OTM – Only This Much
SET RELATION & FUNCTION

MATH, LR & STATS

CA FOUNDATION DEC 2023

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SESSION LINK:

https://www.youtube.com/live/5UJco6KW_j0?si=K1fXLfOqT0W7sB2F

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PAST TRENDS

Attempt	Marks
May 2018	3
Nov 2018	4
Jun 2019	5
Nov 2019	3
Nov 2020	4
Jan 2021	3
Jul 2021	4
Dec 2021	3
Jun 2022	5
Dec 2022	3
Jun 2023	5

Sets – Basics

<table>
<tr><td rowspan="1">Meaning</td><td colspan="2">• Object: In our mathematical language, everything in this universe, whether living or non-living, is called an object.
• Sets: Well defined And Distinct Collection of Objects
• Elements: Each object of Set</td></tr>
<tr><td>How to denote</td><td colspan="2">• Sets: Capital Letters
• Elements: Small Letter</td></tr>
<tr><td rowspan="3">Forms of Presentation</td><td>Descriptive Form</td><td>• when set is written in the form of Paragraph and elements are not listed
Examples:
• A = the set of vowels in the English alphabet
• B = the set of even numbers between 2 and 10 both inclusive
• P = the set of first six prime numbers</td></tr>
<tr><td>Roster Form</td><td>• when elements of sets are listed and closed with braces (curly brackets)</td></tr>
<tr><td>Set Builder/ Algebraic Form (only for numbers)</td><td>• Sets can also be presented using algebraic statements which can be understood by examples below.
• The method of writing the set is called as Property Method</td></tr>
<tr><td>Belongs to</td><td colspan="2">• an element 'a' which is part of Set A can be shown as $a \in A$
• If an element b is not part of Set A, then b do not belongs to A can be shown as $b \notin A$</td></tr>
<tr><td>Subset</td><td colspan="2">• if every element of Set A is also an element of Set B we say that A is a subset of B $A \subset B$
• we can say that B is a super set of A shown as $B \supset A$</td></tr>
</table>

Types of Subsets	• **Proper Subset:** When A is a subset of B and both sets **are not equal**, then A is a **proper** subset of B. • **Improper Subset:** When A is a subset of B and also B is a subset of A, then both are improper subsets of each other, and this is possible only when they are equal. $A \subseteq B$
Number of Subsets	• No. of possible subsets of any set = 2^n • No. of proper subsets of any set = $2^n - 1$
Equal Sets	• Two sets are equal if they have **exactly same** elements • **Order** of elements has **no relevance**
Null Set / Empty Set / Void Set	• A set which contains **no elements** • It is a proper subset of all sets • It has no proper subsets • Denoted by $\{\}$ or φ
Cardinal Number	• The number of distinct elements contained in a finite set A is called its cardinal number. • It is shown as **n(A)** **Example**: If A = {2, 5, 7, 9} then n(A) = 4
Equivalent Sets	• Two sets having same cardinal number are called as Equivalent Sets • If n(A) = n(B) then A and B are equivalent sets
Finite and Infinite Sets	• **Finite Set:** if set contains finite number of elements • **Infinite Set**: if set contains infinite number of elements where it is impossible to list all. (to show an infinite set in roster form, we use three dots after few elements)

PYQ Dec 22

If A = {1, 2, 3, 4, 5, 6, 7, 8, 9} and B = {2, 4, 6, 7, 9}, then how many proper subset of $A \cap B$ can be created?

a. 16 b. 15 c. 32 d. 31

Ans: d

PYQ Jun 19
PYQ May 18
PYQ Dec 22

The number of proper subsets of the set {3,4,5,6,7} is

a. 32 b. 31 c. 30 d. 25

Ans: b

PYQ Nov 20
PYQ Jun 22

Two finite sets respectively have x and y number of elements. The total number of subsets of the first is 56 more than the total number of subsets of the second. The value of x and y respectively is

a. 6 and 3 b. 4 and 2 c. 2 and 4 d. 3 and 6

Ans: a

PYQ Nov 20
PYQ Jan 21

The set of cubes of the natural number of is

a. null set b. a finite set
c. an infinite set d. a finite set of three numbers

Ans: c

Sets – Operations

Intersection Sets	• A new set that contains all the **common elements** between set A and set B is called as intersection set of set A and B. • It is denoted by $A \cap B$
Union Set	• A set that contains all the elements of Set A and Set B without repeating the common elements between them is called **Union Set** of A and B • It is denoted by $A \cup B$
Universal Set	• The set which contains all the elements under consideration in a particular problem is called the universal set denoted by S.
Complimentary Set	**Complimentary Set of P:** • It is a set that contains all the elements of universe other than P • It is denoted by P' or P^c
De-Morgan's Law	$(P \cap Q)' = P' \cup Q'$ **or** $(P \cup Q)' = P' \cap Q'$
Set A-B	It is a set that contains all the elements of A which are not common with B. A-B Set can also be called as **Only A**
Set B-A	It is a set that contains all the elements of B which are not common with A. B-A Set can also be called as **Only B**
Power Set	• The collection of all possible subsets of a given set A is called the power set of A. • It is denoted by **P(A)**
Cardinal Number	• Total number of elements in a set • Set A = {3, 6, 5, 7}, n(A) = 4

