



## MATHS

### BOOKS - CHHAYA PUBLICATION MATHS (BENGALI ENGLISH)

#### SET THEORY

##### Examples

1. Write down the following statements in set-theoretic notations:

3 is an element of a set A



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2. Write down the following statements in set-theoretic notations:

4 does not belong to a set B





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3. Write down the following statements in set-theoretic notations:

C is a subset of D



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4. Write down the following statements in set-theoretic notations:

P and Q are disjoint sets.



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5. Represent the following sets in tabular (or Roster) form :

set of factors of 30



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6. Represent the following sets in tabular (or Roster) form :

$$X = \{a : a \in \mathbb{N} \text{ and } a \text{ is a perfect square and } 2 < a \leq 49\}$$



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7. Represent the following sets in tabular (or Roster) form :

$$Y = \{x : x \text{ is an even natural number greater than } 20\}$$



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8. Represent the following sets in tabular (or Roster) form :

$$\mathbb{Z} = \left\{ x : x = \frac{n+2}{n^2-2} \text{ where } 2 \leq n \leq 5 \text{ and } n \in \mathbb{N} \right\}.$$



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9. Write the following sets in set-builder form:

set of letters in the word 'Statistics'

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10. Write the following sets in set-builder form:

$$A = \{3, 6, 9, 12, 15, \dots\}$$

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11. Write the following sets in set-builder form:

set of integers either equal or greater than 3 but less than 25.

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12. Which of the following sets is the null set  $\phi$ ? Briefly say why?

$$A = \{x : x \text{ is } > 1 \text{ and } x \text{ is } < 1\}$$

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13. Which of the following sets is the null set  $\phi$ ? Briefly say why?

$$B = \{x : x + 3 = 3\}$$



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14. Which of the following sets is the null set  $\phi$ ? Briefly say why?

$$C = \{\phi\}$$



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15. Show the relationships among the following three sets in respect of subsets and supersets:

$$\mathbb{Z}^+ = \{x : x \text{ is a positive integer}\}$$

$$\mathbb{Z} = \{x : x \text{ is an integer}\}$$

$$\mathbb{R} = \{x : x \text{ is a real number}\}$$



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**16.** State with reasons whether the sets defined in each of the following cases are equal :

$$X = \phi, Y = \{\phi\}$$



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**17.** State with reasons whether the sets defined in each of the following cases are equal :

$$A = \{x : x^2 - 3x + 2 = 0\}, B = \{x : x \text{ is a digit in the number } 212\}$$



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**18.** State with reasons whether the sets defined in each of the following cases are equal :

$$P = \{x : x \text{ is an integer and } -2 \leq x \leq 2\}, Q = \{x : x(x^2 - 1)(x^2 - 4)\}$$



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19. State whether each of the following sets is finite or infinite :

$$A = \{x : x \text{ is an odd integer greater than } 100\}$$



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20. State whether each of the following sets is finite or infinite :

$$B = \{x : x \text{ is real and } -1 \leq x < 1\}$$



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21. State whether each of the following sets is finite or infinite :

$$C = \{x : x \text{ is an odd negative integer greater than } -140\}.$$



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22. Given,  $A = \{2, 3, 4\}$ , determine all the eight subsets of A.



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**23.** Given  $A = \{x,y,z\}$  , state with reasons which of the following statements are correct:

$$\{x\} \in A$$



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**24.** Given  $A = \{x,y,z\}$  , state with reasons which of the following statements are correct:

$$x \in A$$



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**25.** Given  $A = \{x,y,z\}$  , state with reasons which of the following statements are correct:

$$\{x\} \subset A$$



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**26.** Given  $A = \{x, y, z\}$  , state with reasons which of the following statements are correct:

$$y \subseteq A$$



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**27.** Given  $A = \{x, y, z\}$  , state with reasons which of the following statements are correct:

$$\phi \in A$$



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**28.** Given  $A = \{x, y, z\}$  , state with reasons which of the following statements are correct:

$$\phi \subseteq A$$



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**29.** Given  $A = \{x, y, z\}$ , state with reasons which of the following statements are correct:

$$\{x, y, z\} \subseteq A$$



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**30.** Given  $A = \{x, y, z\}$ , state with reasons which of the following statements are correct:

$$\{z\} \in P(A)$$



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**31.** Given  $A = \{1, 2, 3\}$ ,  $B = \{2, 4\}$ ,  $C = \{2, 3, 5\}$ .

Find  $A \cap B$ ,  $A \cap C$  and  $(A \cap B) \cup (A \cap C)$



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**32.** Given  $A = \{1, 2, 3\}$ ,  $B = \{2, 4\}$ ,  $C = \{2, 3, 5\}$ .

$B \cup C$  and  $A \cap (B \cup C)$ .

Hence, verify the result  $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$ .



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**33.** Let the sets A and B be given by,  $A = \{1, 2, 3, 4\}$ ,  $B = \{2, 4, 6, 8, 10\}$

and the universal set  $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ . Find

$(A \cup B)'$  and  $(A \cap B)'$



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**34.** Given  $A = \{1, 2, 3, 4\}$ ,  $B = \{3, 4, 5\}$  and  $C = \{1, 4, 5\}$ ,

verify the following statement :

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



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35. If  $S = \{a, b, c, d, e, f\}$  be the universal set and  $A, B, C$  are three subsets of  $S$ , where  $A = \{a, c, d, f\}$ ,  $B \cap C = \{a, b, f\}$ , find  $(A \cup B) \cap (A \cup C)$  and  $B' \cup C'$ .



