Unit 6 Sets

Exercise 6.1

1. Write the following sets in descriptive form.

(i) A = {4, 8, 12, 16, ...}

Solution: To write the given set in descriptive form just write it in words.

Descriptive form = 'A' is a set of multiples of 4

(ii) B = {6, 12, 18, 24, 30, 36}

Solution: To write the given set in descriptive form just write it in words.

Descriptive form = 'B' is a set of multiples of 6 less than 37

(iii) C = {2, 3, 5, 7, 11, 19, 23, 29}

Solution: To write the given set in descriptive form just write it in words.

Descriptive form = 'C' is a set of prime numbers less than 30

(iv) D = {0, 1, 2, 3, 4, ... ,100}

Solution: To write the given set in descriptive form just write it in words.

Descriptive form = 'D' is a set of whole numbers up to 100

(v) $E = \{x \mid x \in Z \wedge 10 \leq x \leq 30\}$

Solution: To write the given set in descriptive form just write it in words.

Descriptive form = 'E' is a set of positive integers from 10 to 30

(vi) $F = \{x \mid x \in N \wedge x \geq 20\}$

Solution: To write the given set in descriptive form just write it in words.

Descriptive form = 'F' is a set of natural numbers greater than or equal to 20

(vii) $G = \{x \mid x \in N \wedge x < 18\}$

Solution: To write the given set in descriptive form just write it in words.

Descriptive form = 'G' is a set of natural numbers less than 18

2. Write the following sets in tabular form.

(i) A = Positive multiples of 7 less than 50

Solution: To write the given set in tabular form just write its elements in curly brackets.

Tabular form = A = {7, 14, 21, 28, 35, 42, 49}

(ii) B = Positive numbers less than 70 divisible by 11

Solution: To write the given set in tabular form just write its elements in curly brackets.

Tabular form = B = {11, 22, 33, 44, 55, 66}

(iii) C= Set of all natural numbers

Solution: To write the given set in tabular form just write its elements in curly brackets.

Tabular form = C = {1, 2, 3, 4, …}

(iv) D = Set of all odd numbers

Solution: To write the given set in tabular form just write its elements in curly brackets.

Tabular form = D = {1, 3, 5, 7, …}

(v) E = Positive multiples of 11 greater than 50

Solution: To write the given set in tabular form just write its elements in curly brackets.

Tabular form = E = {55, 66, 77, 88, 99, …}

(vi) F = Positive numbers greater than 50 and divisible by 12

Solution: To write the given set in tabular form just write its elements in curly brackets.

Tabular form = F = {60, 72, 84, 96, 108, 120, 132, …}

(vii) $G = \{x \mid x \in N : 3 < x < 20\}$

Solution: To write the given set in tabular form just write its elements in curly brackets.

Tabular form = G = {4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19}

3. Write the following sets in the set-builder form.

(i) A = {3, 4, 5, 6, 7, ..., 100}

Solution: To write the given set in set-builder form just express its elements using mathematical symbols and enclosed them in curly brackets.

$\text{Set builder form} = A = \{x \mid x \in N \wedge 3 \leq x \leq 100\}$

(ii) B = {0, 1, 2, …, 11}

Solution: To write the given set in set-builder form just express its elements using mathematical symbols and enclosed them in curly brackets.

$\text{Set builder form} = B = \{x \mid x \in W \wedge x \leq 11\}$

(iii) C = Set of even numbers greater than 20

Solution: To write the given set in set-builder form just express its elements using mathematical symbols and enclosed them in curly brackets.

$\text{Set builder form} = C = \{x \mid x \in E \wedge x > 20\}$

(iv) D = {2, 3, 5, 7, 11, 13, 17, 19, 23}

Solution: To write the given set in set-builder form just express its elements using mathematical symbols and enclosed them in curly brackets.

$\text{Set builder form} = D = \{x \mid x \in P \wedge x \leq 23\}$

(v) E = {11, 12, 13, 14, 15}

Solution: To write the given set in set-builder form just express its elements using mathematical symbols and enclosed them in curly brackets.

$\text{Set builder form} = E = \{x \mid x \in N \wedge 11 \leq x \leq 15\}$

(vi) F = {10, 11, 12, 13, ...}

Solution: To write the given set in set-builder form just express its elements using mathematical symbols and enclosed them in curly brackets.

$\text{Set builder form} = F = \{x \mid x \in N \wedge x \geq 10\}$

(vii) **G = {−2, −1, 0, 1, 2, 3}**

Solution: To write the given set in set-builder form just express its elements using mathematical symbols and enclosed them in curly brackets.

$$\text{Set builder form} = G = \{x \mid x \in Z \wedge -2 \le x \le 3\}$$

(viii) **H = Set of odd numbers less than 100**

Solution: To write the given set in set-builder form just express its elements using mathematical symbols and enclosed them in curly brackets.

$$\text{Set builder form} = H = \{x \mid x \in O \wedge x < 100\}$$

Exercise 6.2

1. Is the first set subset or superset of the second set or no relation?

(i) **A = {1, 2, 3, 4} , B = {1, 2, 3, 4, 5, 6, 7, 8}**

Solution: As all elements of set A are contained in set B so A is subset of B or $A \subset B$.

(ii) **C = {2, 7, 8, 9} , D = {2, 7}**

Solution: As all elements of set D are contained in set C so C is super set of D or $C \supset D$.

(iii) **E = {a, b, c, d} , F = {a, c, d}**

Solution: As all elements of set F are contained in set E so E is super set of F or $E \supset F$.

(iv) **G = {7, 8, 9} , H = {7, 9, 10, 8, 2}**

Solution: As all elements of set G are contained in set H so G is subset of H or $G \subset H$.

(v) **I = {1, 2, 3,4} , J = {2, 3, 4, 5, 6}**

Solution: As all elements of set I are not contained in set J or vice versa so there exist no relation.

(vi) **K = {a, h, c} , L = {h, c, d, e, f}**

Solution: As all elements of set K are not contained in set L or vice versa so there exist no relation.

2. Are the following sets equal or equivalent or both or no relation?

(i) **A = {1, 2, 3, 4} , B = {3, 4, 2, 1}**

Solution: As number of elements are equal and same in both sets so these sets are equal sets.

Symbolic form: A = B

Note: Equal sets are also equivalent sets.

