Math1313
Chapter 6 – Section 6.1
Part I – Set Notation and Terminology
A set is a collection of objects.

An element is an object of a set.

Notation: \( \in \) means "element of"
\( \notin \) means "not an element of"

Set-builder notation:
Let \( B = \{1, 2, 3, 4, 5\} \). The set \( B \) in set-builder notation is \( B = \{x \mid 1 \leq x \leq 5\} \).

Example 1: Let \( A = \{a, b, c, d\} \) and \( B = \{x \mid 1 \leq x \leq 5\} \).

Answer True or False:

\( a \in A \)  
\( b \notin B \)  
\( 4 \notin A \)  
\( 2 \in A \)
**Equal sets** are sets that have exactly the same elements.

A is a **subset** of B if every element of A is also in B.

**Notation:**
- $\subseteq$ means "a subset of"
- $\not\subseteq$ means "not a subset of"

**Note:** Two sets are equal if and only if each is a subset of the other.

Example 2: Let $C = \{1, 2, 3, 4, 5, 6\}$, $D = \{2, 4, 6\}$ and $E = \{2, 1, 4, 3, 6, 5\}$.

**Answer True or False:**

- $D \subseteq C$
- $E \subseteq D$
- $E \not\subseteq C$
If \( A \subseteq B \) and \( A \neq B \), then \( A \) is a **proper subset** of \( B \).

In other words: \( A \) is a **proper subset** of \( B \) if the following two conditions hold.

1. \( A \) is a subset of \( B \).
2. There exist at least one element in \( B \) that is not in \( A \).

If \( A \) is a proper subset of \( B \) then we write \( A \subset B \).

Example 3: Let \( G = \{1, 2, 3, 4, 5, 6, 7\} \), \( H = \{3, 5, 6, 7\} \), \( I = \{2, 4, 7, 8\} \), and \( J = \{5, 7\} \).

Answer True or False:

\[
\begin{align*}
H & \subset G \\
I & \not\subset G \\
J & \subset H \\
J & \subset I
\end{align*}
\]
The **empty set** is a set that contains no elements.

**Note:** $\emptyset$ denotes the empty set. It is a subset of every set.

Example 4: Let $A = \{1, 2, 3\}$. List all subsets of the set $A$. 
The **universal set** is the set of all elements of interest in a particular discussion.

A **Venn diagram** is a visual representation of sets.

Some Venn diagrams can look like:  

Given two sets $A$ and $B$, the **union** of $A$ and $B$, denoted $A \cup B$, is the set of all elements that belong to either $A$ or $B$ or both.

An example of set union using a Venn diagram looks like:  

Given two sets $A$ and $B$, the **intersection** of $A$ and $B$, denoted $A \cap B$, is the set of all elements in common with both $A$ and $B$.

An example of set intersection using a Venn diagram looks like:
If $A \cap B = \emptyset$, then we say the intersection is the **null intersection** and that $A$ and $B$ are **disjoint**.

Let $U$ be a universal set and $A \subseteq U$, then the set of all elements in $U$ that are not in $A$ is the **complement** of $A$.

An example of set complementation using a Venn diagram looks like: