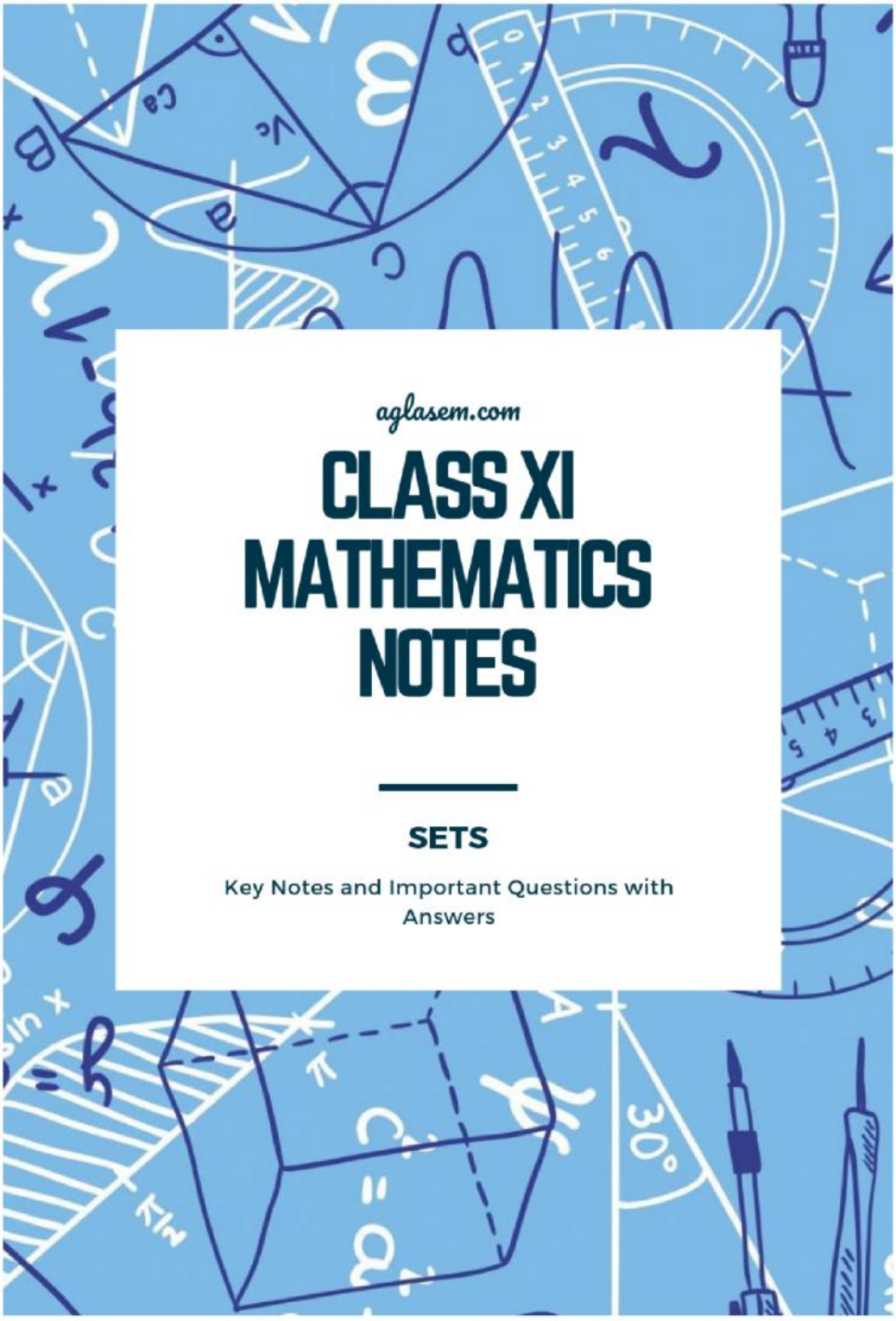

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CLASS XI
MATHEMATICS
NOTES
SETS
Key Notes and Important Questions with Answers

CHAPTER - 1

SETS

KEY POINTS

- A set is a well-defined collection of objects.
- There are two methods of representing a set:
  - (a) Roster or Tabular form e.g.natural numbers less than 5 = {1, 2, 3, 4}
  - (b) Set-builder form or Rule method e.g.: Vowels in English alphabet= {*x*: *x* is a vowel in the English alphabet }



Georg Cantor
(1845-1918)

- **Types of sets:**
  - (i) Empty set or Null set or void set
  - (ii) Finite set
  - (iii) Infinite set
  - (iv) Singleton set
- Subset :– A set A is said to be a subset of set B if $a \in A \Rightarrow a \in B, \forall a \in A$. We write it as $A \subseteq B$
- Equal sets :– Two sets A and B are equal if they have exactly the same elements i.e A = B if $A \subset B$ and $B \subset A$
- Power set : The collection of all subsets of a set A is called power set of A, denoted by P(A) i.e. P(A) = { B : $B \subset A$ }
- If A is a set with n(A) = m then n [P(A)] = 2^m.