(ii) **C = {3, 4, 5, 6} , D = {a, b, c, d}**

Solution: As number of elements are equal but not same in both sets so these sets are equivalent sets.

Symbolic form: $C \leftrightarrow D$

(iii) **E = {1, 4, 5, 6} , F = {2, 3, a, b, c}**

Solution: As number of elements are not equal and also not same in both sets so there exist no relation.

(iv) **G = {4, 5, 6} , H = {e, f, g}**

Solution: As number of elements are equal but not same in both sets so these sets are equivalent sets.

Symbolic form: $G \leftrightarrow H$

(v) I = {1, 7, 9, 8} , J = {a, c, d, e}

Solution: As number of elements are equal but not same in both sets so these sets are equivalent sets.

Symbolic form: $I \leftrightarrow J$

(vi) K = {11, 12, 13, 14} , L = {15, 16, 17, 18)}

Solution: As number of elements are equal but not same in both sets so these sets are equivalent sets.

Symbolic form: $K \leftrightarrow L$

3. Are the following sets disjoint or overlapping?

(i) A = {2, 3, 4, 5}, B = {6, 7, 8, 9, 10}

Solution: As there is no element common in both sets so set A and set B are disjoint.

(ii) C = {1, 2, 3}, D = {2, 3, 4, 5}

Solution: As some elements are common in both sets so set C and set D are overlapping.

(iii) E = {1, 4, 5, 6}, F = {6, 7, 8, 9}

Solution: As some elements are common in both sets so set E and set F are overlapping.

(iv) G = {1, 5, 7}, H = {7, 5, 2}

Solution: As some elements are common in both sets so set G and set H are overlapping.

4. Find the union of the following sets.

(i) A = {1, 4, 5} , B = {5, 6, 7, 8}

Solution: Union of two sets means to write all the elements of both sets into one set but no element can be repeated.

$$A \cup B = \{1, 4, 5\} \cup \{5, 6, 7, 8\}$$
$$= \{1, 4, 5, 6, 7, 8\}$$

(ii) C = {4, 5, 6} , D = {1, 2, 3}

Solution: Union of two sets means to write all the elements of both sets into one set but no element can be repeated.

$$C \cup D = \{4, 5, 6\} \cup \{1, 2, 3\}$$
$$= \{1, 2, 3, 4, 5, 6\}$$

(iii) E = {7, 8, 9} , F = {9, 10, 11, 7}

Solution: Union of two sets means to write all the elements of both sets into one set but no element can be repeated.

$$E \cup F = \{7, 8, 9\} \cup \{9, 10, 11, 7\}$$
$$= \{7, 8, 9, 10, 11\}$$

(iv) G = {12, 13, 1} H = {1, 3, 4}

Solution: Union of two sets means to write all the elements of both sets into one set but no element can be repeated.

$$G \cup H = \{12, 13, 1\} \cup \{1, 3, 4\}$$
$$= \{1, 3, 4, 12, 13\}$$

5. Find the intersection of the following sets.

(i) A = {4, 5, 6} , B = {6, 7, 8}

Solution: Intersection of two sets means to write the common elements of both sets into one set.

$$A \cap B = \{4, 5, 6\} \cap \{6, 7, 8\}$$
$$= \{6\}$$

(ii) C = {2, 3, 4}, D = {1, 3, 4}

Solution: Intersection of two sets means to write the common elements of both sets into one set.

$$C \cap D = \{2,\ 3,\ 4\} \cap \{1,\ 3,\ 4\}$$
$$= \{3,\ 4\}$$

(iii) E = {1, 4, 5, 6} , F = {4, 5, 1}

Solution: Intersection of two sets means to write the common elements of both sets into one set.

$$E \cap F = \{1,\ 4,\ 5,\ 6\} \cap \{4,\ 5,\ 1\}$$
$$= \{1,\ 4,\ 5\}$$

(iv) G = {2, 3, 4} , H = {5, 6, 7, 8}

Solution: Intersection of two sets means to write the common elements of both sets into one set.

$$G \cap H = \{2,\ 3,\ 4\} \cap \{5,\ 6,\ 7,\ 8\}$$
$$= \{\ \}$$

6. Find the difference of the following sets (A − B).

(i) A = {1, 2, 3, 4} , B = {4, 5, 6}

Solution: Difference of set A and set B means the set of those elements which belong to set A but not belong to set B.

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

(ii) A = {6, 7, 8}, B = {6, 7}

Solution: Difference of set A and set B means the set of those elements which belong to set A but not belong to set B.

$$A - B = \{6, 7, 8\} - \{6, 7\}$$
$$= \{8\}$$

(iii) A = {a, b, c, d} , B = {b, c, d}

Solution: Difference of set A and set B means the set of those elements which belong to set A but not belong to set B.

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

(iv) A = {1, 2, 3, 4} , B = {3, 4, 5, 6}

Solution: Difference of set A and set B means the set of those elements which belong to set A but not belong to set B.

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

7. Find the complement of the following sets consider U = {1, 2, 3, 4, ..., 10}.

(i) A = {1, 2, 3, 4, 5}

Solution: To find complement of set A subtract it from the given universal set U.

$$A^c = U - A = \{1, 2, 3, 4, ..., 10\} - \{1, 2, 3, 4, 5\}$$
$$= \{6, 7, 8, 9, 10\}$$

(ii) B = {4, 5, 6, 7}

Solution: To find complement of set B subtract it from the given universal set U.

$$B^c = U - B = \{1, 2, 3, 4, ..., 10\} - \{4, 5, 6, 7\}$$
$$= \{1, 2, 3, 8, 9, 10\}$$

(iii) C = {1, 2, 3, 9, 10}

Solution: To find complement of set C subtract it from the given universal set U.

$$C^c = U - C = \{1, 2, 3, 4, ..., 10\} - \{1, 2, 3, 9, 10\}$$
$$= \{4, 5, 6, 7, 8\}$$

(iv) **D = {2, 4, 6, 8, 10}**

Solution: To find complement of set D subtract it from the given universal set U.

$D^c = U - D = \{1, 2, 3, 4, ..., 10\} - \{2, 4, 6, 8, 10\}$

$= \{1, 3, 5, 7, 9\}$

(v) **E = {1, 3, 5, 7, 9}**

Solution: To find complement of set E subtract it from the given universal set U.

$E^c = U - E = \{1, 2, 3, 4, ..., 10\} - \{1, 3, 5, 7, 9\}$

$= \{2, 4, 6, 8, 10\}$

(vi) **F = {2, 3, 5, 7}**

Solution: To find complement of set F subtract it from the given universal set U.

$F^c = U - F = \{1, 2, 3, 4, ..., 10\} - \{2, 3, 5, 7\}$

$= \{1, 4, 6, 8, 9, 10\}$

(vii) **G = {1, 4, 6, 8, 9}**

Solution: To find complement of set G subtract it from the given universal set U.

$G^c = U - G = \{1, 2, 3, 4, ..., 10\} - \{1, 4, 6, 8, 9\}$

$= \{2, 3, 5, 7, 10\}$

Exercise 6.3

1. Verify that $A \cup A^c = U$ where U= {1, 2, 7, 9, 8, 3, 4}.

(i) **A = {7, 3, 9, 8}**

Solution: To verify $A \cup A^c = U$ solve left hand side by computing complement of the set A and then take union with set A. Given that U = {1, 2, 7, 9, 8, 3, 4}. So

$A^c = U - A = \{1, 2, 7, 9, 8, 3, 4\} - \{7, 3, 9, 8\}$

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

Now,

$A \cup A^c = \{7, 3, 9, 8\} \cup \{1, 2, 4\}$

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

$= U$

(ii) **A = {1, 2, 7}**

Solution: To verify $A \cup A^c = U$ solve left hand side by computing complement of the set A and then take union with set A. Given that U = {1, 2, 7, 9, 8, 3, 4}. So

$A^c = U - A = \{1, 2, 7, 9, 8, 3, 4\} - \{1, 2, 7\}$

$= \{9, 8, 3, 4\}$

Now,

$A \cup A^c = \{1, 2, 7\} \cup \{9, 8, 3, 4\}$

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

$= U$

(iii) **A = {1}**

Solution: To verify $A \cup A^c = U$ solve left hand side by computing complement of the set A and then take union with set A. Given that U = {1, 2, 7, 9, 8, 3, 4}. So

$A^c = U - A = \{1, 2, 7, 9, 8, 3, 4\} - \{1\}$

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

Now,

$A \cup A^c = \{1\} \cup \{2, 7, 9, 8, 3, 4\}$

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

$= U$

(iv) A = {3, 4, 8}

Solution: To verify $A \cup A^c = U$ solve left hand side by computing complement of the set A and then take union with set A. Given that U = {1, 2, 7, 9, 8, 3, 4}. So

$A^c = U - A = \{1, 2, 7, 9, 8, 3, 4\} - \{3, 4, 8\}$

$= \{1, 2, 7, 9\}$

Now,

$A \cup A^c = \{3, 4, 8\} \cup \{1, 2, 7, 9\}$

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

$= U$

2. Verify that $A \cap A^c = \phi$ where U = {1, 2, 3, 4, 12, 13, 14, 15}.

(i) A= {1, 12}

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, 4, 12, 13, 14, 15}. So

$A^c = U - A = \{1, 2, 3, 4, 12, 13, 14, 15\} - \{1, 12\}$

$= \{2, 3, 4, 13, 14, 15\}$

Now,

$A \cap A^c = \{1, 12\} \cap \{2, 3, 4, 13, 14, 15\}$

$= \phi$

> Remember!
>
> φ shows nothing means empty set. It means a set having no element.

(ii) A= {1, 2, 3}

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, 4, 12, 13, 14, 15}. So

$A^c = U - A = \{1, 2, 3, 4, 12, 13, 14, 15\} - \{1, 2, 3\}$

$= \{4, 12, 13, 14, 15\}$

Now,

$A \cap A^c = \{1, 2, 3\} \cap \{4, 12, 13, 14, 15\}$

$= \phi$

(iii) A= {1, 2, 3, 13, 14}

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, 4, 12, 13, 14, 15}. So

$A^c = U - A = \{1, 2, 3, 4, 12, 13, 14, 15\} - \{1, 2, 3, 13, 14\}$

$= \{4, 12, 15\}$

Now,

$A \cap A^c = \{1, 2, 3, 13, 14\} \cap \{4, 12, 15\}$

$= \phi$

(iv) **A= {14, 15}**

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, 4, 12, 13, 14, 15}. So

$A^c = U - A = \{1, 2, 3, 4, 12, 13, 14, 15\} - \{14, 15\}$

$= \{1, 2, 3, 4, 12, 13\}$

Now,

$A \cap A^c = \{14, 15\} \cap \{1, 2, 3, 4, 12, 13\}$

$= \phi$

3. Verify that $(A \cup B)^c = A^c \cap B^c$, where U = {1, 2, 3, ..., 10}.

(i) **A = {2, 3, 4} , B = {1, 2, 3, 4, 5, 6}**

Solution: To verify $(A \cup B)^c = A^c \cap B^c$ we have to solve L.H.S. and R.H.S. separately.

L.H.S.

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

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

Now, we will calculate $(A \cup B)^c$

$(A \cup B)^c = U - (A \cup B)$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 3, 4, 5, 6\}$

$= \{7, 8, 9, 10\}$

R.H.S.

$A^c = U - A$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{2, 3, 4\}$

$= \{1, 5, 6, 7, 8, 9, 10\}$

$B^c = U - B$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 3, 4, 5, 6\}$

$= \{7, 8, 9, 10\}$

Now, we will calculate $A^c \cap B^c$

$A^c \cap B^c = \{1, 5, 6, 7, 8, 9, 10\} \cap \{7, 8, 9, 10\}$

$= \{7, 8, 9, 10\}$

As L.H.S = R.H.S it verify that $(A \cup B)^c = A^c \cap B^c$.

(ii) **A = {1, 2, 9, 10} , B = {2, 3, 7, 10}**

Solution: To verify $(A \cup B)^c = A^c \cap B^c$ we have to solve L.H.S. and R.H.S. separately.

L.H.S.

$A \cup B = \{1, 2, 9, 10\} \cup \{2, 3, 7, 10\}$

$= \{1, 2, 3, 7, 9, 10\}$

Now, we will calculate $(A \cup B)^c$

$(A \cup B)^c = U - (A \cup B)$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 3, 7, 9, 10\}$

$= \{4, 5, 6, 8\}$

R.H.S.

