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CHAPTER NOTES

Sets Class 11 Notes | CBSE Maths Chapter 1

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Sets Class 11 Notes | CBSE Maths Chapter 1

Sets is Chapter 1 of CBSE Class 11 Maths — and it is the quiet workhorse of your entire higher-mathematics journey. A set is simply a well-defined collection of objects, and once you can write, compare, and combine sets, you unlock relations, functions, probability, and almost every topic that follows. Get comfortable here and the rest of Class 11 Maths feels far less intimidating.

By the end of these notes you will be able to represent any set in roster and set-builder form, classify sets, work with subsets and the power set, draw and read Venn diagrams, perform every operation (union, intersection, difference, complement), apply De Morgan's laws, and solve practical cardinality problems on two and three sets. This is a foundational, scoring chapter carrying roughly 5–6 marks in boards and is the launchpad for Relations and Functions.

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Key Concepts

1. Set and Its Representation

A **set** is a well-defined collection of distinct objects. "Well-defined" means there is a clear rule to decide whether an object belongs to the set or not — "the collection of tall students" is not a set (tall is vague), but "the collection of students taller than 6 ft" is.

The objects in a set are called its **elements** or **members**. Sets are denoted by capital letters (A, B, C) and elements by small letters (a, b, c).

Belongs To

- If a is an element of set A , we write $a \in A$ (read "a belongs to A").
- If a is not an element of A , we write $a \notin A$ (read "a does not belong to A").

Two Ways to Represent a Set

- **Roster (Tabular) form:** list all elements inside braces, separated by commas, e.g. $A = \{1, 2, 3, 4, 5\}$. Order does not matter and elements are never repeated.
- **Set-builder form:** state the common property of the elements, e.g. $A = \{x : x \text{ is a natural number and } x < 6\}$.

Some standard sets: **N** (natural numbers), **W** (whole numbers), **Z** (integers), **Q** (rationals), **R** (real numbers).

2. Types of Sets

Classifying a set by how many elements it has — and how it relates to others — makes the operations later much easier.

Empty (Null) Set

A set with no elements is the **empty set**, written $\emptyset$ or $\{\}$. Example: $\{x : x \text{ is a natural number and } x < 1\} = \emptyset$.

Singleton Set

A set with exactly one element, e.g. $\{0\}$ or $\{x : x + 5 = 8\} = \{3\}$.

Finite and Infinite Sets

- **Finite set:** the counting of elements comes to an end, e.g. the days of the week.
- **Infinite set:** the counting never ends, e.g. $N = \{1, 2, 3, \dots\}$.

Equal Sets

Two sets A and B are **equal** ($A = B$) if they have exactly the same elements. $\{1, 2, 3\} = \{3, 2, 1\}$ because order and repetition do not matter.

Equivalent Sets

Two finite sets are **equivalent** if they have the same number of elements (same cardinal number), even if the elements themselves differ.

3. Subsets, Supersets and Intervals

A set A is a **subset** of B (written $A \subseteq B$) if every element of A is also in B. Then B is a **superset** of A ($B \supseteq A$).

- Every set is a subset of itself: $A \subseteq A$.
- The empty set is a subset of every set: $\emptyset \subseteq A$.
- **Proper subset ($A \subset B$):** $A \subseteq B$ but $A \neq B$ (B has at least one extra element).
- If $A \subseteq B$ and $B \subseteq A$, then $A = B$.

Intervals as Subsets of R

- **Open interval (a, b):** $\{x : a < x < b\}$ — endpoints excluded.
 - **Closed interval [a, b]:** $\{x : a \leq x \leq b\}$ — endpoints included.
 - **Half-open:** $[a, b)$ and $(a, b]$.
-

4. Power Set

The **power set** of A , written $P(A)$, is the set of all subsets of A (including $\emptyset$ and A itself).

If $n(A) = m$, then $n[P(A)] = 2^m$

Example: $A = \{1, 2\}$. Then $P(A) = \{\emptyset, \{1\}, \{2\}, \{1, 2\}\}$, which has $2^2 = 4$ subsets. The number of *proper* subsets is $2^m - 1$.

5. Universal Set

The **universal set** U is the set that contains all the objects under consideration in a particular discussion; every other set is then a subset of U .

For example, while studying sets of integers we may take $U = \mathbb{Z}$. The choice of universal set depends entirely on the context of the problem.

6. Venn Diagrams

Venn diagrams are pictures that show the relationships between sets. The universal set U is drawn as a rectangle and the individual sets as circles inside it.

