1. (10 pts.) Suppose \( f : A \to B \) and \( g : B \to C \).
   Prove that if \( g \) is 1-1 and \( g \circ f \) is onto, then \( f \) is onto.

2. (20 pts.) Suppose \( f : A \to B \) is onto. Prove or give a counterexample to each of the following statements.
   (a) If \( A \) is countable, then \( B \) is countable.
   (b) If \( B \) is countable, then \( A \) is countable.

3. (20 pts.) Suppose \( A \) is a nonempty bounded subset of \( \mathbb{R} \).
   (a) Prove that \( \text{sup} \ A \) is not an interior point of \( \mathbb{R} \setminus A \).
   (b) Prove that if \( A \) is closed, then \( \text{sup} \ A \in A \).

4. (25 pts.) Prove or disprove that \( A \) is a closed subset of \( \mathbb{R} \), if
   (a) \( A \) is a singleton
   (b) \( A \) is finite
   (c) \( A = \mathbb{Z} \)
   (d) \( A = \mathbb{Q} \)
   (e) \( A = (-\infty, 0] \)
   (f) Extra credit: \( A = \{ \frac{1}{n} : n \in \mathbb{Z}^+ \} \cup \{0\} \)