$A^c = U - A$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 9, 10\}$

$= \{3, 4, 5, 6, 7, 8\}$

$B^c = U - B$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{2, 3, 7, 10\}$
$= \{1, 4, 5, 6, 8, 9\}$

Now, we will calculate $A^c \cap B^c$

$A^c \cap B^c = \{3, 4, 5, 6, 7, 8\} \cap \{1, 4, 5, 6, 8, 9\}$
$= \{4, 5, 6, 8\}$

As L.H.S = R.H.S it verify that $(A \cup B)^c = A^c \cap B^c$.

(iii) $A = \{1, 2, 4, 8\}$, $B = \{1, 3, 5, 7\}$

Solution: To verify $(A \cup B)^c = A^c \cap B^c$ we have to solve L.H.S. and R.H.S. separately.

L.H.S.

$A \cup B = \{1, 2, 4, 8\} \cup \{1, 3, 5, 7\}$
$= \{1, 2, 3, 4, 5, 7, 8\}$

Now, we will calculate $(A \cup B)^c$

$(A \cup B)^c = U - (A \cup B)$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 3, 4, 5, 7, 8\}$
$= \{6, 9, 10\}$

R.H.S.

$A^c = U - A$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 4, 8\}$
$= \{3, 5, 6, 7, 9, 10\}$

$B^c = U - B$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 3, 5, 7\}$
$= \{2, 4, 6, 8, 9, 10\}$

Now, we will calculate $A^c \cap B^c$

$A^c \cap B^c = \{3, 5, 6, 7, 9, 10\} \cap \{2, 4, 6, 8, 9, 10\}$
$= \{6, 9, 10\}$

As L.H.S = R.H.S it verify that $(A \cup B)^c = A^c \cap B^c$.

(iv) $A = \{1, 2, 3, 5, 7, 9\}$, $B = \{5, 7, 9\}$

Solution: To verify $(A \cup B)^c = A^c \cap B^c$ we have to solve L.H.S. and R.H.S. separately.

L.H.S.

$A \cup B = \{1, 2, 3, 5, 7, 9\} \cup \{5, 7, 9\}$
$= \{1, 2, 3, 5, 7, 9\}$

Now, we will calculate $(A \cup B)^c$

$(A \cup B)^c = U - (A \cup B)$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 3, 5, 7, 9\}$
$= \{4, 6, 8, 10\}$

R.H.S.

$A^c = U - A$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 3, 5, 7, 9\}$
$= \{4, 6, 8, 10\}$

$B^c = U - B$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{5, 7, 9\}$
$= \{1, 2, 3, 4, 6, 8, 10\}$

Now, we will calculate $A^c \cap B^c$

$A^c \cap B^c = \{4, 6, 8, 10\} \cap \{1, 2, 3, 4, 6, 8, 10\}$

$= \{4, 6, 8, 10\}$

As L.H.S = R.H.S it verify that $(A \cup B)^c = A^c \cap B^c$.

(v) A = {1, 3, 5, 7} , B = {2, 4, 6, 8}

Solution: To verify $(A \cup B)^c = A^c \cap B^c$ we have to solve L.H.S. and R.H.S. separately.

L.H.S.

$A \cup B = \{1, 3, 5, 7\} \cup \{2, 4, 6, 8\}$

$= \{1, 2, 3, 4, 5, 6, 7, 8\}$

Now, we will calculate $(A \cup B)^c$

$(A \cup B)^c = U - (A \cup B)$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 3, 4, 5, 6, 7, 8\}$

$= \{9, 10\}$

R.H.S.

$A^c = U - A$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 3, 5, 7\}$

$= \{2, 4, 6, 8, 9, 10\}$

$B^c = U - B$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{2, 4, 6, 8\}$

$= \{1, 3, 5, 7, 9, 10\}$

Now, we will calculate $A^c \cap B^c$

$A^c \cap B^c = \{2, 4, 6, 8, 9, 10\} \cap \{1, 3, 5, 7, 9, 10\}$

$= \{9, 10\}$

As L.H.S = R.H.S it verify that $(A \cup B)^c = A^c \cap B^c$.

(vi) A= {1, 3, 5, 7, 9} , B= {2, 4, 6, 8, 10}

Solution: To verify $(A \cup B)^c = A^c \cap B^c$ we have to solve L.H.S. and R.H.S. separately.

L.H.S.

$A \cup B = \{1, 3, 5, 7, 9\} \cup \{2, 4, 6, 8, 10\}$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

Now, we will calculate $(A \cup B)^c$

$(A \cup B)^c = U - (A \cup B)$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$= \{\ \}$

R.H.S.

$A^c = U - A$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{1, 3, 5, 7, 9\}$

$= \{2, 4, 6, 8, 10\}$

$B^c = U - B$

$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} - \{2, 4, 6, 8, 10\}$

$= \{1, 3, 5, 7, 9\}$

Now, we will calculate $A^c \cap B^c$

$A^c \cap B^c = \{2, 4, 6, 8, 10\} \cap \{1, 3, 5, 7, 9\}$

$= \{\ \}$

As L.H.S = R.H.S it verify that $(A \cup B)^c = A^c \cap B^c$.

4. Verify that $(A \cap B)^c = A^c \cup B^c$, where U= {11, 12, 13, ..., 20, 21}.

(i) A = {11, 12, 19, 20} , B = {19, 11, 13, 17}

Solution: To verify $(A \cap B)^c = A^c \cup B^c$ we have to solve L.H.S. and R.H.S separately.

L.H.S.

$A \cap B = \{11, 12, 19, 20\} \cap \{19, 11, 13, 17\}$
$= \{11, 19\}$
$(A \cap B)^c = U - (A \cap B)$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{11, 19\}$
$= \{12, 13, 14, 15, 16, 17, 18, 20, 21\}$

R.H.S.

$A^c = U - A$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{11, 12, 19, 20\}$
$= \{13, 14, 15, 16, 17, 18, 21\}$
$B^c = U - B$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{19, 11, 13, 17\}$
$= \{12, 14, 15, 16, 18, 20, 21\}$

Now, we will calculate $A^c \cup B^c$

$A^c \cup B^c = \{13, 14, 15, 16, 17, 18, 21\} \cup \{12, 14, 15, 16, 18, 20, 21\}$
$= \{12, 13, 14, 15, 16, 17, 18, 20, 21\}$

As, L.H.S = R.H.S it verify that $(A \cap B)^c = A^c \cup B^c$.