- Equivalent sets : Two finite sets *A* and *B* are equivalent, if their cardinal numbers are same *i.e.,* $n(A) = n(B)$.
- Proper subset and super set : If $A \subset B$ then A is called the proper subset of B and B is called the superset of A.

Types of Intervals

Open Interval (a, b) = { x $\in$ R : a < x < b }

Closed Interval [a, b] = { x $\in$ R : a $\leq$ x $\leq$ b }

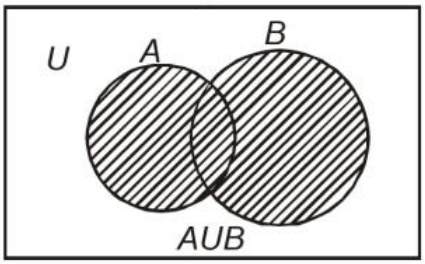
Semi open or Semi closed Interval,

(a,b] = { x $\in$ R : a < x $\leq$b}

[a,b) = { x $\in$ R : a $\leq$ x < b}

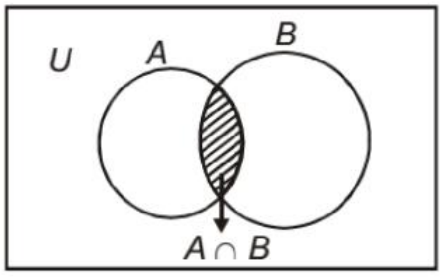
- Union of two sets A and B is,

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

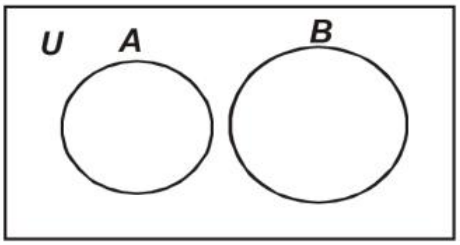


- Intersection of two sets A and B is,

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

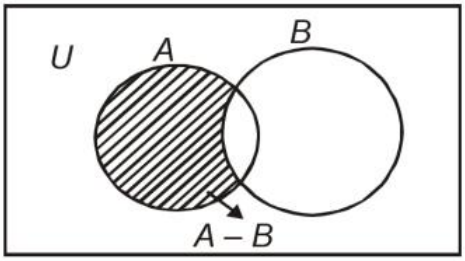


- Disjoint sets: Two sets A and B are said to be disjoint if A $\cap$ B = ϕ



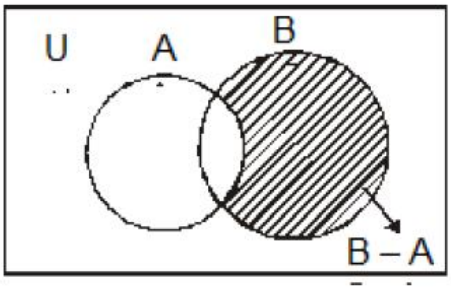
- Difference of sets A and B is,

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



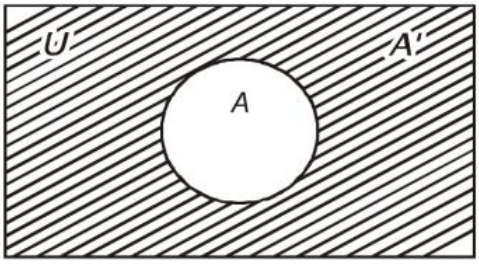
- Difference of sets B and A is,

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



- Complement of a set A, denoted by A' or A^c is

  $A' = A^c = U - A = \{ x : x \in U \text{ and } x \notin A\}$



- Properties of complement sets :

  1. Complement laws

(i) $A \cup A' = U$ (ii) $A \cap A' = \phi$ (iii) $(A')' = A$

2. De Morgan's Laws

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

Note :This law can be extended to any number of sets.

3. $\phi' = \cup$ and $\cup' = \phi$

4. If $A \subset B$ then $B' \subset A'$

Laws of Algebra of sets.

