1. Show that $p \lor q \rightarrow r \equiv (p \rightarrow r) \land (q \rightarrow r)$

2. Show that $(p \rightarrow r) \lor (q \rightarrow r) \equiv (p \land q) \rightarrow r$. 
3. Prove the following: The sum of two integers is even iff their difference is even.
4. Let $A = \{n \mid n = 2k + 5 \text{ for some } k \in \mathbb{N}\}$ and $B = \{n \mid n = 2j + 1 \text{ for some } j \in \mathbb{N}\}$. Is $A \subseteq B$?

5. Let $A = \{n \in \mathbb{N} \mid n = 2k^2 - 3, \text{ for some } k \in \mathbb{N}\}$ and $B = \{n \in \mathbb{N} \mid n = j^2 + 3 \text{ for some } j \in \mathbb{N}\}$. Prove that $A \nsubseteq B$.

6. Let $A = \{n \in \mathbb{N} \mid n \geq 2 \text{ and } n = 4j - 5, \text{ for some } j \in \mathbb{N}\}$ and $B = \{n \in \mathbb{N} \mid n \geq 0 \text{ and } n = 2k + 1 \text{ for some } k \in \mathbb{N}\}$. Prove that $A \subset B$. 
7. Let $x$ be an integer. If $x > 1$, then $x^3 + 1$ is composite.
8. Show that at least three of any 25 days chosen must fall in the same month of the year.
9. Recall the *cartesian product* of $A$ and $B$, denoted by $A \times B$, is the set of all ordered pairs formed by taking an element from $A$ together with an element from $B$ in all possible ways. That is, $A \times B = \{(a, b) \mid a \in A, b \in B\}$. Prove that if $A$ and $B$ are non-empty sets then $A \times B = B \times A$ iff $A = B$. 
10. For any integer \( n \geq 2 \), prove that if no prime \( p \leq \sqrt{n} \) divides \( n \), then \( n \) must be prime.