PYQ Nov 18

If $A = \{1,2,3,4,5,6,7\}$ and $B = \{2,4,6,8\}$. Cardinal Number of A – B is

a. 4 b. 3 c. 9 d. 7

Ans: a

PYQ Jun 19

If A = $\{1,2,3,4,5,6,7,8,9\}$, B = $\{1,3,4,5,7,8\}$, C = $\{2,6,8\}$ then find $(A - B) \cup C$

a. {2, 6} b. {2, 6, 8}
c. {2, 6, 8, 9} d. None of these

Ans: c

PYQ Jun 19

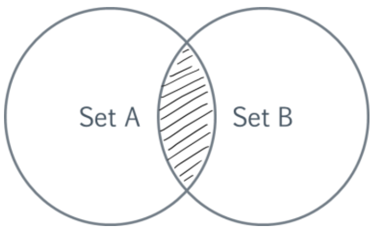
Let U be the universal set, A and B are the subsets of U. If n(U) = 650, n(A) = 310, $n(A \cap B)$ = 95 and n(B) = 190, then $n(\bar{A} \cap \bar{B})$ is equal to

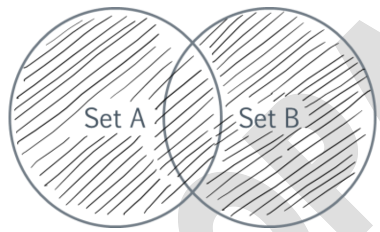
a. 400 b. 200
c. 300 d. 245

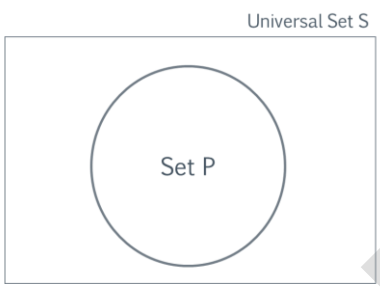
Ans: d

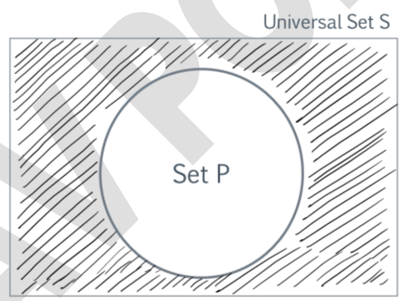
Venn Diagrams

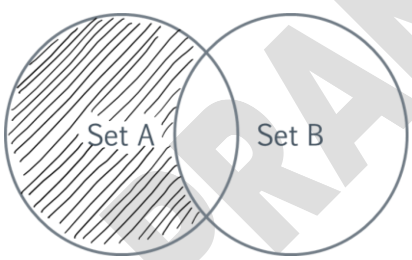
2 Sets Formula	$n(A\cup B)=n(A)+n(B)-n(A\cap B)$
3 Sets Formula	$n(A\cup B\cup C)=n(A)+n(B)+n(C)-n(A\cap B)$ $-n(B\cap C)-n(C\cap A)+n(A\cap B\cap C)$
Important Tip	Total Quantity given in the question may be taken as **Universal** or **Union** –will depend on data available in the question and situation.

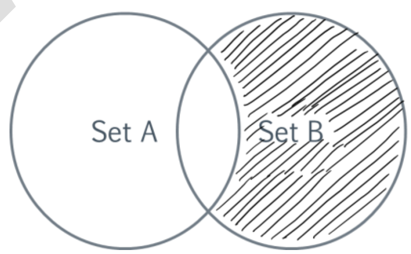












PYQ May 18 **PYQ Nov 20**	In a town of 20,000 families, it was found that 40% families buy newspaper A, 20% families buy newspaper B, 10% families buy newspaper C, 5% families buy A and B, 3% buy B and C and 4% buy A and C. If 2% families buy all the three newspapers, then the number of families which buy A only is: a. 6600 b. 6300 c. 5600 d. 600