(ii) A = {9, 16} , B = {12, 14, 16, 18, 20}

Solution: To verify $(A \cap B)^c = A^c \cup B^c$ we have to solve L.H.S. and R.H.S separately.

L.H.S.

$A \cap B = \{9, 16\} \cap \{12, 14, 16, 18, 20\}$
$= \{16\}$
$(A \cap B)^c = U - (A \cap B)$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{16\}$
$= \{11, 12, 13, 14, 15, 17, 18, 19, 20, 21\}$

R.H.S.

$A^c = U - A$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{9, 16\}$
$= \{11, 12, 13, 14, 15, 17, 18, 19, 20, 21\}$
$B^c = U - B$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{12, 14, 16, 18, 20\}$
$= \{11, 13, 15, 17, 19, 21\}$

Now, we will calculate $A^c \cup B^c$

$A^c \cup B^c = \{11, 12, 13, 14, 15, 17, 18, 19, 20, 21\} \cup \{11, 13, 15, 17, 19, 21\}$
$= \{11, 12, 13, 14, 15, 17, 18, 19, 20, 21\}$

As, L.H.S = R.H.S it verify that $(A \cap B)^c = A^c \cup B^c$.

(iii) A = {11} , B = {11, 12}

Solution: To verify $(A \cap B)^c = A^c \cup B^c$ we have to solve L.H.S. and R.H.S separately.

L.H.S.

$A \cap B = \{11\} \cap \{11, 12\} = \{11\}$

$(A \cap B)^c = U - (A \cap B)$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{11\}$
$= \{12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$

R.H.S.

$A^c = U - A$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{11\}$
$= \{12, 13, 14, 15,16, 17, 18, 19, 20, 21\}$

$B^c = U - B$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{11, 12\}$
$= \{13, 14, 15, 16, 17, 18, 19, 20, 21\}$

Now, we will calculate $A^c \cup B^c$

$A^c \cup B^c = \{12, 13, 14, 15,16, 17, 18, 19, 20, 21\} \cup \{13, 14, 15, 16, 17, 18, 19, 20, 21\}$
$= \{12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$

As, L.H.S = R.H.S it verify that $(A \cap B)^c = A^c \cup B^c$.

(iv) $A = \{11, 13, 19\}$, $B = \{13, 19, 14\}$

Solution: To verify $(A \cap B)^c = A^c \cup B^c$ we have to solve L.H.S. and R.H.S separately.

L.H.S.

$A \cap B = \{11, 13, 19\} \cap \{13, 19, 14\}$
$= \{13, 19\}$

$(A \cap B)^c = U - (A \cap B)$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{13, 19\}$
$= \{11, 12, 14, 15, 16, 17, 18, 20, 21\}$

R.H.S.

$A^c = U - A$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{11, 13, 19\}$
$= \{12, 14, 15, 16, 17, 18, 20, 21\}$

$B^c = U - B$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{13, 19, 14\}$
$= \{11, 12, 15, 16, 17, 18, 20, 21\}$

Now, we will calculate $A^c \cup B^c$

$A^c \cup B^c = \{12, 14, 15, 16, 17, 18, 20, 21\} \cup \{11, 12, 15, 16, 17, 18, 20, 21\}$
$= \{11, 12, 14, 15, 16, 17, 18, 20, 21\}$

As, L.H.S = R.H.S it verify that $(A \cap B)^c = A^c \cup B^c$.

(v) $A = \{12, 19\}$, $B = \{20, 21\}$

Solution: To verify $(A \cap B)^c = A^c \cup B^c$ we have to solve L.H.S. and R.H.S separately.

L.H.S.

$A \cap B = \{12, 19\} \cap \{20, 21\}$
$= \{\ \}$

$(A \cap B)^c = U - (A \cap B)$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{\ \}$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$

R.H.S.

$A^c = U - A$
$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{12, 19\}$
$= \{11, 13, 14, 15, 16, 17, 18, 20, 21\}$

$B^c = U - B$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{20, 21\}$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19\}$

Now, we will calculate $A^c \cup B^c$

$A^c \cup B^c = \{11, 13, 14, 15, 16, 17, 18, 20, 21\} \cup \{11, 12, 13, 14, 15, 16, 17, 18, 19\}$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$

As, L.H.S = R.H.S it verify that $(A \cap B)^c = A^c \cup B^c$.

(vi) A = {13, 14, 15, 16, 17} , B = {15, 16, 17, 18, 19}

Solution: To verify $(A \cap B)^c = A^c \cup B^c$ we have to solve L.H.S. and R.H.S separately.

L.H.S.

$A \cap B = \{13, 14, 15, 16, 17\} \cap \{15, 16, 17, 18, 19\}$

$= \{15, 16, 17\}$

$(A \cap B)^c = U - (A \cap B)$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{15, 16, 17\}$

$= \{11, 12, 13, 14, 18, 19, 20, 21\}$

R.H.S.

$A^c = U - A$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{13, 14, 15, 16, 17\}$

$= \{11, 12, 18, 19, 20, 21\}$

$B^c = U - B$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{15, 16, 17, 18, 19\}$

$= \{11, 12, 13, 14, 20, 21\}$

Now, we will calculate $A^c \cup B^c$

$A^c \cup B^c = \{11, 12, 18, 19, 20, 21\} \cup \{11, 12, 13, 14, 20, 21\}$

$= \{11, 12, 13, 14, 18, 19, 20, 21\}$

As, L.H.S = R.H.S it verify that $(A \cap B)^c = A^c \cup B^c$.

(vii) A = {11, 13, 15, 17, 19} , B = {12, 14, 16, 18, 20}

Solution: To verify $(A \cap B)^c = A^c \cup B^c$ we have to solve L.H.S. and R.H.S separately.

L.H.S.

$A \cap B = \{11, 13, 15, 17, 19\} \cap \{12, 14, 16, 18, 20\}$

$= \{\ \}$

$(A \cap B)^c = U - (A \cap B)$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{\ \}$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$

R.H.S.

