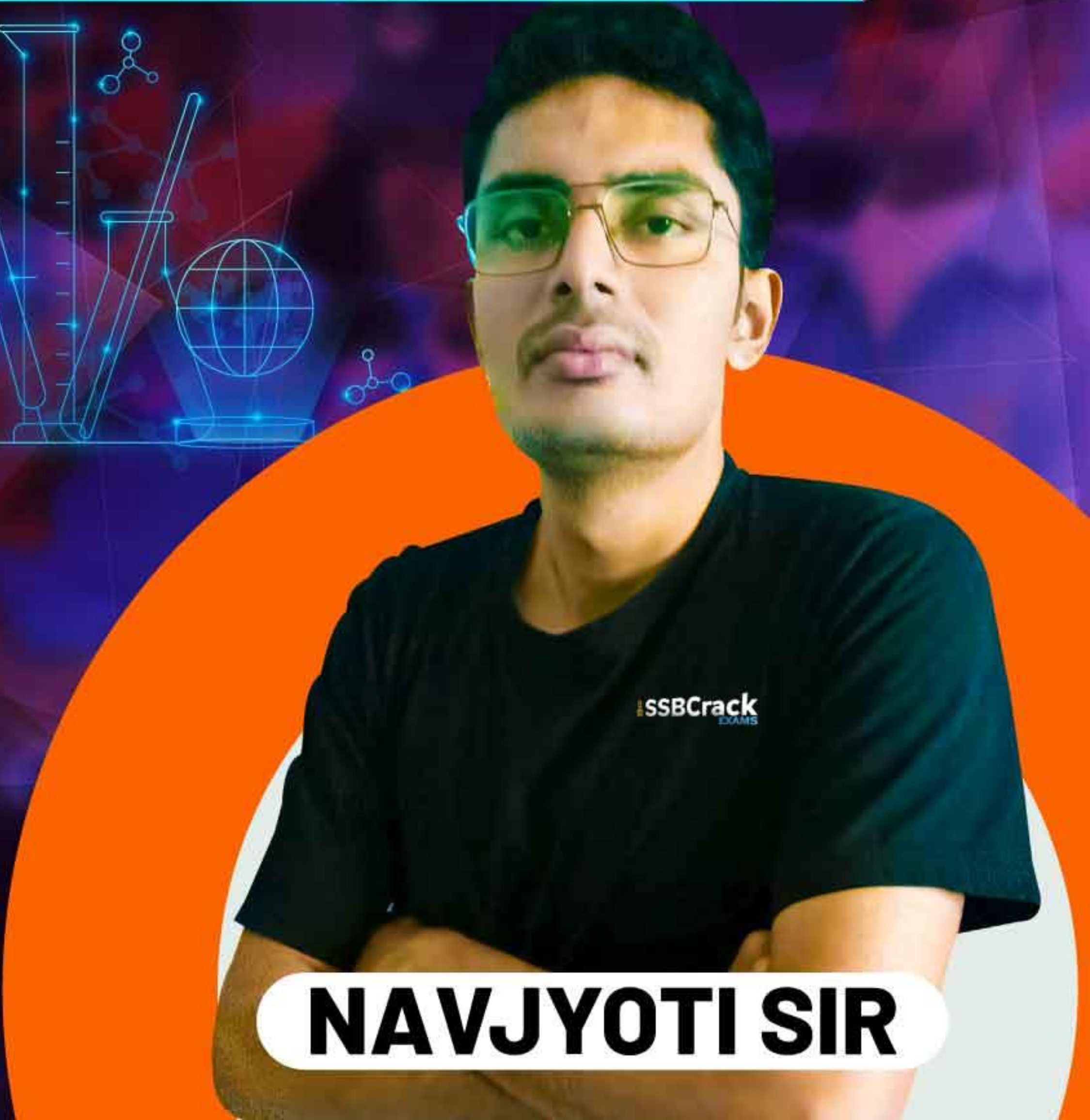
# CDS-AFCAT 2 2024

LIVE

# MATHS

## SET THEORY




NAVJYOTI SIR

# 24 June 2024 Live Classes Schedule

| | | |
|---|---|---|
| 8:00AM | 24 JUNE 2024 DAILY CURRENT AFFAIRS | RUBY MA'AM |
| 9:00AM | 24 JUNE 2024 DAILY DEFENCE UPDATES | DIVYANSHU SIR |

## SSB INTERVIEW LIVE CLASSES

| | | |
|---|---|---|
| 9:00AM | MOCK PERSONAL INTERVIEW | ANURADHA MA'AM |

## AFCAT 2 2024 LIVE CLASSES

| | | |
|---|---|---|
| 2:30PM | STATIC GK - IMPORTANT STRAITS & INTERNATIONAL BORDERS | DIVYANSHU SIR |
| 4:00PM | MATHS - SET THEORY | NAVJYOTI SIR |
| 5:30PM | ENGLISH - WORD SUBSTITUTION - CLASS 2 | ANURADHA MA'AM |

## NDA 2 2024 LIVE CLASSES

| | | |
|---|---|---|
| 11:30AM | GK - ANCIENT HISTORY - CLASS 3 | RUBY MA'AM |
| 2:30PM | GS - CHEMISTRY MCQS - CLASS 1 | SHIVANGI MA'AM |
| 6:30PM | MATHS - DIFFERENTIATION - CLASS 2 | NAVJYOTI SIR |

## CDS 2 2024 LIVE CLASSES

| | | |
|---|---|---|
| 11:30AM | GK - ANCIENT HISTORY - CLASS 3 | RUBY MA'AM |
| 2:30PM | GS - CHEMISTRY MCQS - CLASS 1 | SHIVANGI MA'AM |
| 4:00PM | MATHS - SET THEORY | NAVJYOTI SIR |

# SETS

→ collection

→ specific (same for everyone)

→ represented by capital letter (A – Z).

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

elements

$B = \{a, e, i, o, u\}$

curly brackets at start and end.

Following collections are sets

(i) The collection of all positive integers.

(ii) The collection of all capitals of states of India.

# ELEMENTS

set name = {(element1), (element2), (element3) ..}

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

1 is an element of A.

$1 \in A$

(belongs to)

$5 \notin A$

$B = \{1, 2, \boxed{\{3, 4\}}, 5, 6\}$

$5 \in B$

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

$3 \notin B$

$4 \notin B$

# REPRESENTATION OF SETS

(2) Set-builder $\{x : \text{property}(x)\}$

(1) Roster / List

$A = \{$set of all vowels of English alphabet$\}$

✓ $A = \{a, e, i, o, u\}$

✓ $B = \{2, 4, 6, 8 \ldots\}$

$B = \{x : x = 2n \text{ and } n \in N\}$

✓ $C = \{7, 49, 343\}$

$C = \{x : x = 7^n \text{ where } 1 \leq n \leq 3 ; n \in N\}$

N – set of all natural nos.

Z – integers

Q – rational nos.

R – real nos.

Z+ – set of all positive integers.

# REPRESENTATION OF SETS



$$\left(\frac{Nr}{Nr+1}\right)$$

$$A = \left\{ \frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \frac{5}{6} \right\}$$ (roster)

$$B = \left\{ x : x = \frac{n}{n+1} ; 1 \leq n < 7, n \in N \right\}$$

SSBCrack EXAMS

# TYPES OF SETS

$\{\ \} = \phi$

(i) **Empty set** A set consisting of no element is called an empty set or null set or void set and is denoted by symbol $\phi$ or $\{\}$.

*e.g.*, $A = \{x : x \in N \text{ and } 3 < x < 4\} = \phi$. $= \{\ \}$

A set which is not empty is called non-empty set or non-void set.

$\{\ \} \longrightarrow$ empty set

(ii) **Singleton set** A set consisting of only one element is called a singleton set.