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36. For any two sets  $A$  and  $B$ , if  $P(A) = P(B)$ , then show that  $A = B$ , here  $P(A)$  is the power set of  $A$ .



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37. For any two sets  $A$  and  $B$ , prove that

$$P(A) \cup P(B) \subseteq P(A \cup B)$$



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38. For any two sets  $A$  and  $B$ , prove that

$$P(A \cap B) = P(A) \cap P(B)$$

where  $P(A)$  is the power set of  $A$ .



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39. If  $A = \{x : 1 \leq x \leq 2\}$  and  $B = \{x : 0 < x \leq 4\}$ , find

$$A \cup B$$



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40. If  $A = \{x : 1 \leq x \leq 2\}$  and  $B = \{x : 0 < x \leq 4\}$ , find

$$A \cap B$$



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41. If  $A = \{x : 1 \leq x \leq 2\}$  and  $B = \{x : 0 < x \leq 4\}$ , find

$$A - B \text{ and}$$



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**42.** If  $A = \{x : 1 \leq x \leq 2\}$  and  $B = \{x : 0 < x \leq 4\}$ , find

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



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**43.** List the sets A,B and C , given that,

$$A \cup B = \{p, q, r, s\}, A \cup C = \{q, r, s, t\}, A \cap B = \{q, r\}, A \cap C = \{q, s\}$$



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**44.** Let  $A = \{1,2,3,4,5,6,7,8,9\}$ ,  $B=\{2,4,6,8\}$ ,  $C=\{1,3,5,7,9\}$ ,  $D=\{3,4,5\}$  and  $E = \{3,5\}$

which set can equal X, if we are given the following information ?

X and B are disjoint



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**45.** Let  $A = \{1,2,3,4,5,6,7,8,9\}$ ,  $B=\{2,4,6,8\}$ ,  $C=\{1,3,5,7,9\}$ ,  $D=\{3,4,5\}$  and  $E = \{3,5\}$   
which set can equal  $X$ , if we are given the following information ?

$$X \subset A \text{ but } X \not\subset C$$



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**46.** Let  $A = \{1,2,3,4,5,6,7,8,9\}$ ,  $B=\{2,4,6,8\}$ ,  $C=\{1,3,5,7,9\}$ ,  $D=\{3,4,5\}$  and  $E = \{3,5\}$   
which set can equal  $X$ , if we are given the following information ?

$$X \subset D \text{ but } X \not\subset B$$



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**47.** Let  $A = \{1,2,3,4,5,6,7,8,9\}$ ,  $B=\{2,4,6,8\}$ ,  $C=\{1,3,5,7,9\}$ ,  $D=\{3,4,5\}$  and  $E = \{3,5\}$   
which set can equal  $X$ , if we are given the following information ?

$$X \subset C \text{ but } X \not\subset A$$



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**48.** For any three sets A,B and C, prove that,

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



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**49.** For any three sets A,B and C, prove that,

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



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**50.** For any three sets A,B and C, prove that,

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



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**51.**  $A = \{x : x \in \mathbb{N}\}$ ,  $B = \{x : x = 2n, n \in \mathbb{N}\}$  and  $D = \{x : x \text{ is a prime natural number}\}$ . Find  $A \cap B$ .



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52. If  $B \subseteq A$ , then prove that,  $B - A = \phi$ .



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53. Applying the laws of algebra of sets, prove that,

$$A - B = B^c - A^c$$



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54. Applying the laws of algebra of sets, prove that,

$$(A \cup B) \cap (A \cup B^c) = A$$



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55. Applying the laws of algebra of sets, prove that,

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

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56. Applying the laws of algebra of sets, prove that,

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

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57. Applying set algebra, show that,

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

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58. Applying set algebra, show that,

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

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59. Applying set algebra, show that,

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



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60. Applying set operations find the H.C.F. of the three numbers 15, 40 and 105.



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61. Using set operations find the L.C.M. of the three numbers 12, 15 and 20.



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62. Let  $\mathbb{N}$  be the set of natural numbers and  $a \in \mathbb{N}$ . If  $a\mathbb{N} = \{ax : x \in \mathbb{N}\}$  and  $p\mathbb{N} \cap q\mathbb{N} = r\mathbb{N}$ , where  $p, q, r \in \mathbb{N}$ , then show that  $r$  is the LCM of  $p$  and  $q$ .

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**63.** Applying set operations, prove that,  $2+3 = 5$ .

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**64.** In an examination, 45 % of the candidates have passed in English, 40 % have passed in Bengali, while 30 % have passed in both the subjects. Find the total number of candidates if 90 of them have failed in both the subjects.

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**65.** It is known that in a group of people, each of which speaks at least one of the languages English, Hindi and Bengali, 31 speak English, 36 speak Hindi and 27 speak Bengali. 10 speak both English and Hindi, 9 both English and Bengali and 11 both Hindi and Bengali. Using a Venn diagram

or otherwise, prove that the group contains at least 64 people and not more than 73 people.



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**66.** In a survey concerning the smoking habits of consumers it was found that 50 % smoke cigarette A, 45 % smoke B, 40 % smoke C, 25 % smoke A and B, 10 % smoke B and C, 16 % smoke C and A, 8 % smoke all the three brands. What percentage do not smoke ?