$A^c = U - A$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{11, 13, 15, 17, 19\}$

$= \{12, 14, 16, 18, 20, 21\}$

$B^c = U - B$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{12, 14, 16, 18, 20\}$

$= \{11, 13, 15, 17, 19, 21\}$

Now, we will calculate $A^c \cup B^c$

$A^c \cup B^c = \{12, 14, 16, 18, 20, 21\} \cup \{11, 13, 15, 17, 19, 21\}$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$

As, L.H.S = R.H.S it verify that $(A \cap B)^c = A^c \cup B^c$.

(viii) A = {11, 13, 15, 17, 19, 21} B = {12, 14, 16, 18, 20}

Solution: To verify $(A \cap B)^c = A^c \cup B^c$ we have to solve L.H.S. and R.H.S separately.

L.H.S.

$A \cap B = \{11, 13, 15, 17, 19, 21\} \cap \{12, 14, 16, 18, 20\}$

$= \{\ \}$

$(A \cap B)^c = U - (A \cap B)$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{\ \}$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$

R.H.S.

$A^c = U - A$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{11, 13, 15, 17, 19, 21\}$

$= \{12, 14, 16, 18, 20\}$

$B^c = U - B$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\} - \{12, 14, 16, 18, 20\}$

$= \{11, 13, 15, 17, 19, 21\}$

Now, we will calculate $A^c \cup B^c$

$A^c \cup B^c = \{12, 14, 16, 18, 20\} \cup \{11, 13, 15, 17, 19, 21\}$

$= \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$

As, L.H.S = R.H.S it verify that $(A \cap B)^c = A^c \cup B^c$.

Review Exercise 6

1. Choose the correct option.

(i) Which set is a subset of {1, 2, 3, 4}?

(a) {3, 5} (b) {1, 3, 6} (c) {1, 6} $\boxed{\text{(d) } \{3, 4\}}$

(ii) Which set is a super set of {1, 2}?

$\boxed{\text{(a) } \{1, 2, 3\}}$ (b) {7, 8, 9} (c) {1,4} (d) {1, 5, 6}

(iii) If A = {1, 2, 3}, B = {2, 3} then A − B =?

$\boxed{\text{(a) } \{1\}}$ (b) {2} (c) {2,3} (d) {3}

(iv) If A = (1, 2, 3, 4}, B = {2, 4, 5, 7} then $A \cap B = ?$

(a) {3, 2, 4} $\boxed{\text{(b) } \{4, 2\}}$ (c) {2, 3} (d) {5}

(v) If A = {1, 2}, B = {2, 3} then $A \cup B = ?$

$\boxed{\text{(a) } \{1, 2, 3\}}$ (b) {1, 2,4} (c) {1,2} (d) {1,3}

2. Find the union of the following sets.

(i) A = {1, 7, 8}, B = {8, 9, 10, 11}

Solution: Union of two sets means to write all the elements of both sets into one set but no element can be repeated.

$A \cup B = \{1, 7, 8\} \cup \{8, 9, 10, 11\}$

$= \{1, 7, 8, 9, 10, 11\}$

(ii) C = {2, 7, 1, 4, 5}, D = {11, 12, 13}

Solution: Union of two sets means to write all the elements of both sets into one set but no element can be repeated.

$C \cup D = \{2, 7, 1, 4, 5\} \cup \{11, 12, 13\}$

$= \{1, 2, 4, 5, 7, 11, 12, 13\}$

(iii) **E = {1, 2, 3,4}, F = {1, 3, 5, 7}**

Solution: Union of two sets means to write all the elements of both sets into one set but no element can be repeated.

$$E \cup F = \{1, 2, 3, 4\} \cup \{1, 3, 5, 7\}$$
$$= \{1, 2, 3, 4, 5, 7\}$$

(iv) **G = {2, 4, 6, 8, ...}, H = {1, 3, 5, 7, ...}**

Solution: Union of two sets means to write all the elements of both sets into one set but no element can be repeated.

$$G \cup H = \{2, 4, 6, 8, \ldots\} \cup \{1, 3, 5, 7, \ldots\}$$
$$= \{1, 2, 3, 4, 5, 6, 7, \ldots\}$$

3. Find the intersection of the following sets.

(i) **A = {1, 5, 7, 8}, B = {7, 8}**

Solution: Intersection of two sets means to write the common elements of both sets into one set.

$$A \cap B = \{1, 5, 7, 8\} \cap \{7, 8\}$$
$$= \{7, 8\}$$

(ii) **C = {5, 7, 8, 9}, D = {1, 7, 8, 9, 10}**

Solution: Intersection of two sets means to write the common elements of both sets into one set.

$$C \cap D = \{5, 7, 8, 9\} \cap \{1, 7, 8, 9, 10\}$$
$$= \{7, 8, 9\}$$

(iii) **E = {2, 4, 6, 8, ...}, F = {4, 8, 12, ...}**

Solution: Intersection of two sets means to write the common elements of both sets into one set.

$$E \cap F = \{2, 4, 6, 8, \ldots\} \cap \{4, 8, 12, \ldots\}$$
$$= \{4, 8, 12, 16, \ldots\}$$

(iv) **G = {4, 8, 12, 16, ...}, H = {8, 16,24, ...}**

Solution: Intersection of two sets means to write the common elements of both sets into one set.

$$G \cap H = \{4, 8, 12, 16, \ldots\} \cap \{8, 16, 24, \ldots\}$$
$$= \{8, 16, 24, 32, \ldots\}$$

4. Find the complement of the following sets, if U = {1, 2, 3, ...} as a universal set.

(i) **A = {2, 4, 6, 8, ...}**

Solution: To find complement of set A subtract it from the given universal set U.

$$A^c = U - A = \{1, 2, 3, \ldots\} - \{2, 4, 6, 8, \ldots\}$$
$$= \{1, 3, 5, 7, 9, \ldots\}$$

(ii) **B = {1, 3, 5, 7, …}**

Solution: To find complement of set B subtract it from the given universal set U.

$$B^c = U - B = \{1, 2, 3, \ldots\} - \{1, 3, 5, 7, 9, \ldots\}$$
$$= \{2, 4, 6, 8, \ldots\}$$

(iii) **C = {4, 5, 6, 7, 8, ...}**

Solution: To find complement of set C subtract it from the given universal set U.

$$C^c = U - C = \{1, 2, 3, \ldots\} - \{4, 5, 6, 7, 8, \ldots\}$$
$$= \{1, 2, 3\}$$

(iv) **D = {11, 12, 13, ...}**

Solution: To find complement of set D subtract it from the given universal set U.

$$D^c = U - D = \{1, 2, 3, \ldots\} - \{11, 12, 13, \ldots\}$$
$$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

(v) **E = {1, 2, 3, ..., 100}**

Solution: To find complement of set C subtract it from the given universal set U.

