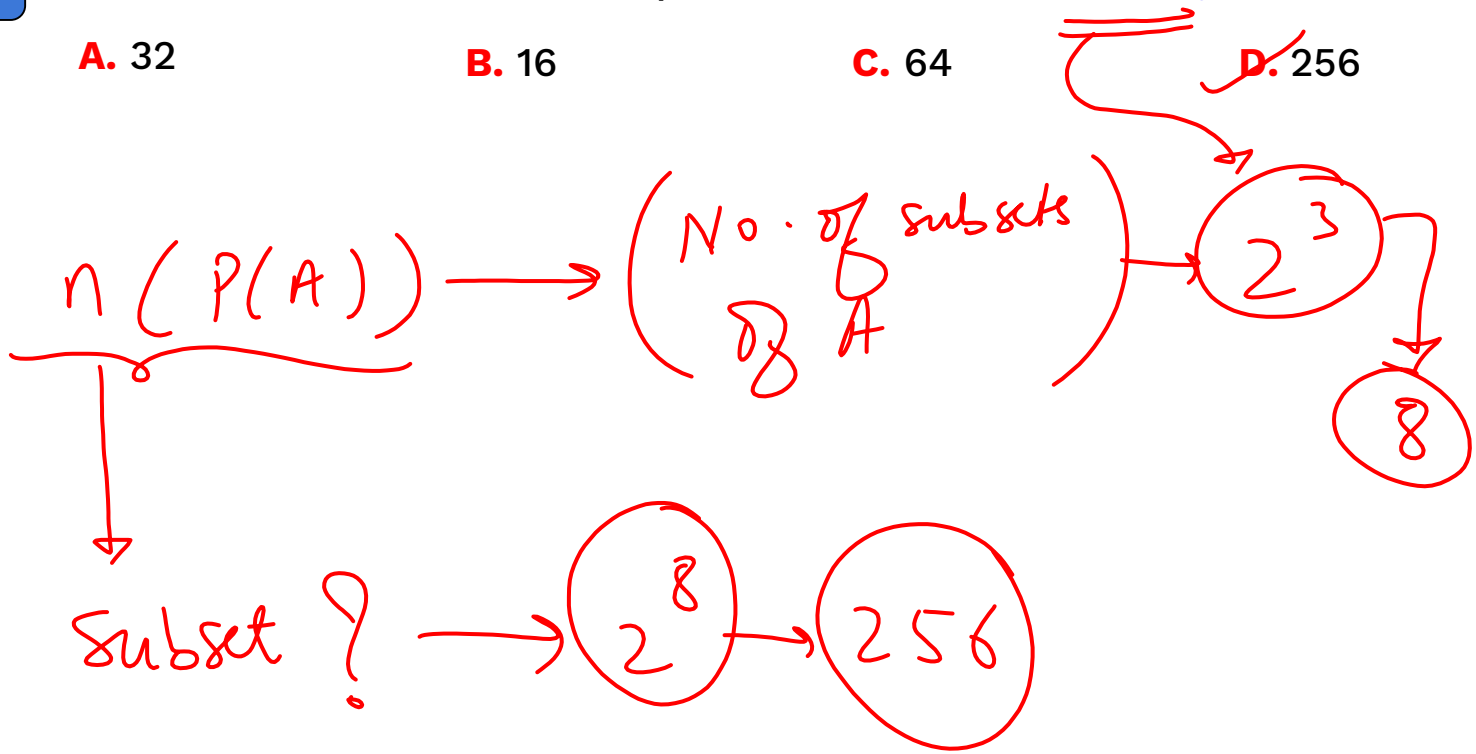
Find power set of set A = {1, 2}

$$P(A) = \{ \{\}, \{1\}, \{2\}, \{1,2\} \}$$

Example

The number of subsets of the power set of set **A = {a, b, c}** is

A. 32 **B.** 16 **C.** 64 **D.** 256



Example

If A is a null set and **B = P(P(P(A)))**, where **P(A)** denotes power set of A, then which of the following is/are correct.

