1. Construct the truth table for the compound proposition: $[q \lor (\neg q \rightarrow \neg p)] \leftrightarrow (p \rightarrow \neg q)$

2. Use the Laws of Logic to verify: $p \land (p \lor q) \equiv p$.

3. What is the negation of the quantified statement: Every dog that chases parked cars has a flat nose.

4. Find $A \times B$ for the sets $A = \{ \emptyset, \{1\} \}$ and $B = \{ \{0\}, \emptyset \}$

5. Show that the function $f: \mathbb{R} \rightarrow \mathbb{R}$ given by $f(x) = 9x + 7$ is One-To-One and Onto.

6. Let the function $f: \mathbb{R} \rightarrow \mathbb{R}$ be $f(x) = x + 3$ and the function $g: \mathbb{R} \rightarrow \mathbb{R}$ be $g(x) = x^2 + 2x + 1$. Find: 
   (a) $f(g(x))$  
   (b) $g(f(x))$

7. (a) Find the big-O estimate for the function $F(n) = (n^4 \log n + n^6 + 6n)(n^2 + 1)$.  
   (b) Find the Hamming Distance between 100110011001 and 101100111000.  
   (c) Using the Euclidean Algorithm, find $\text{gcd}(1024, 120)$.

8. If $a$, $b$, and $c$ are integers with $a = b + c$, prove that $\text{gcd}(a, b) = \text{gcd}(b, c)$.
   (Hint: if $\text{gcd}(a, b) \leq \text{gcd}(b, c)$ and $\text{gcd}(a, b) \geq \text{gcd}(b, c)$, then $\text{gcd}(a, b) = \text{gcd}(b, c)$).

9. Use the following Theorem:
   **THEOREM:** For all integers, $n$, and prime numbers, $p$, if $p$ divides $n^2$, then $p$ divides $n$.
   to prove by the Method of Contradiction that $\sqrt{3}$ is irrational.

10. Let $a$ be a Real Number not equal to 0 or 1. Use Math Induction to prove for all integers $n \geq 0$,

    $$\sum_{i=0}^{n} a^i = \frac{a^{n+1} - 1}{a - 1}.$$ 

11. (a) How many ways can Art, Betty, Chad, Deb, Ed, Fran, Glen, Helen, Ivan, and Jane form a line if Ed cannot be immediately between Betty and Ivan?

    (b) The Mars Candy Company sells bags of M&M candies with 60 pieces candy colored from 8 different colors in them. How many different bags can they produce if they want at least 1 of the first color, 2 of the second, color, 3 of the third color, 4 of the fourth color, ..., and 8 of the eighth color?