$E^c = U - E = \{1, 2, 3, \ldots\} - \{1, 2, 3, \ldots, 100\}$
$= \{101, 102, 103, 104, \ldots\}$

(vi) **F = {101, 102, 103, ...}**

Solution: To find complement of set C subtract it from the given universal set U.

$F^c = U - F = \{1, 2, 3, \ldots\} - \{101, 102, 103, 104, \ldots\}$
$= \{1, 2, 3, \ldots, 100\}$

5. Verify that $A \cup A^c = U$ where U= {1, 2, 3, …} is universal set.

(i) **A = {1, 2, 3, ..., 100}**

Solution: To verify $A \cup A^c = U$ solve left hand side by computing complement of the set A and then take union with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, \ldots\} - \{1, 2, 3, \ldots, 100\}$
$= \{101, 102, 103, 104, \ldots\}$

Now,

$A \cup A^c = \{1, 2, 3, \ldots, 100\} \cup \{101, 102, 103, 104, \ldots\}$
$= \{1, 2, 3, \ldots\}$
$= U$

(ii) **A = {2, 4, 6, 8, ...}**

Solution: To verify $A \cup A^c = U$ solve left hand side by computing complement of the set A and then take union with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, \ldots\} - \{2, 4, 6, 8, \ldots\}$
$= \{1, 3, 5, 7, \ldots\}$

Now,

$A \cup A^c = \{2, 4, 6, 8, \ldots\} \cup \{1, 3, 5, 7, \ldots\}$
$= \{1, 2, 3, \ldots\}$
$= U$

(iii) **A = {1, 3, 5, 7, ...}**

Solution: To verify $A \cup A^c = U$ solve left hand side by computing complement of the set A and then take union with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, \ldots\} - \{1, 3, 5, 7, \ldots\}$
$= \{2, 4, 6, 8, \ldots\}$

Now,

$A \cup A^c = \{1, 3, 5, 7, \ldots\} \cup \{2, 4, 6, 8, \ldots\}$
$= \{1, 2, 3, \ldots\}$
$= U$

(iv) **A = {11, 12, 13, ...}**

Solution: To verify $A \cup A^c = U$ solve left hand side by computing complement of the set A and then take union with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, \ldots\} - \{11, 12, 13, \ldots\}$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

Now,

$A \cup A^c = \{11, 12, 13, ...\} \cup \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

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

$= U$

(v) A = {101, 102, ...}

Solution: To verify $A \cup A^c = U$ solve left hand side by computing complement of the set A and then take union with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, ...\} - \{101, 102, ...\}$

$= \{1, 2, 3, 4, ..., 100\}$

Now,

$A \cup A^c = \{101, 102, ...\} \cup \{1, 2, 3, 4, ..., 100\}$

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

$= U$

6. Verify that $A \cap A^c = \phi$ where universal set U = {1, 2, 3, ...}.

(i) A = {2, 3, 4, ...}

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, …\} - \{2, 3, 4, …\}$

$= \{1\}$

Now,

$A \cap A^c = \{2, 3, 4, ...\} \cap \{1\}$

$= \phi$

(ii) A = {4, 5, 6, 7, ...}

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, …\} - \{4, 5, 6, 7, ...\}$

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

Now,

$A \cap A^c = \{4, 5, 6, 7, ...\} \cap \{1, 2, 3\}$

$= \phi$

(iii) A = {2, 4, 6, 8, ...}

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, …\} - \{2, 4, 6, 8, ...\}$

$= \{1, 3, 5, 7, …\}$

Now,

$A \cap A^c = \{2, 4, 6, 8, ...\} \cap \{1, 3, 5, 7, …\}$

$= \phi$

(iv) A = {1, 3, 5, 7, ...}

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, \dots\} - \{1, 3, 5, 7, \dots\}$
$= \{2, 4, 6, 8, \dots\}$

Now,

$A \cap A^c = \{1, 3, 5, 7, \dots\} \cap \{2, 4, 6, 8, \dots\}$
$= \phi$

(v) A = {11, 12, 13, ...}

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, \dots\} - \{11, 12, 13, \dots\}$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

Now,

$A \cap A^c = \{11, 12, 13, \dots\} \cap \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
$= \phi$

(vi) A = {101, 102, ...}

Solution: To verify $A \cap A^c = \phi$ solve left hand side by computing complement of the set A and then take intersection with set A. Given that U = {1, 2, 3, …}. So

$A^c = U - A = \{1, 2, 3, \dots\} - \{101, 102, \dots\}$
$= \{1, 2, 3, \dots, 100\}$

Now,

$A \cap A^c = \{101, 102, 103, \dots\} \cap \{1, 2, 3, \dots, 100\}$
$= \phi$

7. Verify that $(A \cup B)^c = A^c \cap B^c$ where U = N.

(i) A = {1, 3, 5, ...}, B = {2, 4, 6, ...}

Solution: To verify $(A \cup B)^c = A^c \cap B^c$ we have to solve L.H.S. and R.H.S. separately.

L.H.S.

$A \cup B = \{1, 3, 5, \dots\} \cup \{2, 4, 6, \dots\}$
$= \{1, 2, 3, 4, 5, 6, \dots\}$

Now, we will calculate $(A \cup B)^c$

Given that U = N = Set of natural numbers = {1, 2, 3, 4, …}

$(A \cup B)^c = U - (A \cup B)$
$= \{1, 2, 3, 4, \dots\} - \{1, 2, 3, 4, 5, 6, \dots\}$
$= \{\ \}$

R.H.S.

$A^c = U - A$
$= \{1, 2, 3, 4, \dots\} - \{1, 3, 5, \dots\}$
$= \{2, 4, 6, 8, \dots\}$

$B^c = U - B$
$= \{1, 2, 3, 4, \dots\} - \{2, 4, 6, \dots\}$
$= \{1, 3, 5, 7, \dots\}$

Now, we will calculate $A^c \cap B^c$

$A^c \cap B^c = \{2, 4, 6, 8, \dots\} \cap \{1, 3, 5, 7, \dots\}$
$= \{\ \}$

As L.H.S = R.H.S it verify that $(A \cup B)^c = A^c \cap B^c$.