A. $\{\} \subset B$ ✓

B. $\{\{\}\} \subset B$ ✓ $\{\phi\} \subset B$

C. $\{\{\}\} \in B$ ✓ $\{\phi\} \in B$

D. $\{\} \in B$ ✓ $\phi \in B$

$A = \{\} = \phi \longrightarrow n(A) = 0 \longrightarrow n(P(A)) = 2^0 = 1$

$P(A) = \{\phi\} \longrightarrow n(P(A)) = 1 \longrightarrow n(P(P(A))) = 2^1 = 2$

$P(P(A)) = \{\phi, \{\phi\}\}$

$P(P(P(A))) = \{\phi, \{\phi\}, \{\{\phi\}\}, \{\phi, \{\phi\}\}\} = B$

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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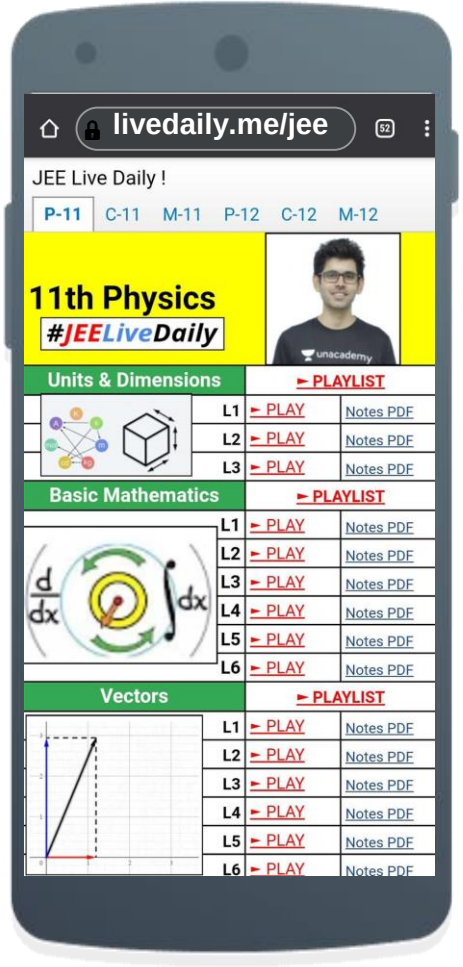

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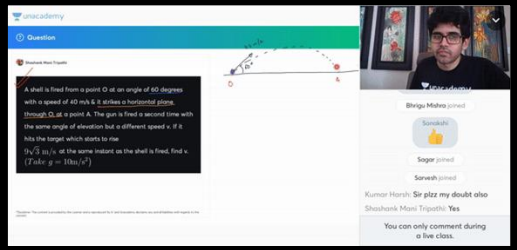