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**67.** A factor inspector examined the defects in hardness, finishing and dimensions of an item. After examining 100 items he gave the following report:

All three defects 5, defect in hardness and finishing 10, defect in dimensions and finishing 8, defect in dimensions and hardness 20. Defect in finishing 30, in hardness 23 and in dimensions 50. The inspector was fined, why?



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**68.** Two finite sets have  $m$  and  $n$  elements. The number of elements in the power set of first set is 48 more than the total number of elements in the power set of the second set. Find the values of  $m$  and  $n$ .



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### Multiple Choice Questions

**1.** The number of subsets in a set consisting of four distinct elements is \_\_\_\_\_

A. 4

B. 8

C. 16

D. 64

**Answer: C**



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2. The number of proper subsets in a set consisting of five distinct elements is\_\_\_\_\_

A. 5

B. 10

C. 32

D. 31

**Answer: D**



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3. If  $x \in A \Rightarrow x \in B$  then\_\_\_\_\_

A.  $A=B$

B.  $A \subset B$

C.  $A \subseteq B$

D.  $B \subseteq A$

**Answer: C**



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**4.** If  $A \subseteq B$  and  $B \subseteq A$  then \_\_\_\_

A.  $A = \phi$

B.  $A \cap B = \phi$

C.  $A = B$

D. none of these

**Answer: C**



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5. For two sets if  $A \cup B = A \cap B$  then \_\_\_\_\_

A.  $A \subseteq B$

B.  $B \subseteq A$

C.  $A = B$

D. none of these

**Answer: C**



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6.  $A - B = \phi$  if \_\_\_\_\_

A.  $A \neq B$

B.  $A \subset B$

C.  $B \subset A$

D.  $A \cap B = \phi$

**Answer: B**



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7. If  $A \cap B = B$  then \_\_\_\_\_

A.  $A \subseteq B$

B.  $B \subseteq A$

C.  $A = B$

D.  $A = \phi$

**Answer: B**



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8. If A and B are two disjoint sets then  $n(A \cup B) =$

A.  $n(A) + n(B)$

B.  $n(A) - n(B)$

C. 0

D. none of these

**Answer: A**



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9. For any two set A and B,  $n(A) + n(B) - n(A \cap B) =$

A.  $n(A \cup B)$

B.  $n(A) - n(B)$

C.  $\phi$

D. none of these

**Answer: A**



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10. The dual of  $A \cup U = U$  is \_\_\_\_

A.  $A \cup U = U$

B.  $A \cup \phi = \phi$

C.  $A \cup \phi = A$

D.  $A \cap \phi = \phi$

**Answer: D**



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11. The dual of  $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$  is \_\_\_\_

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

B.  $(A \cup B) \cup (A \cup C)$

C.  $(A \cap B) \cap (A \cap C)$

D.  $(A \cup B) \cap (A \cup C)$

**Answer: A**



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**12.** State which of the following statement is true?

- A. Subset of an infinite set is an infinite set.
- B. The set of even integers greater than 889 is an infinite set.
- C. The set of odd negative integers greater than (-150) is an infinite set.
- D.  $A = \{x : x \text{ is real and } 0 < x \leq 1\}$  is a singleton set.

**Answer: B**



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13. State which of the following statement is not true?

A. If  $a \in A$  and  $a \in B$  then  $A \subseteq B$ .

B. If  $A \subseteq B$  and  $B \subseteq C$  then  $A \subseteq C$ .

C. If  $A \subseteq B$  and  $B \subseteq A$ , then  $A = B$ .

D. For any set A, if  $A \cup \phi = \phi$  ( $\phi$  being the null set) then  $A = \phi$ .

**Answer: A**



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14. State which of the following is the set of factors of the number 12\_\_\_

A. {2,3,4,6}

B. {2,3,4,6,12}

C. {2,3,4,8,6}

D. {1,2,3,4,6,12}

**Answer: D**



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**15.** State which of the following is a null set?

A.  $\{0\}$

B.  $\{\phi\}$

C.  $\{x: x \text{ is an integer and } 1 < x < 2\}$

D.  $\{x: x \text{ is a real number and } 1 < x < 2\}$

**Answer: C**



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**16.** If  $B$  be power set of  $A$ , state which of the following is true?

A.  $A \supset B$

B.  $B \supset A$

C.  $A \in B$

D.  $A = B$

**Answer: C**



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17. If  $x \in A \cup B$ , state which of the following is true?

A.  $x \in A$

B.  $x \in B$

C.  $x \in A \vee x \in B$

D.  $x \in A \wedge x \in B$

**Answer: C**



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18. If  $x \in A \cap B$ , state which of the following is true?

A.  $x \in A \wedge x \in B$

B.  $x \in B$

C.  $x \in A \vee x \in B$

D.  $x \notin A$

**Answer: A**



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19. If  $A = \{2, 4, 6, 8\}$ , state which of the following is true?

A.  $\{2, 4\} \in A$

B.  $\{2, 4\} \subseteq A$

C.  $\{2, 4\} \subset A$

D.  $\{2, 4\} \in A^c$

**Answer: C**



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**20.** State which of the following statements is true?

A.  $\{a\} \in \{a, b, c\}$

B.  $a \notin \{a, b, c\}$

C.  $a \subset \{a, b, c\}$

D.  $\{a\} \subset \{a, b, c\}$

**Answer: D**



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**21.** State which two of the following four sets are equal?