(ii) **A = {5, 10, 15, ..., 50}, B = {10, 20, 30, 40}**

Solution: To verify $(A\cup B)^c = A^c \cap B^c$ we have to solve L.H.S. and R.H.S. separately.

L.H.S.

$A\cup B = \{5, 10, 15, ..., 50\} \cup \{10, 20, 30, 40\}$
$= \{5, 10, 15, ..., 50\}$

Now, we will calculate $(A\cup B)^c$

Given that U = N = Set of natural numbers = {1, 2, 3, 4, …}

$(A\cup B)^c = U - (A\cup B)$
$= \{1, 2, 3, 4, \ldots\} - \{5, 10, 15, ..., 50\}$
$= \{1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 16, 17, 18, 19, 21, 22, 23, 24, 26, 27, 28, 29, 31, 32, 33, 34, 36, 37, 38, 39, 41, 42, 43, 44, 46, 47, 48, 49, 51, 52, \ldots\}$

R.H.S.

$A^c = U - A$
$= \{1, 2, 3, 4, \ldots\} - \{5, 10, 15, ..., 50\}$
$= \{1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 16, 17, 18, 19, 21, 22, 23, 24, 26, 27, 28, 29, 31, 32, 33, 34, 36, 37, 38, 39, 41, 42, 43, 44, 46, 47, 48, 49, 51, 52, \ldots\}$

$B^c = U - B$
$= \{1, 2, 3, 4, \ldots\} - \{10, 20, 30, 40\}$
$= \{1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, \ldots\}$

Now, we will calculate $A^c \cap B^c$

$A^c \cap B^c = \{1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 16, 17, 18, 19, 21, 22, 23, 24, 26, 27, 28, 29, 31, 32, 33, 34, 36, 37, 38, 39, 41, 42, 43, 44, 46, 47, 48, 49, 51, 52, \ldots\} \cap \{1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, \ldots\}$
$= \{1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 16, 17, 18, 19, 21, 22, 23, 24, 26, 27, 28, 29, 31, 32, 33, 34, 36, 37, 38, 39, 41, 42, 43, 44, 46, 47, 48, 49, 51, 52, \ldots\}$

As L.H.S = R.H.S it verify that $(A\cup B)^c = A^c \cap B^c$.

(iii) **A = {1, 2, 3, ..., 11}, B = {12, 13, 14, ...}**

Solution: To verify $(A\cup B)^c = A^c \cap B^c$ we have to solve L.H.S. and R.H.S. separately.

L.H.S.

$A\cup B = \{1, 2, 3, ..., 11\} \cup \{12, 13, 14, ...\}$
$= \{1, 2, 3, 4, 5, 6, \ldots\}$

Now, we will calculate $(A\cup B)^c$

Given that U = N = Set of natural numbers = {1, 2, 3, 4,…}

$(A\cup B)^c = U - (A\cup B)$
$= \{1, 2, 3, 4, \ldots\} - \{1, 2, 3, 4, 5, 6, \ldots\}$
$= \{\ \}$

R.H.S.

$A^c = U - A$
$= \{1, 2, 3, 4, \ldots\} - \{1, 2, 3, ..., 11\}$
$= \{12, 13, 14, \ldots\}$

$B^c = U - B$
$= \{1, 2, 3, 4, \ldots\} - \{12, 13, 14, ...\}$
$= \{1, 2, 3, 4, \ldots, 10\}$

Now, we will calculate $A^c \cap B^c$

$A^c \cap B^c = \{12, 13, 14, \ldots\} \cap \{1, 2, 3, 4, \ldots, 10\}$
$= \{\ \}$

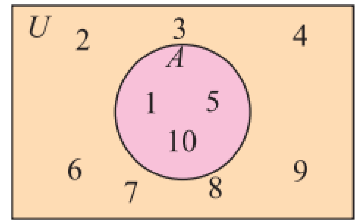
As L.H.S = R.H.S it verify that $(A \cup B)^c = A^c \cap B^c$.

8. If U = {1, 2, 3, ..., 10}, A = {1, 5, 10} and B = {1, 3, 5, 7, 9}, represent the following sets on Venn diagram.

(i) A

Solution: To draw Venn diagram draw rectangle for universal set and circle for other subsets.

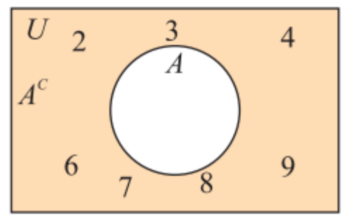
Here we want to represent 'A' which is a subset of U so we draw it inside the rectangle. Place elements of set A in the circle and the remaining elements of U will placed in the rectangle.



(ii) A^c

Solution: To draw Venn diagram draw rectangle for universal set and circle for other subsets.

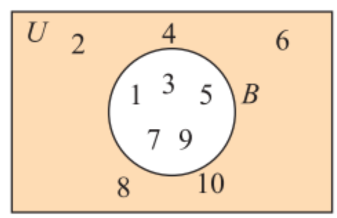
Here we want to represent 'A^c' which means the portion other than 'A' so colour the rectangle. As $A^c = U - A$.



(iii) B

Solution: To draw Venn diagram draw rectangle for universal set and circle for other subsets.

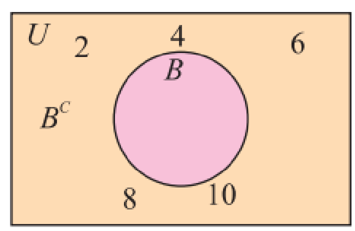
Here we want to represent 'B' which is a subset of U so we draw it inside the rectangle. Place elements of set B in the circle and the remaining elements of U will placed in the rectangle.



(iv) B^c

Solution: To draw Venn diagram draw rectangle for universal set and circle for other subsets.

Here we want to represent 'B^c' which means the portion other than 'B' so colour the rectangle. As $B^c = U - B$.



(v) Both A and B

Solution: To draw Venn diagram draw rectangle for universal set and circle for other subsets.

Here we want to represent both 'A' and 'B' which are subsets of U so we draw two circles inside the rectangle. Place common elements of both sets in the common part of circles and the remaining elements of U will placed in the rectangle.