Ans: a

PYQ Dec 21	Out of a group of 20 teachers in a school, 10 teach Mathematics, 9 teach Physics and 7 teach Chemistry. 4 teach Mathematics and Physics but none teach both Mathematics and Chemistry. How many teach Chemistry and Physics; how many teach only Physics? a. 2, 3 b. 3, 2 c. 4, 6 d. 6, 4

Ans: a

MTP Dec 22 Series 2

Out of total 150 students, 45 passed in Accounts, 30 in Economics and 50 in Maths, 30 in both Accounts and Maths, 32 in both Maths and Economics, 35 in both Accounts and Economics, 25 students passed in all the three subjects. Find the numbers who passed at least in any one of the subjects:

a. 63 b. 53

c. 73 d. None

Ans: b

Relations

Ordered Pair	Two elements a and b, listed in a **specific order**, form an ordered pair, denoted by **(a, b)**
Cartesian Product of Sets:	• If A and B are two non-empty sets, • then the set of all ordered pairs (a, b) such that a belongs to A and b belongs to B , is called the Cartesian product of A and B, denoted by A × B
How to Denote Product Set	$A \times B = \{(a,b) : a \in A, b \in B\}$
Why Product Set	$n(A \times B) = n(A) \times n(B)$
Relation Set	• Relation set from **A to B** is any **subset of product set** AxB • containing only those elements which **satisfy a given relation** between both the elements of ordered pair • Format: $R : A \to B = \{(a,b) : a \text{ is related to } b, a \in A, b \in B\}$
Types of Relations	**Reflexive**: If relation sets contains ordered pair in the form of **(a,a), (b,b)** and so on **Symmetric**: If relation set contains an ordered pair **(a,b) it must also contain (b,a)** **Transitive**: If relation set contains an ordered pair **(a,b) and (b,c) it must also contain (a,c)** **Equivalence**: If a relation is Reflexive, Symmetric and Transitive then it is called as **Equivalence**
Number of Relations between two sets	• 2^n where n = no. of elements in the product set

PYQ Nov 18

If A = {1,2} and B = {3,4}. Determine the number of relations from A and B:

a. 3 b. 16 c. 5 d. 6

Ans: b

PYQ Jun 19

If A = {1,2,3,4,…,10} a relation on A i.e. $R = \{(x,y) : x + y = 10, x \in A, y \in A, x \geq y\}$ then domain of R^{-1} is

a. {5, 4, 3, 2, 1} b. {0, 3, 5, 7, 9}

c. {1, 2, 4, 5, 6, 7} d. None

Ans: a

PYQ Jan 21

In the set of all straight lines on a plane which of the following is not TRUE?

a. "Parallel to" is an equivalence relation
b. "Perpendicular to" is a symmetric relation
c. "Perpendicular to" is an equivalence relation
d. "Parallel to" is a reflexive relation

Ans: c

PYQ Dec 21

If a is related to b if and only if the difference in a and b is an even integer. This relation is

a. Symmetric, reflexive but not transitive
b. Symmetric, transitive but not reflexive
c. Transitive, reflexive but not symmetric
d. Equivalence relation

Ans: d

PYQ Dec 22

Let A = (1,2,3) and consider the relation R =
Then R is: $\{(1,1),(2,2),(3,3),(1,2),(2,3),(1,3)\}$

a. Symmetric and transitive
b. Reflexive but not transitive
c. Reflexive but not symmetric
d. Neither symmetric, nor transitive

Ans: c

Functions

<table>
<tr><td>Function Set</td><td>Function Set:
It is a relation set with the condition that
No distinct ordered pairs of set have same first element</td></tr>
<tr><td>Denote a Function</td><td>if f is a function defined from Set A to Set B it is denoted as
$f : A \rightarrow B$</td></tr>
<tr><td>Check Function using Mapping</td><td><table><tr><th>Mapping</th><th>Considered as Function</th></tr><tr><td>One to One</td><td>Function</td></tr><tr><td>One to Many</td><td>Not a Function</td></tr><tr><td>Many to One</td><td>Function</td></tr></table></td></tr>
</table>

<table>
<tr><td>Terms Used in Function</td><td>If a function is defined from Set A to Set B i.e., $f : A \to B$
<table>
<tr><td>Domain</td><td>Set A = First Set = Set from where first elements (inputs) of ordered pair are taken</td></tr>
<tr><td>Codomain of Function</td><td>Set B = Second Set = Set from where second elements (outputs) are taken</td></tr>
<tr><td>Range of Function</td><td>Set of those elements of Codomain which are part of Function Set. It is a subset of Codomain. It may or may not be equal to Codomain.</td></tr>
<tr><td>Preimage</td><td>Input or First element in an ordered pair of Function Set</td></tr>
<tr><td>Image</td><td>Output or Second element in an ordered pair of Function Set</td></tr>
</table></td></tr>
<tr><td>Types of Function – Based on Mapping</td><td>
<table>
<tr><td>One-One Function (Injective)</td><td>• Let $f : A \to B$, if different elements in A have different images in B, then f is said to be a one-one
• Also called as injective function or mapping.</td></tr>
<tr><td>Many-One Function</td><td>• Let $f : A \to B$, if two or more elements in A have common image in B, then f is said to be many-one</td></tr>
</table></td></tr>
<tr><td>Types of Function – Based on Range</td><td>
<table>
<tr><td>Onto Function (Surjective)</td><td>• Let $f : A \to B$, if every element in B has at least one pre-image in A, then f is said to be an onto function.
• Also called as Surjective Function
• In an onto function, Range = Codomain</td></tr>
<tr><td>Into Function</td><td>• Let $f : A \to B$, If even one element in B codomain is not having any pre-image in A, then f is said to be an into function.
• In other words, if even one is single in Codomain Set
• In an onto function, $\text{Range} \subset \text{Codomain}$</td></tr>
</table></td></tr>
<tr><td>Bijection Function</td><td>• A one-one and onto function is said to be bijective.
• It is also called as one-to-one correspondence.
Injective + Surjective = Bijective</td></tr>
<tr><td>Identity Function</td><td>• Identical = Same
• If in a function set values of preimage and image are same for all ordered pairs.</td></tr>
<tr><td>Constant Function</td><td>• If in a function the value of image remains constant for any value of preimage</td></tr>
<tr><td>Equal Functions</td><td>• Two functions f and g are said to be equal, written as $f = g$
• if they have the same domain and they satisfy the condition $f(x) = g(x)$, for all x.</td></tr>
<tr><td>Composition of Functions</td><td>• $fog = fog(x) = f[g(x)]$
• $gof = gof(x) = g[f(x)]$</td></tr>
</table>

Inverse Functions	• In a function a set of preimages when used as input gives us images, now to obtain such a function which can be used in reverse way i.e., using image values as input and gives pre-images as output.
Steps to obtain inverse of a function	1. Write your function in the form of y: $y=f(x)$ 2. From above expression, find the value of x: $x=\square$ 3. Interchange value of x and y: $y=\square$, now the RHS is inverse function of $f(x)$

PYQ Nov 18
PYQ Jun 19

Identify which of the below is a function

a. $\{(1,1),(1,2),(1,3)\}$
b. $\{(1,1),(2,1),(2,3)\}$
c. $\{(1,2),(2,2),(3,2),(4,2)\}$
d. None of these

Ans: c

PYQ May 18

Let N be the set of all natural numbers; E be the set of all even natural numbers then the function; $f:N\to E$ defined as $f(x)=2x$ where $x\in N$ is _______ function.

a. One-One and Into
b. Many-One and Into
c. One-One and Onto
d. Many-One and Onto

Ans: c

PYQ Nov 18

A is {1,2,3,4} and B is {1,4,9,16,25} if a function f is defined from set A to B where $f(x)=x^2$ then the range of f is

a. {1, 2, 3, 4}
b. {1, 4, 9, 16}
c. {1, 4, 9, 16, 25}
d. None

Ans: b

PYQ Jun 19

If $f(x)=x^2$ and $g(x)=\sqrt{x}$ then

a. $gof(3)=3$
b. $gof(-3)=9$
c. $gof(9)=3$
d. $gof(-9)=3$

Ans: a

PYQ Nov 19

$f(n)=f(n-1)+f(n-2)$ when n = 2, 3, 4... f (0) = 0, f (1) = 1 then f (7)

a. 3
b. 5
c. 8
d. 13

Ans: d

PYQ Nov 19

$f(x)=\frac{x+1}{x}$ find $f^{-1}(x)$

a. $\frac{1}{x-1}$
b. $\frac{1}{y-1}$
c. $\frac{1}{y}-1$
d. x

Ans: a

PYQ Nov 20

The inverse function f^{-1} of f(y) = 3y is:

a. 1/3y
b. y/3
c. -3y
d. 1/y

Ans: b

PYQ Jan 21

Let F : R be defined by

$$f(x)=\begin{cases} 2x\_for\_x>3 \\ x^2\_for\_1<x\leq 3 \\ 3x\_for\_x\leq 1 \end{cases}$$

The value of f(-1) + f(2) + f(4) is

a. 9
b. 14
c. 5
d. 6

Ans: a