A.  $A = \{0\}$

B.  $B = \{\phi\}$

C.  $C = \{x : x \text{ is a perfect square and } 2 \leq x \leq 6\}$

D.  $D = \{x : x \text{ is an integer and } -1 < x < 1\}$

**Answer: A and D**



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**22.** Some well-defined sets are given below. Identify the null set:

A.  $A = \{x : x \text{ is the cube of an integer and } 2 \leq x \leq 7\}$

B.  $B = \{0\}$

C.  $C = \{\phi\}$

D.  $D = \{x : x \text{ is an integer and } 2 < x \leq 3\}$

**Answer: A**



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23. State which of the following sets is an infinite set?

A.  $A = \{x : x \text{ is an integer and } -1 \leq x < 1\}$

B. B= set of negative even integers greater than (-100)

C. C=set of positive integers less than 100

D.  $D = \{x : x \text{ is real and } -1 \leq x < 1\}$

**Answer: D**



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### Very Short Answer Type Questions

1. Define with examples:

Finite and infinite sets



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## 2. Define with examples:

Null set



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## 3. Define with examples:

Universal set



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## 4. Define with examples:

Singleton set



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## 5. Define with examples:

Equal sets





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6. Define with examples:

Subset and proper subset



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7. Define with examples:

Union of two sets



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8. Define with examples:

Intersection of two sets



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**9. Define with examples:**

Disjoint sets



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**10. Define with examples:**

Complement of a set



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**11. Define with examples:**

Difference of two sets



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**12. Define with examples:**

Power set





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**13. Distinguish :**

Null set and universal set



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**14. Distinguish :**

Union and intersection of two sets



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**15. Distinguish :**

Subset and proper subset



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**16. Distinguish :**

Union and difference of two sets



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**17. Distinguish :**

Universal set and complement of a set



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**18. Write short notes on:**

Power set



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**19. Write short notes on:**

null set

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20. If  $A = \{a, b, c\}$ , name

the subsets of  $A$ ,

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21. If  $A = \{a, b, c\}$ ,

write the proper subsets of  $A$ .

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22. Define power set of a set  $A$ . Find the power set of  $A = \{\{1\}, \{2, 3\}\}$ .

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**23.** If  $A = \{1, 2, 3, 4\}$ ,  $B = \{2, 4, 5, 8\}$  and  $C = \{3, 4, 5, 6, 7\}$ , find  $A \cup B$



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**24.** If  $A = \{1, 2, 3, 4\}$ ,  $B = \{2, 4, 5, 8\}$  and  $C = \{3, 4, 5, 6, 7\}$ , find  $B \cap C$



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**25.** If  $A = \{1, 2, 3, 4\}$ ,  $B = \{2, 4, 5, 8\}$  and  $C = \{3, 4, 5, 6, 7\}$ , find  $A \cup (B \cup C)$



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**26.** If  $A = \{1, 2, 3, 4\}$ ,  $B = \{2, 4, 5, 8\}$  and  $C = \{3, 4, 5, 6, 7\}$ , find  $A \cup (B \cap C)$ .

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27. If  $P = \{a, b, c, d, e\}$  and  $Q = \{a, e, i, o, u\}$ , prove that

$$P \subset P \cup Q$$

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28. If  $P = \{a, b, c, d, e\}$  and  $Q = \{a, e, i, o, u\}$ , prove that

$$P \cap Q \subset P.$$

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29. If  $A \subseteq B$  and  $B \subseteq C$ , prove that  $A \subseteq C$ .

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30. If  $A \cup B = B$ , show that,  $A \subseteq B$ .

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[Watch Video Solution](#)

31. If  $A \subseteq B$ , prove that,  $A - B = \phi$ .

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32. For any two sets A and B, if  $A \cup B = A \cap B$ , show that  $A=B$ .

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33. Represent the set in Roster form:

$A = \{(x, y) : (x, y) \text{ is the co ordinate of point of intersection of line } y = x$

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Short Answer Type Questions

1. Write short notes :

Union, intersection and difference of two sets.



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2. Write short notes :

Universal set and subset.



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3. Write short notes :

The three set operations (union, intersection and complementation).



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4. State De Morgan's law of sets.



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5. State the laws of algebra of sets.



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6. If  $A$  is a finite set and contains  $n$  elements, prove that the power set of  $A$  has  $2^n$  elements.



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7.

Let

$A = \{a, b, c\}$ ,  $B = \{a, b\}$ ,  $C = \{a, b, d\}$ ,  $D = \{c, d\}$  and  $E = \{d\}$ .

State which of the following statements are correct and give reasons:

$B \subset A$



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8.

Let

$A = \{a, b, c\}$ ,  $B = \{a, b\}$ ,  $C = \{a, b, d\}$ ,  $D = \{c, d\}$  and  $E = \{d\}$ .

State which of the following statements are correct and give reasons:

$$D \not\subset E$$



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9.

Let

$A = \{a, b, c\}$ ,  $B = \{a, b\}$ ,  $C = \{a, b, d\}$ ,  $D = \{c, d\}$  and  $E = \{d\}$ .

State which of the following statements are correct and give reasons:

$$D \subset B$$



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10.

Let

$A = \{a, b, c\}$ ,  $B = \{a, b\}$ ,  $C = \{a, b, d\}$ ,  $D = \{c, d\}$  and  $E = \{d\}$ .

State which of the following statements are correct and give reasons:

$$\{a\} \subset A$$



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11.

Let

$$A = \{a, b, c, d, e, f, g, h, i\}, B = \{b, d, f, h\}, C = \{a, c, e, g, i\}, D = \{c, d, e, f, g, h, i\}$$

Which set can equal X if we are given the following information?

