1. Find the flaw(s) in the following induction proof.

**Proposition 1.** If \( n \in \mathbb{N} \), then \( n + 1 \leq n \).

*Proof by induction.* Suppose that \( k + 1 \leq k \). Then \( k + 2 = (k + 1) + 1 \leq k + 1 \) by hypothesis. Therefore by induction \( n + 1 \leq n \) for all natural numbers \( n \). 

2. Use induction to prove that for every \( n \in \mathbb{N} \), it follows that \( 1 + 2^2 + 3^2 + \cdots + n^2 = \frac{n(n + 1)(2n + 1)}{6} \).
3. Let $n$ be an integer greater than or equal to 2. Use induction to prove that for any $n$ sets $A_1, A_2, A_3, \ldots, A_n$ the following holds:

$$A_1 \cup A_2 \cup A_3 \cup \cdots \cup A_n = A_1 \cap A_2 \cap A_3 \cap \cdots \cap A_n.$$

4. Prove that $1 + 2^3 + 3^3 + \cdots + n^3 = (1 + 2 + 3 + \cdots + n)^2$ for any natural number $n$. Hint: it may be helpful to remember that $1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$.