*e.g.*, $\{2\}, \{0\}, \{\phi\}$

$\{0\}, \{\phi\} \neq \{\ \}$

non-empty sets

- The set $\{0\}$ is not an empty set as it contains one element 0. ✓
- The set $\{\phi\}$ is not an empty set as it contains one element $\phi$.

SSBCrack EXAMS

# TYPES OF SETS

(iii) **Finite set** A set having finite number of elements is called finite set.
*e.g.*, $A = \{1, 2, 3\}$ is a finite set.

(iv) **Infinite set** A set which is not finite is called an infinite set.
*e.g.*, $A =$ Set of points lie in a plane is an infinite set.

$S = \{0, 1, 2, 3, 4 \ldots\}$

(v) **Cardinal number of a finite set** The number of elements of a finite set $A$ is called its cardinal number and it is denoted by $n(A)$ or $o(A)$.

$A = \{4, 5, 6, 7\}$

$n(A) = 4$

(vi) **Equivalent sets** Two finite sets $A$ and $B$ are said to be equivalent if they have the same cardinal number. Thus, sets $A$ and $B$ are equivalent if $n(A) = n(B)$.

# TYPES OF SETS

## Subset and Superset

$A = \{4, 7, 8, 10, 11\}$

$B = \{7, 8\}$

All elements of B are in A.

B → Subset

A → Superset (elements other than common between them also)

$\boxed{B \subset A}$ (B is a subset of A)

→ Every set is a subset of itself.

SSBCrack EXAMS

# TYPES OF SETS

## Proper and Improper Subset

$B = \{3, 2, 1\}$ | $n$ (no. of elements) → $n(A) = 3$

no. of subsets $= 2^n$

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

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

no. of proper subsets : $2^n - 1$

where $n$ is the number of elements / cardinality of given set.

# TYPES OF SETS

## Equivalent and Equal Sets

$A = \{2, 3, 5, 9\}$ 4

$B = \{4, 7, 6, 3\}$ 4

no. of elements in A = no. of elements in B = 4 → (Equivalent set)

Equal sets

$A = \{2, 3, 5, 9\}$

$C = \{2, 3, 5, 9\}$

$C = \{3, 2, 5, 9\}$

$C = \{3, 9, 5, 2\}$

order does not matter

$\{4, 8, 10\} = \{8, 4, 10\}$

$\Rightarrow$ A and C are equal sets.

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# TYPES OF SETS

## Power Set

$A = \{1, 2\}$

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

$n(P(A)) =$ no. of subsets of $A$

$= 2^n$ where

$A$ has '$n$' number of elements.

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

$= \{\phi, \{1\}, \{2\}, \{1, 2\}\}$

# TYPES OF SETS

## Universal Set (U)

$A = \{1, 2, 3\}$ , $B = \{4, 6, 9\}$ , $C = \{8, 7, 4\}$

$D = \{1, 2, 3, 4, 6, 7, 8, 9\}$

A, B & C are subsets of D.

D is a universal set (superset of all sets given in a particular question/situation)

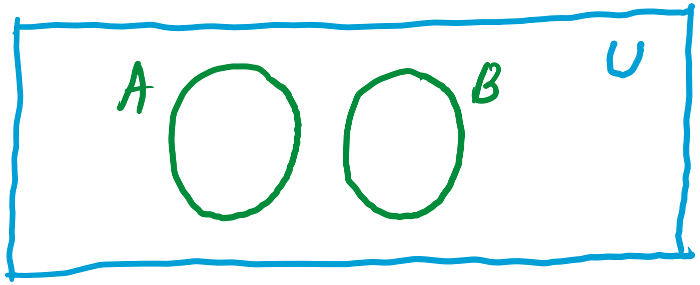
$N$ , $Z$ , $Q$

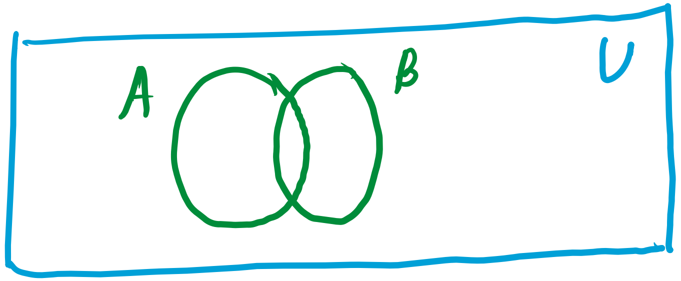
Universal set $\longrightarrow$ $R$ – set of all real numbers,

$(U = R)$

# VENN DIAGRAM





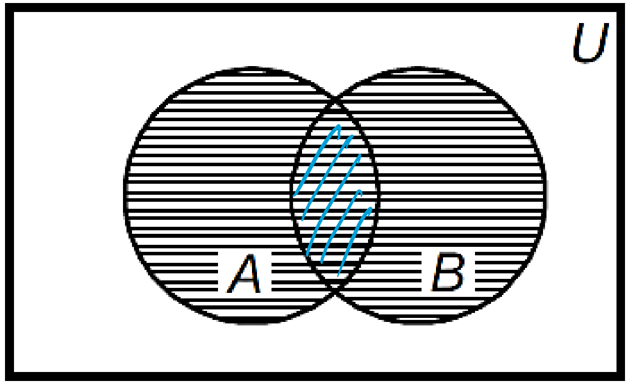




rectangle — universal set (U)

sets for which U is superset, — circle

# OPERATIONS ON SETS

(i) **Union of sets** Let $A$ and $B$ are two sets, then union of $A$ and $B$ is denoted by $A \cup B$ and it consists of each one of which is either in $A$ or in $B$ or in both $A$ and $B$.




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

$B = \{2, 3, 8\}$

$A \cup B = \{1, 2, 3, 8\}$

Thus, $A \cup B = \{x : x \in A \text{ or } x \in B\}$

Clearly, $x \in A \cup B \Leftrightarrow x \in A \text{ or } x \in B$

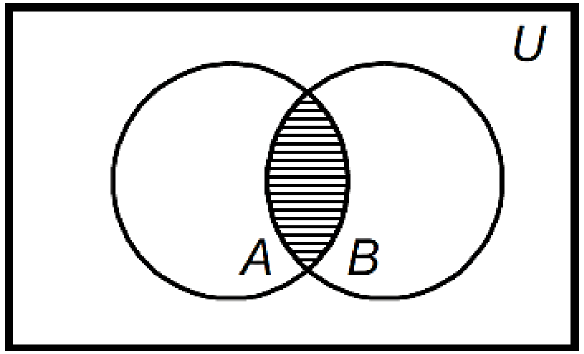
and $x \notin A \cup B \Leftrightarrow x \notin A \text{ and } x \notin B$

In the figure, the shaded part represents $A \cup B$.

It is evident that $A \subseteq A \cup B$, $B \subseteq A \cup B$.

# OPERATIONS ON SETS

(ii) **Intersection of sets** The intersection of two sets $A$ and $B$, denoted by $A \cap B$ is the set of all elements, common to both $A$ and $B$.




Thus, $A \cap B = \{x : x \in A \text{ and } x \in B\}$

Clearly, $x \in A \cap B \Leftrightarrow x \in A \text{ and } x \in B$

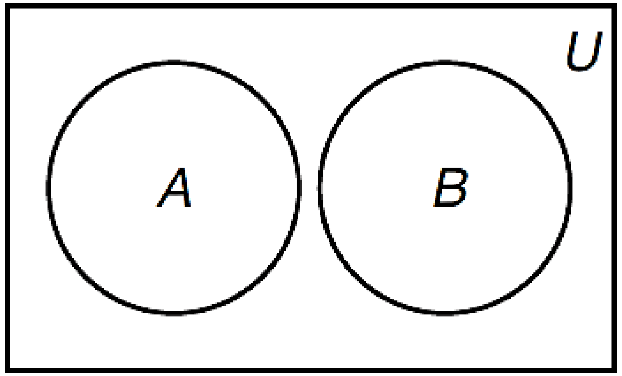
and $x \notin A \cap B \Leftrightarrow x \notin A \text{ or } x \notin B$

In the figure, the shaded part represents $A \cap B$.

It is evident that $A \cap B \subseteq A$, $A \cap B \subseteq B$.

# OPERATIONS ON SETS

(iii) **Disjoint sets** Two sets $A$ and $B$ are said to be disjoint sets, if they have no common element i.e., $A \cap B = \phi$.




The disjoint sets can be represented by Venn diagram as shown in the figure

e.g., let $A = \{1, 2, 3\}$ and $B = \{4, 6\}$

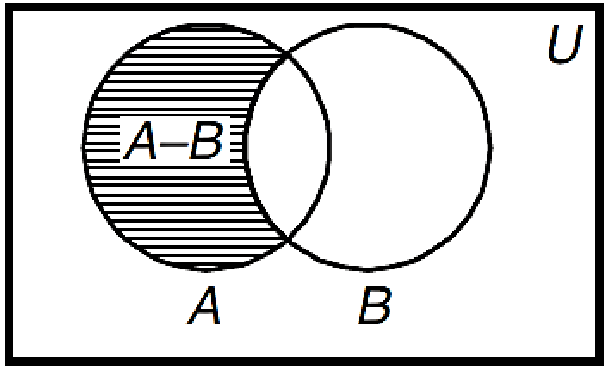
Here, $A$ and $B$ are disjoint sets because $A \cap B = \phi$ .

$$\boxed{A \cap B = \{\ \} = \phi}$$

SSBCrack EXAMS

# OPERATIONS ON SETS

(iv) **Difference of sets** If $A$ and $B$ are two sets, then their difference $A - B$ is the set of all those elements of $A$ which do not belong to $B$.

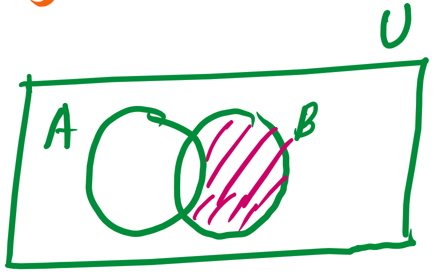



$A = \{2, 4, 7, 6, 8\}$

$B = \{4, 7, 9, 3\}$

$A - B = \{2, 6, 8\}$

$B - A = \{9, 3\}$




Thus, $A - B = \{x : x \in A \text{ and } x \notin B\}$

Clearly, $x \in A - B \Leftrightarrow x \in A \text{ and } x \notin B$.

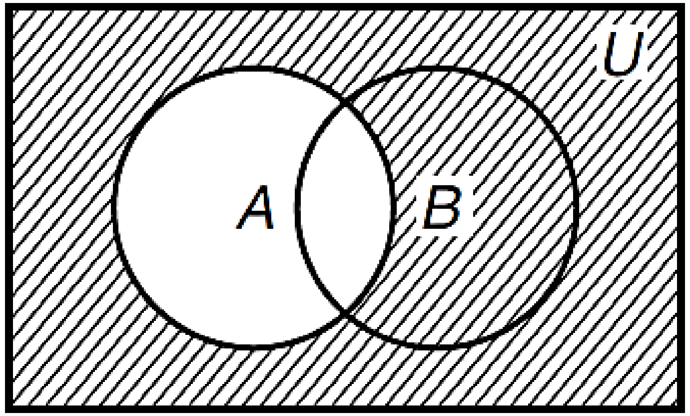
In the figure, the shaded part represents $A - B$.