X and B are disjoint

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12.

Let

$$A = \{a, b, c, d, e, f, g, h, i\}, B = \{b, d, f, h\}, C = \{a, c, e, g, i\}, D = \{c, d, e, f, g, h, i\}$$

Which set can equal X if we are given the following information?

$$X \subset A \text{ but } X \not\subset C$$

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13.

Let

$$A = \{a, b, c, d, e, f, g, h, i\}, B = \{b, d, f, h\}, C = \{a, c, e, g, i\}, D = \{c, d, e, f, g, h, i\}$$

Which set can equal X if we are given the following information?

$$X \subset D \text{ but } X \not\subset B$$



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14.

Let

$$A = \{a, b, c, d, e, f, g, h, i\}, B = \{b, d, f, h\}, C = \{a, c, e, g, i\}, D = \{c, d, e, f, g, h, i\}$$

. Which set can equal X if we are given the following information?

$$X \subset C \text{ but } X \not\subset A$$



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15. If  $A = \{a, b, c, d, e\}$ ,  $B = \{a, c, e, g\}$  and  $C = \{b, c, f, g\}$ , verify that

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



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16. If  $A = \{a, b, c, d, e\}$ ,  $B = \{a, c, e, g\}$  and  $C = \{b, c, f, g\}$ , verify that

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



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17. Let  $S = \{1, 2, 3, 4, 5\}$  be the universal set and let  $A = \{3, 4, 5\}$  and  $B = \{1, 4, 5\}$  be two of its subsets. Verify :  
 $(A \cup B)' = A' \cap B'$  (dash denotes complement).



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18. The set  $S = \{1, 2, 3, \dots, 12\}$  is to be partitioned into three sets A,B,C of equal size. Thus  $A \cup B \cup C = S$ ,  $A \cap B = B \cap C = C \cap A = \phi$ . Find the number of ways to partition S.



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19. If  $A = \{1, 2, 3, 4\}$ ,  $B = \{2, 3, 4, 5\}$ ,  $C = \{1, 3, 4, 5, 6, 7\}$ . Find

$A-B$



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20. If  $A = \{1, 2, 3, 4\}$ ,  $B = \{2, 3, 4, 5\}$ ,  $C = \{1, 3, 4, 5, 6, 7\}$ . Find

$A-C$  and hence verify that,

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



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21. If  $S = \{1, 2, 3, 4, 8, 16, 32\}$  be the universal set and

$A = \{1, 2, 8, 32\}$ ,  $B = \{4, 8, 32\}$  be two of its subsets, verify that,

$$(A^c)^c = A$$



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22. If  $S = \{1, 2, 3, 4, 8, 16, 32\}$  be the universal set and  $A = \{1, 2, 8, 32\}$ ,  $B = \{4, 8, 32\}$  be two of its subsets, verify that,

$$(A \cap B)^c = A^c \cup B^c$$


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23. If  $S = \{1, 2, 3, 4, 8, 16, 32\}$  be the universal set and  $A = \{1, 2, 8, 32\}$ ,  $B = \{4, 8, 32\}$  be two of its subsets, verify that,

$$(A \cup B)^c = A^c \cap B^c$$


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24. If  $P = \{a, b, c, d, e, f\}$  and  $Q = \{a, c, e, f\}$ , prove that  $(P - Q) \cup (P \cap Q)$



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25. If  $P = \{\theta : \sin \theta - \cos \theta = \sqrt{2} \cos \theta\}$  and

$Q = \{\theta : \sin \theta + \cos \theta = \sqrt{2} \sin \theta\}$ , then show that

$P = Q$ .



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26. Given  $A = \{1, 2, 3, 4, 5\}$  and  $B \cup C = \{3, 4, 6\}$ , find

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



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27. Given  $A = \{1, 2, 3, 4, 5\}$  and  $B \cup C = \{3, 4, 6\}$ , find

$(A - B) \cap (A - C)$



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**28.** Define three sets  $P, Q$  and  $R$  such that  $P \cap Q \neq \phi, Q \cap R \neq \phi, R \cap P \neq \phi$  but  $P \cap Q \cap R = \phi$ .



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**29.** Let  $A, B$  and  $C$  be three sets. If  $A \in B$  and  $B \subset C$ , is it true that  $A \subset C$ ? Justify your answer by an example.



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**30.** Let  $S = \{a, b, c, d, e\}$  be the universal set and let  $A = \{a, b, d\}$  and  $B = \{b, d, e\}$  be two of its subsets. Find  $(A \cap B)'$  and  $(A \cup B)'$ .



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**31.** Let  $S = \{1, 2, 3, 4, 5, 6\}$  be the universal set. Let  $A \cup B = \{2, 3, 4\}$ , find  $A^c \cap B^c$  where  $A^c, B^c$  are complements of A and B respectively.



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**32.** If  $a\mathbb{N} = \{ax : x \in \mathbb{N}\}$ , describe  $3\mathbb{N} \cap 7\mathbb{N}$  where  $\mathbb{N}$  is the set of natural numbers.



