1. Find the truth tables for
   (a) $(p \wedge q) \vee \overline{q}$;
   (b) $(p \vee q) \wedge \overline{(\overline{p} \vee q)}$.

2. Are the following statements true or false? Prove your claim.
   (a) $\forall x \in \mathbb{R} \ x^2 - 9 = 0$;
   (b) $\exists x \in \mathbb{R} \ x^2 - 9 = 0$;
   (c) $\forall x \in \mathbb{R} \ \exists y \in \mathbb{R} \ x = y^2$;
   (d) $\exists x \in \mathbb{R} \ \forall y \in \mathbb{R} \ xy = 0$.

3. Prove the following statements using the Principle of Mathematical Induction:
   (a) $\forall n \in \mathbb{N} \ \sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}$;
   (b) $\forall n \in \mathbb{N} \setminus \{1, 2\} \ 2n + 1 \leq 2^n$.

4. By experimenting with some values of n, guess a formula for the sum
$$\sum_{k=1}^{n} \frac{1}{k(k+1)},$$
   and then use mathematical induction to verify your formula.

5. Let $a_n = \frac{1}{n} - \frac{1}{n+1}$, $n \in \mathbb{N}$.
   (a) Find $\sum_{k=1}^{100} a_k$ and $\prod_{k=1}^{100} a_k$.
   (b) Is a increasing or decreasing? Prove your claim.