1. Write the following sets by using the notation $\{x : P(x)\}$.

   a) The set of natural numbers strictly less than 6.
   b) The set of integers whose square is less than 17.
   c) $[2, 6]$
   d) The set of rational numbers less than -1.

2. Let $X = \{x : P(x)\}$. Are the following statements true or false?

   a) If $a \in X$, then $P(a)$ is true.
   b) If $P(a)$, then $a \in X$.
   c) If $\sim P(a)$, then $a \notin X$.

3. Prove that $\{x \in \mathbb{R} : x^2 - 2x - 3 < 0\} = \{x \in \mathbb{R} : -1 < x < 3\}$.

4. List all the proper subsets of $\{\emptyset, \{\emptyset\}\}$.

5. Let $A_n = \left(\frac{1}{2}, \frac{1}{2} + \frac{1}{n}\right)$. Find $\bigcup_{n\in\mathbb{N}} A_n$ and $\bigcap_{n\in\mathbb{N}} A_n$.

6. Define the **set difference** of two sets A and B by $A\backslash B = \{x : x \in A \text{ but } x \notin B\}$. Show that $B\backslash(B\backslash A) = A \cap B$.

7. Problem 2.5.7 in the textbook.

8. Provide a counterexample for each of the following.

   a) If $A \cup C \subseteq B \cup C$, then $A \subseteq B$.
   b) If $(A\backslash B) \cap (A\backslash C) = \emptyset$, then $B \cap C = \emptyset$.
   c) $P(A)\backslash P(B) \subseteq P(A\backslash B)$