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**33.** Let A,B and C be three sets. Show by means of examples that each of the following statements is true:

if  $B \in A$  and  $x \in B$  then  $x \in A$



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**34.** Let A,B and C be three sets. Show by means of examples that each of the following statements is false:

if  $B \subset A$  and  $A \in C$  then  $B \in C$



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**35.** Let A,B and C be three sets. Show by means of examples that each of the following statements is false:

if  $A \not\subset B$  and  $B \not\subset C$  then  $A \not\subset C$



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**36.** For any two sets A and B, prove the following :

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



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**37.** For any two sets A and B, prove the following :

$$A^c - B^c = B - A$$



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**38.** For any two sets A and B, prove the following :

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



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**39.** For any two sets A and B, prove the following :

$$A - B = A \cap B'$$



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**40.** For any two sets A and B, prove the following :

$$B - A^c = A \cap B$$

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**41.** For any two sets A and B, prove the following :

$$B \subseteq (A - B)^c$$

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**42.** For any two sets A and B, prove the following :

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

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**43.** For any two sets A and B, prove the following :

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

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44. Let  $\mathbb{Z}$  be the set of integers and  $A = \{x : x = 6n, n \in \mathbb{Z}\}$ ,  $B = \{x : x = 4n, n \in \mathbb{Z}\}$ , find  $A \cap B$ .



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45. Using set operations find the H.C.F. of the numbers 12, 15 and 18.



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46. Applying set operations find the L.C.M. of the numbers 15, 25 and 30.



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47. If  $r, s, t$  are prime numbers and  $p, q$  are the positive integers such that LCM of  $p, q$  is  $r^2 t^4 s^2$ , then find the number of ordered pair  $(p, q)$ .



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**48.** Using a Venn diagram or otherwise, solve the following problem:

In a class of 70 students, each student has taken either English or Hindi or both. 45 students have taken English and 30 students have taken Hindi. How many students have taken both English and Hindi?



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**49.** Use a Venn diagram to solve the following problem:

In a statistical investigation of 1003 families of Kolkata it was found that 63 families had neither a radio nor a T.V., 794 families had a radio and 187 a television. How many families in that group had both a radio and a T.V.?



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**50.** A market research group conducted a survey of 1000 consumers and reported that 720 consumers liked product A and 450 consumers liked product B. What is the least number that must have liked both products?



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**51.** In a town 60 % read magazine A, 25 % do not read magazine A but read magazine B. Calculate the percentage of those who do not read any magazine. Also find the highest and lowest possible figures of those who read magazine B.



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**52.** Two finite sets A and B have respectively p and q elements. If the total number of subsets of A is 56 more than the total number of subsets of B, then find the values of p and q.



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**53.** Two finite sets A and B have m and n elements respectively. Find the maximum and minimum elements are in  $A \cup B$ .



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## Long Answer Type Questions

1. For a finite set  $A$ , the number of elements in  $A$  is denoted by  $n(A)$ . Use a Venn diagram (or otherwise) to prove that, for any two sets  $A, B$

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



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2. Given,  $A = \{x : 0 < x \leq 2\}$  and  $B = \{x : 1 < x < 3\}$ , find

$$A \cap B$$



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3. Given,  $A = \{x : 0 < x \leq 2\}$  and  $B = \{x : 1 < x < 3\}$ , find

$$A \cup B$$



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4. Given,  $A = \{x : 0 < x \leq 2\}$  and  $B = \{x : 1 < x < 3\}$ , find  $A - B$



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5. Given,  $A = \{x : 0 < x \leq 2\}$  and  $B = \{x : 1 < x < 3\}$ , find  $(A \cup B) - (A \cap B)$



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6. Let  $A = \{x : 2 \leq x < 5\}$  and  $B = \{x : 3 < x < 7\}$  be two subsets of the universal set,  $S = \{x : 0 < x \leq 10\}$ , verify that,  $(A \cup B)^c = A^c \cap B^c$



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7. If  $P = \{p, q, r, s, t, u\}$  and  $Q \cap R = \{q, r, v, w\}$ , find

$$(P \cup Q) \cap (P \cup R)$$



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8. If  $P = \{p, q, r, s, t, u\}$  and  $Q \cap R = \{q, r, v, w\}$ , find

$$(P - Q) \cup (P - R)$$



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9. If A, B, C be three subsets of the universal set S where

$S = \{1, 2, 3, 4, 5, 6, 7\}$ ,  $A = \{1, 3, 5, 6\}$  and  $B \cap C = \{1, 2, 6\}$ , find

$$(A \cup B) \cap (A \cup C) \text{ and } B^c \cup C^c.$$



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10. If  $U = \{a, b, c, d, e, f\}$  be the universal set and A,B,C are three subsets of U, where  $A = \{a, c, d\}$  and  $B \cup C = \{a, d, c, f\}$ , find  $(A \cap B) \cup (A \cap C)$  and



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11. If  $U = \{a, b, c, d, e, f\}$  be the universal set and A,B,C are three subsets of U, where  $A = \{a, c, d\}$  and  $B \cup C = \{a, d, c, f\}$ , find  $(B' \cap C')$



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12. Given  
 $X \cup Y = \{1, 2, 3, 4\}$ ,  $X \cup Z = \{2, 3, 4, 5\}$ ,  $X \cap Y = \{2, 3\}$  and  $X \cap Z = \{2, 3\}$ , find X,Y and Z.



