A set is a collection of objects and is usually denoted with a capital letter.

The objects in a set are called members or elements.

**Symbols**

- ∈ - “is a member of”
- ∉ - “is not a member of”

**Examples**

Consider the two sets $A = \{1, 2, 3, 4, 5, 6\}$ and $B = \{2, 4, 6, 8\}$.

Answer True or False.

- a) $3 \in A$
- b) $1 \notin B$
- c) $8 \in A$

**Solutions**

The first statement is read “Three is a member of set A.” The statement is true.

The second statement is read “One is not a member of set B.” The statement is true.

The last statement is read “Eight is a member of set A.” The statement is false.

**Union**

The union of two sets, denoted $A \cup B$, is the set of all elements from sets $A$, $B$, or both.

**Intersection**

The intersection of two sets, denoted by $A \cap B$, is the set of elements that are common to both sets $A$ and $B$.

**Example**

Let $A = \{1, 2, 3, 4, 5, 6\}$ and $B = \{2, 4, 6, 8\}$

d) Find $A \cup B$.

**Solution**

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

e) Find $A \cap B$.

Solution

\[ A \cap B = \{2, 4, 6\} \]

\[
\begin{array}{ccc}
A & \cap & B \\
1 & 2 & 3 \\
3 & 4 & 6 \\
5 & 6 & 8 \\
\end{array}
\]

Special Sets

The empty set contains no members. It is denoted by \{\} or $\emptyset$.
The universal set contains all possible elements. It is denoted by $U$.
The complement of a set contains elements in the universal set that do not belong to the set under consideration. It is denoted by $A'$.

Example

Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$ and $A = \{2, 4, 6, 8, 9, 10, 11\}$

Solution

\[ A' = \{1, 3, 5, 7, 12\} \]

Venn Diagrams

Venn Diagrams are used to give a visual representation of sets and their relationships. The universal set is shown by a rectangle. All other sets are shown by circles inside the universal set.

Consider the shaded regions for the sets mentioned.
Disjoint sets \( A \) and \( B \) have no common elements.

The intersection of disjoint sets is the empty set.

\[ A \cap B = \emptyset \]

\( A \) is a subset of \( B \) if all members of \( A \) are contained in \( B \).

Note that \( B \) is not a subset of \( A \).

**Example**

\( g) \) Put the following information in a Venn Diagram.

\[ U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} \]
\[ A = \{1, 2, 3, 4, 5, 6\} \]
\[ B = \{2, 4, 6, 8\} \]
\[ C = \{10\} \]
Examples

h) Consider the Venn Diagram and find \( U, A, B, C, A \cap B, A \cup B, \) and \( B \cap C. \)

\[
\begin{align*}
U & = \{1, 2, 3, 4, 5, 6\} \\
A & = \{2, 3, 4\}; \quad B = \{4, 5\}; \quad C = \{3\} \\
A \cap B & = \{4\} \\
A \cup B & = \{2, 3, 4, 5\} \\
B \cap C & = \{}
\end{align*}
\]

Solutions

i) Consider the Venn Diagram below.

Set \( B \) is a subset of set \( A \) because the set \( B \) is contained in the set \( A \).

Sets \( B \) and \( C \) are disjoint: the two sets have no common elements.

Describe the relationship between sets \( A \) and \( B \), and the relationship between sets \( B \) and \( C \).

Check Your Progress 1.1

For Questions 1 – 4, use the Venn Diagram below.

1. Find \( U \).
2. Find \( B \).
3. Find \( A \cap B \).
4. Find \( B \cup C \).
For Questions 5 – 8, use the Venn Diagram below.

5. Find $U$.
6. Find $B$.
7. Find $A \cap B$.
8. Find $C \cup A$.

For Questions 9 and 10, use the Venn Diagram below.

9. Name two disjoint sets.
10. Name two intersecting sets.

For Questions 11 - 15, use the Venn Diagram below to fill in the blanks.

11. $A$ is a subset of ____________.
12. $C$ is a subset of ____________.
13. $B$ is a subset of ____________.
14. Sets $B$ and $C$ intersect at ______.
15. Sets $A$ and $B$ intersect at ____________.