(i) $A \cup \phi = A$

(ii) $A \cap \phi = \phi$

- $A - B = A \cap B' = A - (A \cap B)$
- Commutative Laws :–

  (i) $A \cup B = B \cup A$ (ii) $A \cap B = B \cap A$
- Associative Laws :–

  (i) $(A \cup B) \cup C = A \cup (B \cup C)$

  (ii) $(A \cap B) \cap C = A \cap (B \cap C)$
- Distributive Laws :–

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

  (ii) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
- If $A \subset B$, then $A \cap B = A$ and $A \cup B = B$
- When *A* and *B* are disjoint $n(A \cup B) = n(A) + n(B)$
- When A and B are not disjoint $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
- $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) -$

$n(A \cap C) + n(A \cap B \cap C)$

VERY SHORT ANSWER TYPE QUESTIONS (1 MARK)

Which of the following are sets? Justify your answer.

1. The collection of all the months of a year beginning with letter M
2. The collection of difficult topics in Mathematics.

Let A = {1,3,5,7,9}. Insert the appropriate symbol $\in$ or $\notin$ in blank spaces: – (Question- 3,4)

3. (i) 2 _____ A (ii) {3} _____ A (iii) {3, 5} _____ A
4. Write the set A = { x : x is an integer, $-1 \leq x < 4$} in roster form
5. Write the set B = {3,9,27,81} in set-builder form.

Which of the following are empty sets? Justify. (Question- 6,7)

6. A = { x : x $\in$ N and 3 <x <4}
7. B = { x : x $\in$ N and $x^2 = x$}

Which of the following sets are finite or Infinite? Justify. (Question-8, 9)

8. The set of all the points on the circumference of a circle.
9. B = { x : x $\in$ N and x is an even prime number}
10. Are sets A = { –2,2}, B = { x : x $\in$ Z, $x^2 - 4 = 0$} equal? Why?
11. Write (–5,9] in set-builder form
12. Write {x : x $\in$ R, $-3 \leq x < 7$} as interval.
13. If A = { 1,3,5}, how many elements has P(A)?
14. Write all the possible subsets of A = {5,6}.

If A = Set of letters of the word 'DELHI' and B= the set of letters the words 'DOLL' find (Question- 17,18,19)

15. $A \cup B$

16. $A \cap B$

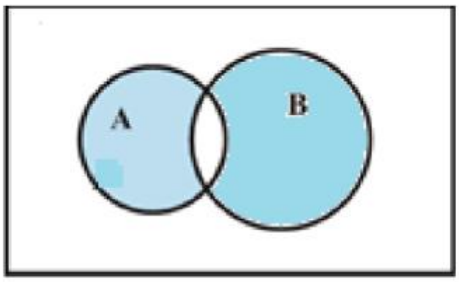
17. $A - B$

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

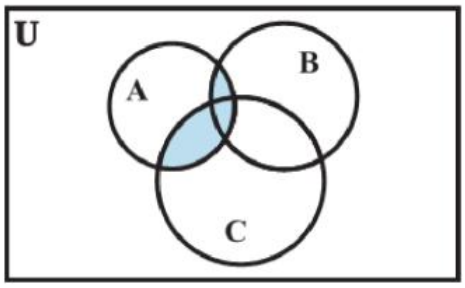
18. Are sets $A = \{1,2,3,4\}$, $B = \{ x : x \in N \text{ and } 5 \leq x \leq 7\}$ disjoint? Why?

What is Represented by the shaded regions in each of the following Venn-diagrams. (Question 19,20)

19.



20.



SHORT ANSWER TYPE QUESTIONS (4 MARKS)

21. If $A = \{ 1, 3, 5, 7, 11, 13, 15, 17\}$

$B = \{ 2, 4, 6, 8 \ldots 18\}$

and $\cup$ is universal set then find $A' \cup [(A \cup B) \cap B']$

22. Two sets A and B are such that

'n' $(A \cup B) = 21$ 'n' $(A) = 10$ 'n' $(B) = 15$ find 'n'$(A \cap B)$ and 'n' $A - B)$

23. Let $A = \{1, 2, 4, 5\}$ $B = \{2, 3, 5, 6\}$ $C = \{4, 5, 6, 7\}$ Verify the following identity

$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

24. If $\cup = \{ x : x \in N$ and $x \leq 10\}$

$A = \{ x : x$ is prime and $x \leq 10\}$

$B = \{ x : x$ is a factor of $24\}$

Verify the following result

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

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

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

25. Find sets A,B and C such that $A \cap B$, $B \cap C$ and $A \cap C$ are non-empty sets and $A \cap B \cap C = \phi$

26. For any sets A and B show that

(i) $(A \cap B) \cup (A-B) = A$ (ii) $A \cup (B-A) = A \cup B$

27. On the Real axis, If A=[0,3]and B=[2,6], than find the following

(i) A' (ii) $A \cup B$

(iii) $A \cap B$ (iv) $A-B$

28. In a survey of 450 people, it was found that 110 play cricket, 160 play tennis and 70 play both cricket as well as tennis. How many play neither cricket nor tennis?

29. In a group of students, 225 students know French, 100 know Spanish and 45 know both. Each student knows either French or Spanish. How many students are there in the group?

30. For all set A, B and C is $(A \cap B) \cup C = A \cap (B \cup C)$? Justify your answer.

31. Two sets A and B are such that $n(A \cup B)=21$, $n(A' \cap B')=9$, $n(A \cap B)=7$ find $n(A \cap B)'$

LONG ANSWER TYPE QUESTIONS (6 MARKS)

32. In a town of 10,000 families it was found that 40% families buy newspaper A, 20% families buy newspaper B and 10% families by 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, find the no of families which buy(1) A only (2) B only (3) none of A, B and C (4) exactly two newspapers (5) exactly one newspaper (6) A and C but not B (7) at least one of A,B, C. What is the importance of reading newspaper?

33. In a group of 84 persons, each plays at least one game out of three viz. tennis, badminton and cricket. 28 of them play cricket, 40 play tennis and 48 play badminton. If 6 play both cricket and badminton and 4 play tennis and badminton and no one plays all the three games, find the number of persons who play cricket but not tennis. What is the importance of sports in daily life?

34. In a class, 18 students took Physics, 23 students took Chemistry and 24 students took Mathematics of these 13 took both Chemistry and Mathematics, 12 took both Physics and Chemistry and 11 took both Physics and Mathematics. If 6 students offered all the three subjects, find:

    (1) The total number of students.

    (2) How many took Maths but not Chemistry.

(3) How many took exactly one of the three subjects.

35. Using properties of sets and their complements prove that

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

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

(3) $(A \cup B) - C = (A - C) \cup (B - C)$

(4) $A - (B \cup C) = (A - B) \cap (A - C)$

(5) $A \cap (B - C) = (A \cap B) - (A \cap C)$.

36. If A is the set of all divisors of the number 15. B is the set of prime numbers smaller than 10 and C is the set of even number smaller than 9, then find the value of $(A \cup C) \cap B$.

37. Two finite sets have m and n elements. The total number of subsets of first set is 56 more than the total number of subsets of the second set. Find the value of m and n.

38. If $X = \{4^n - 3n - 1 \ : \ n \in N\}$
$Y = \{9(n-1) \ : \ n \in N\}$

Find the value of $X \cup Y$

39. A survey show that 63% people watch news channel A whereas 76% people watch news channel B. If x% of people watch both news channels, then prove that $39 \le x \le 63$.

40. From 50 students taking examination in Mathematics, Physics and chemistry, each of the student has passed in at least one of the subject, 37 passes Mathematics, 24 Physics and 43 chemistry. At most 19 passed Mathematics and Physics, almost 29 Mathematics and chemistry and at most 20 Physics and chemistry. What is the largest passible number that could have passes in all the three subjects?

ANSWERS

1. Set
2. Not a set
3. (i) $\notin$ (ii) $\notin$ (iii) $\notin$
4. A = {–1, 0, 1, 2, 3}
5. B = { x : x = 3^n , n $\in$ N and $1 \leq n \leq 4$}
6. Empty set because no natural number is lying between 3 and 4
7. Non-empty set because B = {1}
8. Infinite set because circle is a collection of infinite points whose distances from the centre is constant called radius.
9. Finite set because B = {2}
10. Yes, because $x^2 - 4 = 0; x = 2, -2$ both are integers
11. {x: x $\in$ R, –5 < x $\leq$ 9}
12. [–3,7)
13. $2^3 = 8$
14. ϕ, {5}, {6}, {5,6}
15. A $\cup$ B = {D, E, L, H, I, O}
16. A $\cap$ B = {D, L}
17. A – B = {E, H, I}
18. Yes, because A $\cap$ B = ϕ
19. (A –B)$\cup$ (B – A)
20. (A $\cup$ B) $\cap$ C
21. $\cup$
22. n(A $\cap$ B) = 4, n(A – B) = 6
25. A = {1, 2}, B = {1, 3} C = {2, 3}
27. (i) $(-\infty, 0) \cup (3, \infty)$ (ii) [0, 6]

28. **Hint :** $\cup$ = set of people surveyed

A – set of people who play cricket

B = set of people who play tennis

Number of people who play neither cricket nor tennis

$= n[(A \cup B)'] = n(U) - n(A \cup B)$

$= 450 - 200$

$= 250$

29. There are 280 students in the group.

30. No, For example A = {1,2}, B = {2,3},C = {3.4}

31. 23

32. (i) 3300 (ii) 1400 (iii) 4000 (iv) 800 (v) 4800 (vi) 400 (vii) 5800

33. 6

34. (i) 35 (ii) 11 (iii) 11

36. {2,3,5}

37. n = 3 m = 6

38. Y

40. 14