Section 6.1

Sets and Elements
A set is a collection of items, referred to as the elements of the set.
We usually use a capital letter to name a set and braces to enclose the elements of a set.

$x \in A$ means that x is an element of the set A. If x is not an element of A, we write $x \notin A$.

$B = A$ means that A and B have the same elements. The order in which the elements are listed does not matter.

$B \subseteq A$ means that B is a subset of A; every element of B is also an element of A.
$B \subset A$ means that B is a proper subset of A: $B \subseteq A$, but $B \neq A$.

$\emptyset$ is the empty set, the set containing no elements. It is a subset of every set.

A finite set has finitely many elements. An infinite set does not have finitely many elements.

Set Operations
$A \cup B$ is the union of A and B, the set of all elements that are either in A or in B (or in both).

$$A \cup B = \{x | x \in A \text{ or } x \in B\}$$

$A \cap B$ is the intersection of A and B, the set of all elements that are common to A and B.

$$A \cap B = \{x | x \in A \text{ and } x \in B\}$$

Logical Equivalents
Union: For an element to be in $A \cup B$, it must be in A or in B.
Intersection: For an element to be in $A \cap B$, it must be in A and in B.

Complement
If S is the universal set and $A \subseteq S$, then A' is the complement of A (in S), the set of all elements of S not in A,

$$A' = \{x \in S | x \notin A\}.$$

For an element to be in A', it must be in S but not in A.

Cartesian Product
The Cartesian product of two sets, A and B, is the set of all ordered pairs (a, b) with $a \in A$ and $b \in B$.

$$A \times B = \{(a, b) | a \in A \text{ and } b \in B\}$$

$A \times B$ is the set of all ordered pairs whose first component is in A and whose second component is in B.

Problem 1. List the elements in each of the sets.

a) The set N of all negative integers greater than -3.

b) $B = \{n | n \text{ is an odd positive integer and } 0 \leq n \leq 8\}$

c) The set of outcomes of tossing three (a) distinguishable coins (b) indistinguishable coins.

d) The set of outcomes of rolling two (a) distinguishable dice (b) indistinguishable dice.

e) The set of all outcomes of rolling two distinguishable dice such that the numbers add to 8.

f) The set of all outcomes of rolling two indistinguishable dice such that the numbers add to 8.

Problem 2. Let $A = \{\text{June, Janet, Jill, Justin, Jeffrey, Jello}\}$, $B = \{\text{Janet, Jello, Justin}\}$, and $C = \{\text{Sally, Solly, Molly, Jolly, Jello}\}$. Find each set.

a) $A \cup B$

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

c) $C \cap A$

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

Problem 3. Let $A = \{H, T\}$ be the set of outcomes when a coin is tossed, and let $B = \{1, 2, 3, 4, 5, 6\}$ be the set of outcomes when a die is rolled. Find the following sets.

a) The set of outcomes when a die is rolled and then a coin tossed.

b) The set of outcomes when a coin is tossed twice.

Problem 4. Use Venn diagrams to illustrate the following identities for subsets A, B, and C of S.

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

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

Homework: Read section 6.1, do #14, 18, 34, 36, 46, 50, 54, 66, 74