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CAT Set Theory And Venn Diagrams Formulas

- It's one of the easiest topics of CAT. Most of the formulae in this section can be deduced logically with little effort.
- The difficult part of the problem is translating the sentences into areas of the Venn diagram. While solving, pay careful attention to phrases like 'and, or, not, only, in' as these generally signify the relationship.
- Set is defined as a collection of well-defined objects.
Ex. Set of whole numbers.
- Every object is called an element of the set.
- The number of elements in the set is called cardinal number.

Types of Sets

→ Null Sets:

A set with zero or no elements is called a Null set.

It is denoted by $\{ \}$ or \emptyset . Null set cardinal number is 0.

→ Singleton Sets:

Sets with only one element in them are called singleton sets. Ex. $\{2\}$, $\{a\}$, $\{0\}$

→ Finite and Infinite Sets:

A set having a finite number of elements is called a finite set. A set having infinite or uncountable elements in it is called an infinite set.

→ Universal Sets:

A set which contains all the elements of all the sets and all the other sets in it, is called a universal set.

**→ Subsets:**

A set is said to be a subset of another set if all the elements contained in it are also part of another set.

Ex. If $A = \{1,2\}$, $B = \{1,2,3,4\}$ then, Set “A” is said to be a subset of set B.

→ Equal Sets:

Two sets are said to be equal sets when they contain the same elements Ex. $A = \{a,b,c\}$ and $B = \{a,b,c\}$ then A and B are called equal sets.

→ Disjoint Sets:

When two sets have no elements in common then the two sets are called disjoint sets.

Ex. $A = \{1,2,3\}$ and $B = \{6,8,9\}$ then A and B are disjoint sets.

→ Power Sets:

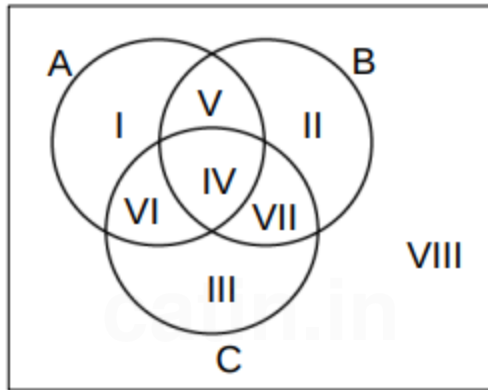
- A power set is defined as the collection of all the subsets of a set and is denoted by $P(A)$
- If $A = \{a, b\}$ then $P(A) = \{ \{ \}, \{a\}, \{b\}, \{a, b\} \}$
- For a set having n elements, the number of subsets are 2^n

→ Properties of Sets:

- The null set is a subset of all sets
- Every set is subset of itself
- $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
- $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
- $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
- $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
- $A \cup \emptyset = A$

→ Venn Diagrams:

A Venn diagram is a figure to represent various sets and their relationship.



I,II,III are the elements in only A, only B & only C resp.

IV – Elements which are in all of A, B and C.

V – Elements which are in A and B but not in C.

VI – Elements which are in A and C but not in B.

VII – Elements which are in B and C but not in A.

VIII – Elements which are not in either A or B or C.

→ Union of sets is defined as the collection of elements either in A or B or both. It is represented by the symbol “U”. Intersection of set is the collection of elements which are in both A and B.

→ Let there are two sets A and B then,

$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

→ If there are 3 sets A, B and C then,

$$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$$

→ To maximise overlap,

→ Union should be as small as possible

→ Calculate the surplus = $n(A) + n(B) + n(C) - n(A \cup B \cup C)$

→ This can be attributed to $n(A \cap B \cap C')$, $n(A \cap B' \cap C)$, $n(A' \cap B \cap C)$, $n(A \cap B \cap C)$.

→ To maximise the overlap, set the other three terms to zero.

→ To minimise overlap:

→ Union should be as large as possible.

→ Calculate the surplus =

$$n(A) + n(B) + n(C) - n(A \cup B \cup C).$$

→ This can be attributed to $n(A \cap B \cap C')$, $n(A \cap B' \cap C)$, $n(A' \cap B \cap C)$, $n(A \cap B \cap C)$.

→ To minimise the overlap, set the other three terms to maximum possible.

→ Some other important properties

→ A' is called complement of set A , or $A' = U - A$

→ $n(A - B) = n(A) - n(A \cap B)$

→ $A - B = A \cap B'$

→ $B - A = A' \cap B$

→ $(A - B) \cup B = A \cup B$