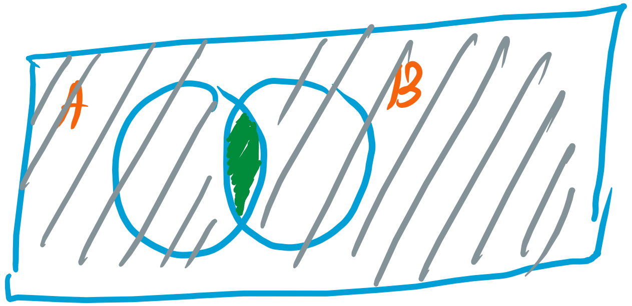
$A - B = A - (A \cap B)$ | $B - A = B - (A \cap B)$

# COMPLEMENT OF SETS



If $U$ is a universal set and $A \subset U$, then complement set of $A$ is denoted by $A'$ or $U - A$.




$(A \cap B)'$

Thus, $A' = U - A = \{x : x \in U, \text{but } x \notin A\}$

It is clear that $x \in A' \Leftrightarrow x \notin A$

- $\phi = U'$
- $\phi' = U$
- $(A')' = A$
- $A \cup A' = U$
- $A \cap A' = \phi$

De-Morgan's laws :

i) $(A \cup B)' = A' \cap B'$

ii) $(A \cap B)' = A' \cup B'$

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

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

**Q)** Which one of the following is a null set ?

(a) $\{0\}$ ✗

(b) $\{\{\{\}\}\}$ ✗

(c) $\{\{\}\}$ ✗

$\{\phi\}$

(d) $\{x \mid x^2 + 1 = 0, x \in R\}$ $= \{\ \} = \phi$ (null set)

$x^2 + 1 = 0$

$x^2 = -1$ | $\underline{x = i} = \sqrt{-1}$

**Q)** Which one of the following is a null set ?

(a) $\{0\}$

(b) $\{\{\{\}\}\}$

(c) $\{\{\}\}$

(d) $\{x \mid x^2 + 1 = 0, x \in R\}$

**Ans: (d)**

**Q)** The set $\{2, 4, 16, 256, \ldots\}$ can be represented as which one of the following?

(a) $\left\{x \in N \mid x = 2^{2^n},\ n \in N\right\}$

(b) $\left\{x \in N \mid x = 2^{2^n},\ n = 0, 1, 2, \ldots\right\}$

(c) $\left\{x \in N \mid x = 2^{4n},\ n = 0, 1, 2, \ldots\right\}$

(d) $\left\{x \in N \mid x = 2^{2n},\ n = 0, 1, 2, \ldots\right\}$

**Q)** The set {2, 4, 16, 256, ...} can be represented as which one of the following?

(a) $\left\{x \in N \mid x = 2^{2^n},\ n \in N\right\}$

(b) $\left\{x \in N \mid x = 2^{2^n},\ n = 0, 1, 2, \ldots\right\}$

(c) $\left\{x \in N \mid x = 2^{4n},\ n = 0, 1, 2, \ldots\right\}$

(d) $\left\{x \in N \mid x = 2^{2n},\ n = 0, 1, 2, \ldots\right\}$

**Ans: (b)**

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Q) If $A = \{a, b, c\}$, then what is the number of proper subsets of A?

(a) 5 (b) 6 (c) 7 (d) 8

no. of proper subsets $= 2^n - 1$

$= 2^3 - 1 = 7$

**Q)** If $A = \{a, b, c\}$, then what is the number of proper subsets of A?

(a) 5 (b) 6 (c) 7 (d) 8

**Ans: (c)**

**Q)** Let A= {x : x is a square of a natural number and x is less than 100} and B is a set of even natural numbers. What is the cardinality of $A \cap B$?

(a) 4 (b) 5

(c) 9 (d) None of the above

$A = \{1, 4, 9, 16, 25, 36, 49, 64, 81\}$

$A \cap B = \{4, 16, 36, 64\}$

cardinality means no. of elements.

**Q)** Let A= {x : x is a square of a natural number and x is less than 100} and B is a set of even natural numbers. What is the cardinality of $A \cap B$?

(a) 4 (b) 5

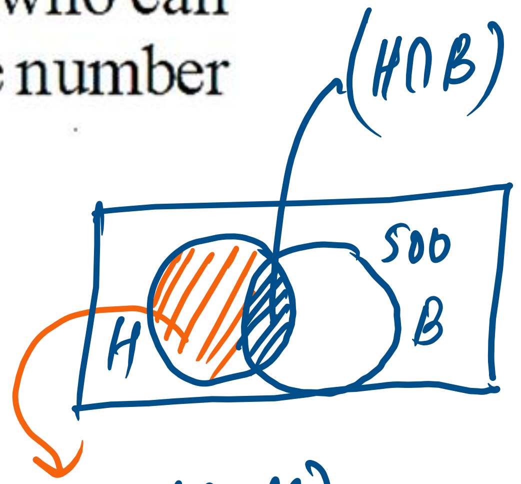
(c) 9 (d) None of the above

**Ans: (a)**

**Q)** In a group of 500 students, there are 475 students who can speak Hindi and 200 can speak Bengali. What is the number of students who can speak Hindi only ?

(a) 275 (b) 300

(c) 325 (d) 350




$$500 = 475 + 200 - n(H \cap B)$$

$$\underline{n(H \cap B)} = 675 - 500$$

$$= 175$$

$$n(\text{only hindi})$$

$$= n(\text{Hindi}) - n(H \cap B)$$

$$= 475 - 175$$

$$= 300$$

Q) In a group of 500 students, there are 475 students who can speak Hindi and 200 can speak Bengali. What is the number of students who can speak Hindi only ?

(a) 275 (b) 300

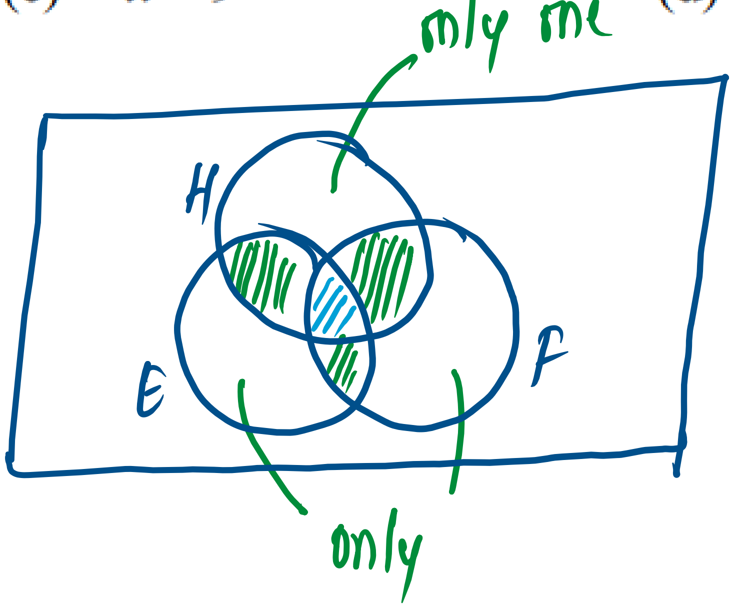
(c) 325 (d) 350

Ans: (b)

**Q)** In a gathering of 100 people, 70 of them can speak Hindi, 60 can speak English and 30 can speak French Further, 30 of them can speak both Hindi and English. 20 can speak both Hindi and French. If $x$ is the number of people who can speak both English and French, then which one of the following is correct? (Assume that everyone can speak at least one of the three languages) **[2016-I]**

(a) $9 < x \leq 30$ (b) $0 \leq x < 8$

(c) $x = 9$ (d) $x = 8$




$n(H \cup E \cup F) = 100$

$n(H) = 70$ $n(E) = 60$

$n(F) = 30$

$n(H \cap E) = 30$ (//// + ///)

$n(H \cap F) = 20$ (//// + ////)

$n(E \cap F) = x = ?$

/// — two

/// — all three

Use, $n(H \cup E \cup F) = n(H) + n(E) + n(F) + \ldots - n(H \cap F \cap E)$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