Section 6.1
Sets and Set Operations

A collection of objects is called a **set.**

An object of a set is called an **element.**

Notation:

$\in$ = "element of"
$\notin$ = "not an element of"

The set C = $\{x \mid x^2 = 9\}$ is in **set builder notation**.

The set C can also be written as follows: C = {-3, 3}.

Let *A* and *B* be two sets. If every element of *A* is also in *B*, *A* is said to be a **subset** of *B*.

Notation:

$\subseteq$ = "subset of"
$\not\subseteq$ = "not a subset of"

Example 1: Let C = {1,2,3,4,5,6}, D = {2,4,6}, E = {2,1,6,4,3,5}, and G = {1, 4, 6}. Which of the following is/are true?

I. D $\subseteq$ C
II. E $\not\subseteq$ C
III. D $\subseteq$ G

The set *A* is a **proper subset** of a set *B* (Notation: $A \subset B$) if the following two conditions hold.

1. $A \subseteq B$

2. There exists at least one element in *B* that is not in *A*.

Example 2: Let G = {5,6,7,8,9,10}, H = {5,8,10}, I = {8, 5}, and J = {5,8}. Which of the following is/are true?

I. H $\subset$ G II. H $\subset$ J III. J $\subset$ H IV. I $\not\subset$ J

A set that contains no elements is called the **empty set.**

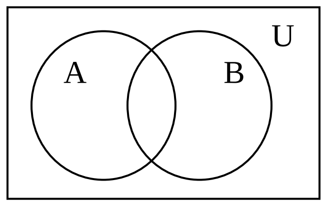
Note: We write Ø to denote the empty set. The symbol Ø is a subset of every set.

Example 3: Let E = $\{x, y, z\}$. List all subsets of the set E.

The **Universal set** is the set of interest in a particular discussion.

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

Some look like:



Let A and B be two sets. **Set Union**: $(A \cup B) = \{x \mid x \in \text{A}$ ***or*** $x \in \text{B}$ or both$\}$.

Let A and B be two sets. **Set Intersection:** $(A \cap B) = \{x \mid x \in \text{A}$ ***and*** $x \in \text{B}\}$.

If $A \cap B = \varnothing$, then we say that A and B are **disjoint**.

Let U be a universal set and $A \subseteq U$. **Complement of a Set A:** $\text{A}^c = \{x \mid x \in \text{U}, x \notin \text{A}\}$.

DeMorgan's Laws

a. $(\text{A} \cup \text{B})^c = \text{A}^c \cap \text{B}^c$ b. $(\text{A} \cap \text{B})^c = \text{A}^c \cup \text{B}^c$

Example 4: Let U={1,2,3,4,5}
A = {1,2,4,5}
B = {4,5}
C = {2,3,4}

Find the given sets.

a. $(\text{A} \cup \text{B})$

b. $(\text{B} \cap \text{C})$

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

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

Example 5: Let U denote the set of all employees at a certain Company. Let
$V=\{x \in U | x$ likes to read Vogue magazine$\}$,
$E=\{x \in U | x$ likes to read The Enquirer$\}$, and
$R=\{x \in U | x$ likes to read Reader's Digest$\}$.

Note: Not every employee at this company likes to read at least one of the three magazines mentioned.

a. Describe the given set in words.

$((E \cap R) \cup V^c)$ = the set of all employees at this company that like to read the

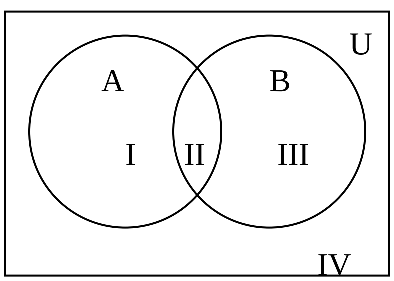
b. Describe the given statement in set notation.

The set of all employees at this company that do not like to read Vogue or The Enquirer.

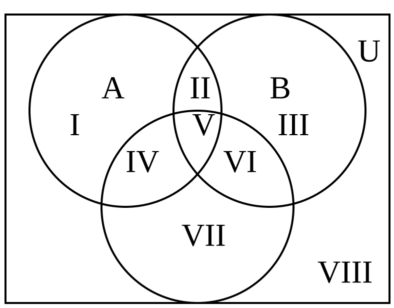
Another good example is example 14 in your book. Read through that example.

Example 6: Use shading to state the region(s) that represent(s) the given set. (Assume the given sets are not disjoint. This is obvious from the Venn diagrams.)

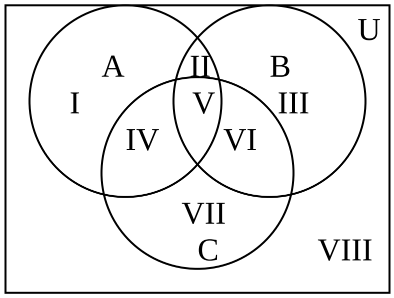
a. $(A \cap B^c)$



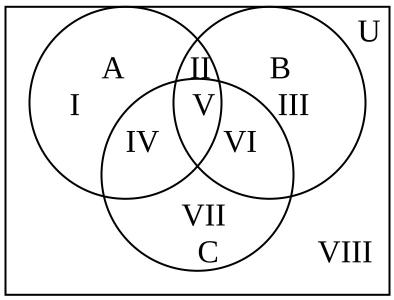
b. $(A^c \cup B)$



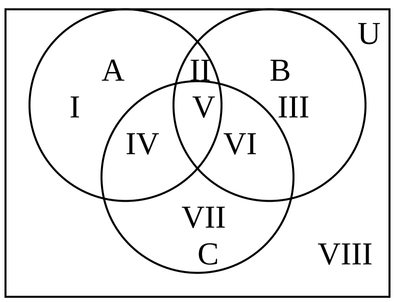
c. $(A \cup (B \cap C))$



d. $((A \cup B)^c \cap C)$



e. $((B \cap C)^c \cap A^c)$



f. $((C^c \cap B^c) \cup A)$