[DIAGRAM: A rectangle labelled U containing two overlapping circles A and B ; the overlap region represents $A \cap B$, while the whole shaded region of both circles represents $A \cup B$.]

Venn diagrams make union, intersection, difference, and complement instantly visible, and they are the fastest way to verify set identities and cardinality problems.

7. Operations on Sets

From two (or more) sets we can build new sets using the following operations.

Union ($\cup$)

$A \cup B$ is the set of elements that are in A , or in B , or in both. $A \cup B = \{x : x \in A \text{ or } x \in B\}$.

Intersection ($\cap$)

$A \cap B$ is the set of elements common to both A and B . $A \cap B = \{x : x \in A \text{ and } x \in B\}$. If $A \cap B = \emptyset$, the sets are called **disjoint**.

Difference (−)

$A - B$ is the set of elements in A but not in B . $A - B = \{x : x \in A \text{ and } x \notin B\}$. In general $A - B \neq B - A$.

Complement (')

The complement of A (with respect to U) is $A' = U - A = \{x : x \in U \text{ and } x \notin A\}$ — all the elements of the universal set that are not in A .

8. Properties of Set Operations

These properties let you simplify expressions and prove set identities quickly.

Law	Statement
Commutative	$A \cup B = B \cup A$; $A \cap B = B \cap A$
Associative	$(A \cup B) \cup C = A \cup (B \cup C)$; $(A \cap B) \cap C = A \cap (B \cap C)$
Distributive	$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$; $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
Identity	$A \cup \emptyset = A$; $A \cap U = A$
Idempotent	$A \cup A = A$; $A \cap A = A$
Complement	$A \cup A' = U$; $A \cap A' = \emptyset$; $(A')' = A$

9. De Morgan's Laws

De Morgan's laws connect complement with union and intersection — the complement of a union is the intersection of the complements, and the complement of an intersection is the union of the complements.

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

These are favourites in proofs and Venn-diagram verification questions, so memorise both forms.

10. Cardinality — Practical Problems on Union and Intersection

The number of elements in a finite set A is its **cardinal number**, written $n(A)$. These formulae solve the “how many students play cricket or football” type problems.

For Two Sets

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

- If A and B are disjoint: $n(A \cup B) = n(A) + n(B)$.
- $n(A - B) = n(A) - n(A \cap B)$.
- $n(\text{only } A) = n(A) - n(A \cap B)$.

For Three Sets

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

[DIAGRAM: Three overlapping circles A, B and C inside U showing seven distinct regions — only-A, only-B, only-C, the three pairwise overlaps, and the central $A \cap B \cap C$.]

Weightage in Board & Entrance Exams

Exam	Typical Weightage	Most-Tested Areas
CBSE Board (Class 11)	5–6 marks (Unit: Sets & Functions)	Set-builder form, power set, operations, cardinality of two/three sets
JEE Main	1–2 questions (with Relations)	Cardinality formulae, De Morgan's laws, subset & power-set counts
CUET / School Tests	4–6 marks	Venn diagrams, union & intersection word problems

[TABLE: Question-type split — VSA (1 mark): roster/set-builder, $\in/\notin$, power-set count; SA (2–3 marks): operations, De Morgan verification, two-set cardinality; LA (4–5 marks): three-set word problems with Venn diagrams.]

Important Definitions & Formulae

Term / Formula	Meaning
Set	A well-defined collection of distinct objects
$\in / \notin$	"belongs to" / "does not belong to"
Empty set $\emptyset$	A set with no elements
Subset $A \subseteq B$	Every element of A is also in B
Power set $P(A)$	Set of all subsets of A; $n[P(A)] = 2^m$ where $n(A) = m$
Universal set U	The set containing all objects under discussion
Union $A \cup B$	$\{x : x \in A \text{ or } x \in B\}$
Intersection $A \cap B$	$\{x : x \in A \text{ and } x \in B\}$
Difference $A - B$	$\{x : x \in A \text{ and } x \notin B\}$
Complement A'	$U - A$; and $(A')' = A$
De Morgan's laws	$(A \cup B)' = A' \cap B'$; $(A \cap B)' = A' \cup B'$
Two-set cardinality	$n(A \cup B) = n(A) + n(B) - n(A \cap B)$

Solved Examples

Example 1

Write the set $A = \{x : x \text{ is an integer and } -3 < x < 3\}$ in roster form.

Answer: The integers strictly between -3 and 3 are $-2, -1, 0, 1, 2$. So **$A = \{-2, -1, 0, 1, 2\}$** .

Example 2

If $A = \{1, 2, 3\}$, write its power set and state the number of subsets.

Answer: $n(A) = 3$, so the number of subsets $= 2^3 = 8$. $P(A) = \{\emptyset, \{1\}, \{2\}, \{3\}, \{1, 2\}, \{1, 3\}, \{2, 3\}, \{1, 2, 3\}\}$.

Example 3

If $A = \{1, 2, 3, 4, 5\}$ and $B = \{2, 4, 6, 8\}$, find $A \cup B$, $A \cap B$ and $A - B$.

Answer: $A \cup B = \{1, 2, 3, 4, 5, 6, 8\}$; $A \cap B = \{2, 4\}$; $A - B = \{1, 3, 5\}$.

Example 4

Let $U = \{1, 2, 3, \dots, 10\}$ and $A = \{2, 4, 6, 8, 10\}$. Find A' .

Answer: $A' = U - A = \{1, 3, 5, 7, 9\}$.

Example 5

In a class of 40 students, 24 like Maths, 18 like Science, and 10 like both. How many like at least one subject? How many like neither?

Answer: $n(M \cup S) = n(M) + n(S) - n(M \cap S) = 24 + 18 - 10 = 32$ like at least one. Neither = $40 - 32 = 8$ students.

Example 6

Verify De Morgan's law $(A \cup B)' = A' \cap B'$ for $U = \{1, 2, 3, 4, 5, 6\}$, $A = \{1, 2, 3\}$, $B = \{3, 4\}$.

Answer: $A \cup B = \{1, 2, 3, 4\}$, so $(A \cup B)' = \{5, 6\}$. $A' = \{4, 5, 6\}$ and $B' = \{1, 2, 5, 6\}$, so $A' \cap B' = \{5, 6\}$. Both sides equal **{5, 6}** — verified.

Important Questions for Board Exams

1-Mark Questions (VSA)

1. Write $\{x : x \text{ is a natural number and } x^2 < 16\}$ in roster form.
2. If $A = \{a, b, c, d\}$, how many subsets and how many proper subsets does it have?
3. State whether $\emptyset \in \{\emptyset\}$ is true or false, and justify your answer.
4. Write the set $\{1, 4, 9, 16, 25\}$ in set-builder form.
5. If $A \subseteq B$, what is $A \cap B$?

2–3-Mark Questions (SA)

1. If $A = \{1, 2, 3, 4\}$ and $B = \{3, 4, 5, 6\}$, find $A \cup B$, $A \cap B$, $A - B$ and $B - A$.
2. For $U = \{1, \dots, 9\}$, $A = \{1, 2, 3, 4\}$, $B = \{2, 4, 6, 8\}$, verify that $(A \cap B)' = A' \cup B'$.
3. Using a Venn diagram, prove that $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$.
4. If $n(A) = 20$, $n(B) = 28$ and $n(A \cup B) = 36$, find $n(A \cap B)$.

4–5-Mark Questions (LA)

1. In a survey of 600 students, 150 take tea, 225 take coffee and 100 take both. Find how many take neither, how many take only tea, and how many take only coffee.

2. In a group of 100 people, 72 speak Hindi and 43 speak English. If each person speaks at least one language, find how many speak both and how many speak only Hindi.
 3. State and prove both of De Morgan's laws, illustrating each with a Venn diagram.
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Quick Revision Points

- A set is a well-defined collection of distinct objects; use $\in$ and $\notin$ for membership
 - Two representations: roster (list) form and set-builder (property) form
 - Types: empty $\emptyset$, singleton, finite/infinite, equal, equivalent
 - $A \subseteq B$ if every element of A is in B; $\emptyset \subseteq A$ and $A \subseteq A$ always hold
 - Power set has 2^m subsets when $n(A) = m$; proper subsets = $2^m - 1$
 - Universal set U contains everything in context; $A' = U - A$ and $(A')' = A$
 - Union $\cup$ (or), Intersection $\cap$ (and), Difference $-$, Complement $'$
 - Laws: commutative, associative, distributive, identity, idempotent, complement
 - De Morgan: $(A \cup B)' = A' \cap B'$ and $(A \cap B)' = A' \cup B'$
 - Two sets: $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
 - Three sets: $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(A \cap C) + n(A \cap B \cap C)$
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Next Chapter: Chapter 2 — Relations and Functions



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