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**13.** Verify the following relations using Venn diagrams :

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



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**14.** Verify the following relations using Venn diagrams :

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



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**15.** Verify the following relations using Venn diagrams :

$$(A \cup B)^c = A^c \cap B^c$$



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**16.** Verify the following relations using Venn diagrams :

$$(A \cap B)^c = A^c \cup B^c$$



**Watch Video Solution**

17. Verify the following relations using Venn diagrams :

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



**Watch Video Solution**

18. Verify the following relations using Venn diagrams :

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



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19. Verify the following relations using Venn diagrams :

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



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20. Draw a Venn diagram of three non-empty sets A , B and C such that

$$A \subset B, C \not\subset B, A \cap C = \phi$$



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21. If A,B and C are three non-empty subsets of the universal set S, draw a Venn diagram to illustrate the following case :

$$A \subset B, B \cap C \neq \phi, A \cap C = \phi, C \not\subset B$$



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22. For any three sets A , B and C prove the followings :

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



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**23.** For any three sets A , B and C prove the followings :

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



**Watch Video Solution**

**24.** For any three sets A , B and C prove the followings :

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



**Watch Video Solution**

**25.** For any three sets A , B and C prove the followings :

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



**Watch Video Solution**

**26.** For any three sets A , B and C prove the followings :

$$(A \cup B)^c = A^c \cap B^c$$

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**27.** For any three sets A , B and C prove the followings :

$$(A \cap B)^c = A^c \cup B^c$$

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**28.** For any three sets A , B and C prove the followings :

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

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**29.** For any three sets A , B and C prove the followings :

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

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**30.** For any three sets A , B and C prove the followings :

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



**Watch Video Solution**

**31.** For any three sets A , B and C prove the followings :

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



**Watch Video Solution**

**32.** Applying Set Algebra, prove the :

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



**Watch Video Solution**

**33.** Applying Set Algebra, prove the :

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



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**34.** Applying Set Algebra, prove the :

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

[Watch Video Solution](#)

**35.** Applying Set Algebra, prove the :

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

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**36.** In an engineering college, 80 students get chance for Computer Science, 75 for information Technology, 72 for Electronics. If 60 students get chance in 1st and 2nd, 50 in 2nd and 3rd, 40 in 1st and 3rd and 30 get chance in all three branches, how many seats are there in the engineering college? [The college has only three disciplines.]

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**37.** In a survey of college students it was found that 40 % use their own books, 50 % use library books, 30 % use borrowed books, 20 % use both their own books and library books. 15 % use their own books and borrowed books, 10 % use library books and borrowed books, and 4 % use their own books, library books and borrowed books. Calculate the percentage of students who do not use a book at all.



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**38.** A company studies the product preferences of 300 consumers. It was found that 226 liked product A, 51 liked product B, 54 liked product C, 21 liked products A and B, 54 liked products A and C, 39 liked products B and C and 9 liked all the three products. Prove that, the study results are not correct. [ Assume that each consumer likes at least one of the three products.]



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**39.** In a city three daily newspapers X,Y,Z are published, 65 % of the citizens read X, 54 % read Y, 45 % read Z, 38 % read X and Y, 32 % read Y and Z, 28 % read X and Z , 12 % do not read any one of these three papers. If the total number of people in the city be 1000000 find the number of citizens who read all the three newspapers. [You may use a Venn diagram or a standard formula for the enumeration of elements of sets.]



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**40.** Out of 1000 students in a college, 540 played football, 465 played cricket and 370 played volleyball, of the total 325 played both football and cricket. 260 played football and volleyball, 234 played cricket and volleyball, 125 played all the three games. How many students did not play any game



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**41.** Out of 1000 students in a college, 540 played football, 465 played cricket and 370 played volleyball, of the total 325 played both football and cricket. 260 played football and volleyball, 234 played cricket and volleyball, 125 played all the three games. How many students played only one game?



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**42.** Out of 1000 students in a college, 540 played football, 465 played cricket and 370 played volleyball, of the total 325 played both football and cricket. 260 played football and volleyball, 234 played cricket and volleyball, 125 played all the three games. How many students played just two games?



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**43.** A group consists of a number of students and each students and each student of the group can speak at least one of the languages Bengali,

Hindi and English. 65 can speak Bengali, 54 Hindi and 37 English, 31 can speak both Bengali and Hindi, 17 both Hindi and English, and 18 both Bengali and English. Determine the greatest and least number of students in the group.



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**44.** Using set operations show that the numbers 231 and 260 are prime to each other.



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**45.** suppose  $A_1, A_2, \dots, A_{30}$  are thirty sets each with five elements and  $B_1, B_2, \dots, B_n$  are  $n$  sets each with three elements.

Let  $A_1 \cup A_2 \cup \dots \cup A_{30} = B_1 \cup B_2 \cup \dots \cup B_n = S$ .

Assume that each element of  $S$  belongs to exactly ten of the  $A$ 's and to exactly nine of the  $B$ 's. Find  $n$ .



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**46.** At a certain conference of 100 people, there are 29 Indian women and 23 Indian men. Of these Indian people 4 are doctors and 24 are either men or doctors. There are no foreign doctors. How many foreigners are attending the conference? How many women doctors are there in the conference?



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**47.** If two sets  $A$  and  $B$  are having 99 elements in common, then find the number of elements common to each of the sets  $A \times B$  and  $B \times A$ .



