1. What are the sets $A \cup B$, $A \cap B$, $A - B$ for the following pair of sets:
   a. $A = \{a, b, c\}$, $B = \emptyset$
   b. $A = \{1, 2, 3, 4, 5\}$, $B = \{2, 4, 6, 8, 10\}$
   c. $A = \{a, b\}$, $B = \{a, b, c, d\}$
   d. $A = \{a, b, \{a, b\}\}$, $B = \{\{a\}, \{a, b\}\}$

2. Let $N$ represent the set of natural numbers $\{1, 2, 3, \ldots\}$. Let $X = \{n \in N \mid n \geq 5\}$, let $Y = \{n \in N \mid n \leq 10\}$, and let $Z = \{n \in N \mid E(n)\}$, where $E(n)$ is a predicate that means “$n$ is even.” Find each of the following sets:
   a. $X \cap Y$
   b. $X \cup Y$
   c. $X - Y$
   d. $N - Z$
   e. $X \cap Z$
   f. $Y \cap Z$
   g. $Y \cup Z$
   h. $Z - N$

3. Find $P(\{1, 2, 3\})$.

4. Assume that $a$ and $b$ are entities and that $a \neq b$. Let $A$ and $B$ be the sets defined by $A = \{a, \{b\}, \{a, b\}\}$ and $B = \{a, b, \{a, \{b\}\}\}$. Determine whether each of the following statements is true or false. Explain your answer.
   a. $b \in A$
   b. $\{a, b\} \subseteq A$
   c. $\{a, b\} \subseteq B$
   d. $\{a, b\} \in B$
   e. $\{a, \{b\}\} \in A$
   f. $\{a, \{b\}\} \in B$

5. Suppose $A$ and $B$ are sets such that $A \subseteq B$. What can you say about $A \cup B$, $A \cap B$, and $A - B$?

6. Let $X$ and $Y$ be sets. Simplify each of the following expressions. Justify each step in the simplification with one of the rules of set theory (Figure 2.2, page 91 in Foundations of Computation).
   a. $X \cup (Y \cup X)$
   b. $(X \cap Y) \cap \overline{X}$
7. Let $A$, $B$, and $C$ be sets. Simplify each of the following expressions. In your answer, the complement operator should only be applied to the individual sets $A$, $B$, and $C$.

a. $\overline{A \cup B \cup C}$

b. $\overline{A \cup B \cap C}$

c. $\overline{A \cup B}$

d. $\overline{B \cap C}$

e. $\overline{A \cap B \cap C}$

f. $\overline{A \cap A \cup B}$

8. Consider the functions from $\mathbb{Z}$ to $\mathbb{Z}$, where $\mathbb{Z}$ is the set of all integers, which are defined by the following formulas. Decide whether each function is onto and whether it is one-to-one. Explain why.

a. $f(n) = 2n$

b. $g(n) = n + 1$

c. $h(n) = n^2 + n + 1$