1. Recall Cantor’s Theorem: For any set $S$, the cardinality of the power set of $S$ is greater than the cardinality of $S$. Use Cantor’s theorem to prove that the set of all sets doesn’t exist.

2. For cardinal numbers $a$ and $b$, define $a + b$ to be the cardinality of $A \cup B$, where $a$ is the cardinality of $A$ and $b$ is the cardinality of $B$.
   
   (a) Show this addition is well defined.
   
   (b) Show that $\aleph_0 + \aleph_0 = \aleph_0$.
   
   (c) Show that $\aleph_0 + c = c$.

3. Let $X$ be a metric space and suppose $\alpha < \beta$. Show that the $\overline{B(x, \alpha)} \subset B(x, \beta)$.

4. Show that the following three properties on a topological space are equivalent:
   
   (a) For any countable collection $\{U_n\}$ of open sets, each of which is dense, their intersection $\bigcap U_n$ is also dense.
   
   (b) For any countable collection $\{A_n\}$ of closed sets, each with empty interior, their union $\bigcup A_n$ also has empty interior.
   
   (c) For any countable collection $\{N_n\}$ of nowhere dense sets, the complement of their union $(\bigcup N_n)^c$ is dense.

5. In a topological space $X$ show that
   
   (a) $\overline{A \cap B} \subset \overline{A \cap B}$ and equality need not hold.
   
   (b) $\overline{A - B} \subset \overline{A - B}$ and equality need not hold.