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**Multiple Correct Answer Type**

**1.** If  $A$  be a set, then \_\_\_\_\_

A.  $A \cap \phi = \phi$

B.  $A \cap \phi = A$

C.  $A \cup \phi = A$

D.  $A \cup \phi = \phi$

**Answer: A,C**



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2. If  $A = \{a, b, c, d\}$  and  $B = \{b, c, d, e\}$  be two sets then \_\_\_\_\_

A.  $A - B = \{a\}$

B.  $B - A = \{e\}$

C.  $A - B = \{b, c, d\}$

D.  $B - A = \{b, c, d\}$

**Answer: A,B**



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3. If  $A, B$  and  $C$  are three finite sets,  $n(A) = 10$ ,  $n(B) = 15$ ,  $n(C) = 20$ ,  $n(A \cap B) = 8$  and  $n(B \cap C) = 9$ , then the value of  $n(A \cup B \cup C)$  will be\_\_\_\_\_

A. 26

B. 27

C. 28

D. none of these

**Answer: A,B,C**



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4. Given  $A, B, C$  are three sets. State which of the followings are true\_\_\_\_

A.  $A \cup B = B \cup A$

B.  $A \cap B = B \cap A$



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

D.  $(A \cap B) \cap C = A \cap (B \cap C)$

**Answer: A,B,C**



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**5. State which of the followings are null set?**

A.  $\{x \in \mathbb{R} : x^2 + 1 = 0\}$

B.  $\{x \in \mathbb{C} : x > x\}$

C.  $\{x \in \mathbb{R} : x^2 + x = 0\}$

D.  $\{x \in \mathbb{R} : x^2 + 2 = 0\}$

**Answer: A,B**



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1. If  $a\mathbb{N} = \{ax : x \in \mathbb{N}\}$  then  $3\mathbb{N} \cap 7\mathbb{N} = 3P\mathbb{N}$  what will be the value of  $P$ ?



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2. If  $A$  and  $B$  are two sets such that  $n(A) = 70$ ,  $n(B) = 60$  and  $n(A \cup B) = 110$ , then  $n(A \cap B) = 5K$ . What will be the value of  $K$ ?



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3. If  $n(A) = 3$ ,  $n(B) = 6$  and  $A \subseteq B$ , then find  $n(A \cup B)$ .



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4. If  $A = \{2, 4, 5\}$  and  $B = \{7, 8, 9\}$  then find  $n(A \times B)$ .



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5. Let  $S = \{0, 1, 5, 4, 7\}$ , number of subsets of  $S$  is  $32\mathbb{Q}$ , then find the value of  $\mathbb{Q}$ .

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### Comprehension Type

1. In a class there are 115 students of which 65 like cricket, 45 like football and 42 like hockey, 20 like both football and cricket, 25 like both cricket and hockey and 15 like both hockey and football. Further 8 of the students like all the three games.

Number of students who like at least one of these three games

A. 98

B. 99

C. 100

D. 101

**Answer: C**



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2. In a class there are 115 students of which 65 like cricket, 45 like football and 42 like hockey, 20 like both football and cricket, 25 like both cricket and hockey and 15 like both hockey and football. Further 8 of the students like all the three games.

Number of students who like exactly one game

A. 50

B. 55

C. 54

D. 56

**Answer: D**



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3. In a class there are 115 students of which 65 like cricket, 45 like football and 42 like hockey, 20 like both football and cricket, 25 like both cricket and hockey and 15 like both hockey and football. Further 8 of the students like all the three games.

Number of students who like exactly two games

A. 34

B. 36

C. 35

D. 37

**Answer: B**



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4.

Let

$A = \{x : x \in \mathbb{N}\}$ ,  $B = \{x : x \in 2n, n \in \mathbb{N}\}$ ,  $C = \{x : x = 2n - 1, n \in \mathbb{N}\}$  a

$D = \{x : x \text{ is a prime number}\}$  then \_\_\_\_

$A \cap C$  is

A. A

B. C

C. D

D.  $\{2\}$

**Answer: B**



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5.

Let

$A = \{x : x \in \mathbb{N}\}, B = \{x : x \in 2n, n \in \mathbb{N}\}, C = \{x : x = 2n - 1, n \in \mathbb{N}\}$  a

$D = \{x : x \text{ is a prime number}\}$  then \_\_\_\_

$B \cap C$  is

A.  $\phi$

B.  $\{2\}$

C. B

D. D

**Answer: A**



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**6.**

**Let**

$A = \{x : x \in \mathbb{N}\}$ ,  $B = \{x : x \in 2n, n \in \mathbb{N}\}$ ,  $C = \{x : x = 2n - 1, n \in \mathbb{N}\}$  a

$D = \{x : x \text{ is a prime number}\}$  then \_\_\_\_

$C \cap D$  is



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### Assertion Reason Type

**1.** Let  $A = \{1, 2, 3\}$  and  $B = \{3, 8\}$

**Statement-I :**  $(A \cup B) \times (A \cap B) = \{(1, 3), (2, 3), (3, 3), (8, 3)\}$

Statement-II :  $(A \times B) \cap (B \times A) = \{(3, 3)\}$

- A. Statement-I is true, Statement-II is true and Statement-II is a correct explanation for statement-I.
- B. Statement-I is true, Statement-II is true but Statement-II is not a correct explanation of Statement-I.
- C. Statement-I is true, Statement-II is false.
- D. Statement-I is false, Statement-II is true.

**Answer: B**



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**2. Let X and Y be two sets**

Statement-I :  $X \cap (Y \cup X)' = \phi$

Statement-II : If  $n(X \cup Y) = P$  and  $n(X \cap Y) = \phi$  then

$n(X \Delta Y) = P - Q$  [where  $X \Delta Y = (A - B) \cup (B - A)$ ]



- A. Statement-I is true, Statement-II is true and Statement-II is a correct explanation for statement-I.
- B. Statement-I is true, Statement-II is true but Statement-II is not a correct explanation of Statement-I.
- C. Statement-I is true, Statement-II is false.
- D. Statement-I is false, Statement-II is true.

**Answer: B**



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