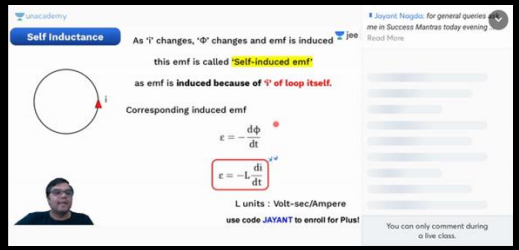

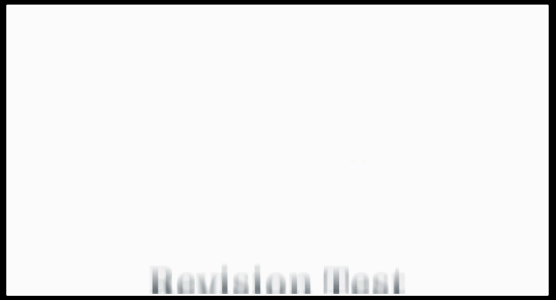

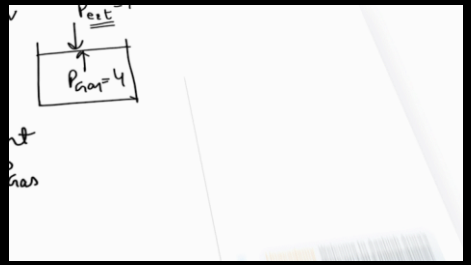

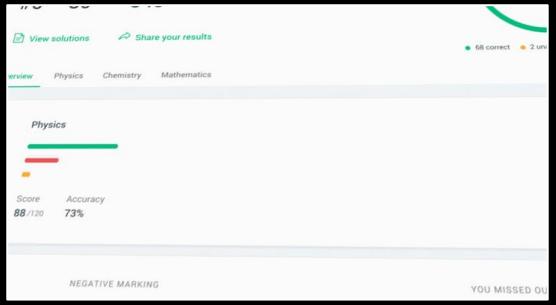

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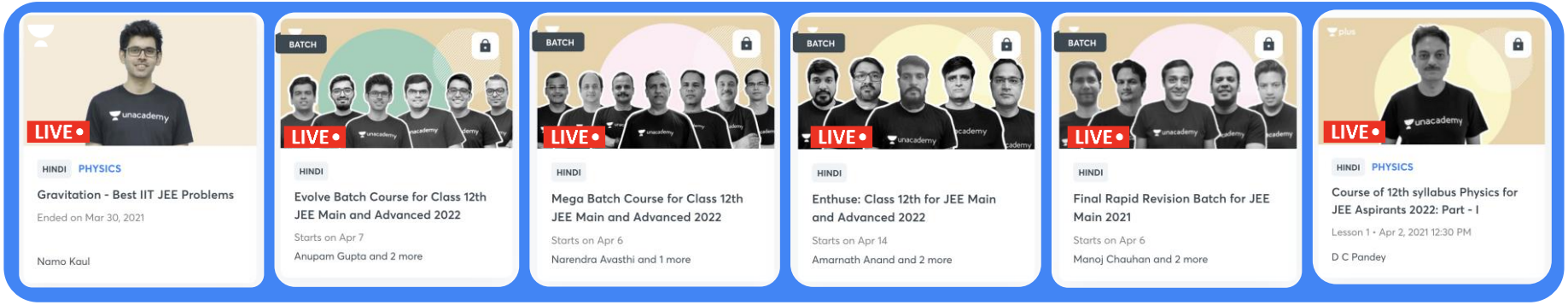

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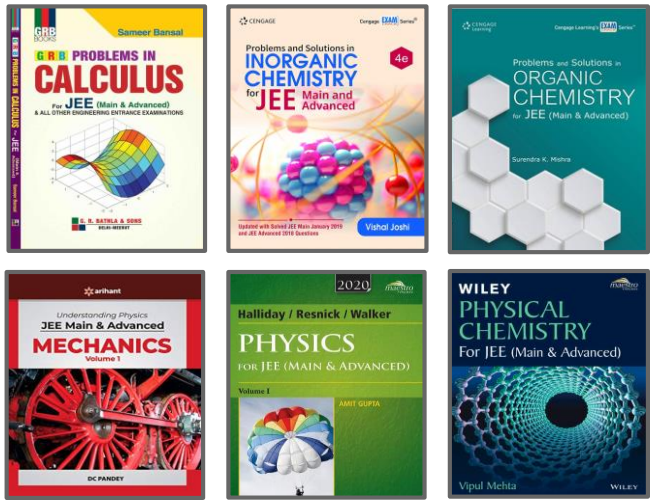

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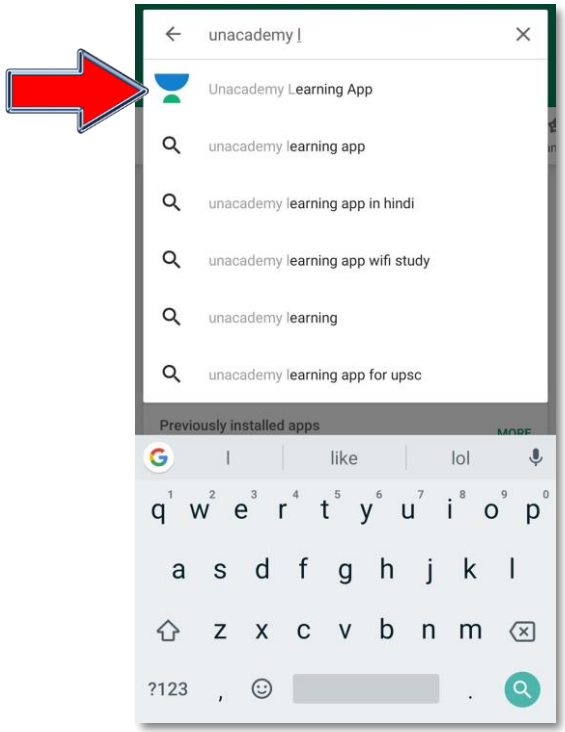
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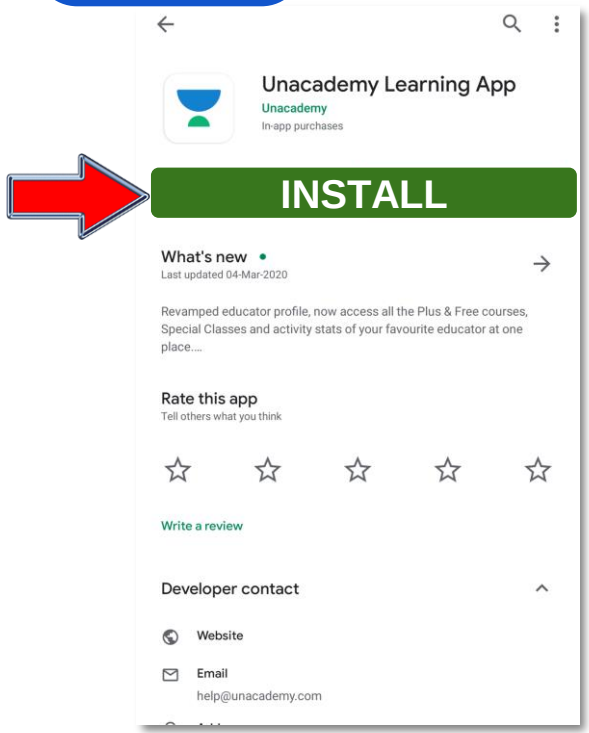
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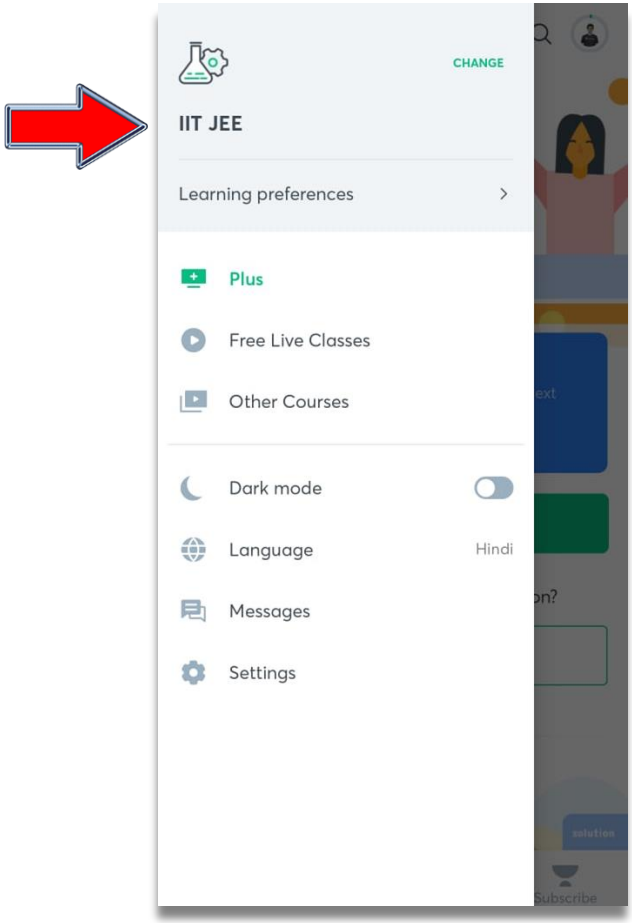
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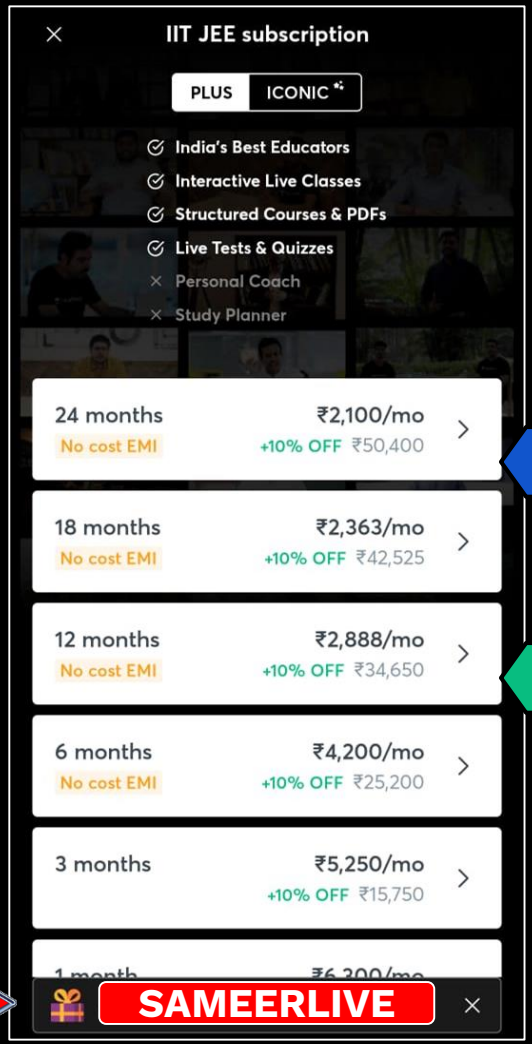

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