**1.** Use the Laws of Logic to show: $r \to (\neg q \to \neg p) \equiv p \to (r \to q)$

**2**. Negate: **There exists an Integer, *n*, such that *n* is prime and *n* is even**.

**3**. Find the Contrapositive form of: **All cars with fancy stereos are expensive**.

**4.** Find the Big-O of the algorithm with complexity:

$$(4x^5 + 8x^2 + 2)(5x^2 + 3) + (6x^4 + 2x^2 + 1)(12x^2).$$

**5**. What is the probability that a binary string of length 8 will have no more than two 1's?

**6**. How many ways can I fill a cooler with cans of soda if the cooler holds 50 cans, I have 6 different types of soda, and I want at least 5 of each type in the cooler?

**7**. Graph the relation R = $\{(a,b) \mid a,b \in \{1, 2, 3, 4, 5, 6, 7\}$ and $b = [(a^2 + 2) \bmod 4]\}$.

**8**. Find the $M_R \circ M_R$ of the relation on {1, 2, 3, 4}:

R = {(1,3), (1,4), (2,2), (2,4), (3,1), (3,2), (3,3), (4,1), (4,2), (4,3)}

**9**. Let $f$ = {(1,4), (2,1), (3,3), (4,5), (5,2)}, $g$ = {(1,2), (2,4), (3,1), (4,3), (5,5)}, and $h$ = {(1,5), (2,3), (3,1), (4,2), (5,4)}. Find $h \circ g \circ f$.

**10.** Find the Disjunctive Normal Form of the Boolean Expression that describes a 3-way light switch controlling a lightbulb that includes the case of being ON when all three switches are ON.

**11**. Find the next 5 terms of $s_n = 4s_{n-1} - 3s_{n-2}$ when $s_0 = (-1)$ and $s_1 = 0$.

**12**. How many ways can I line up 4 Pennies, 3 Nickels, 6 Dimes, 2 Quarters, and 3 Half-dollars, if all the coins are from 1990? (e.g. PNPNDDQPNDHDDQHHDP)

**13**. Graph an example of a Reflexive and Symmetric relation on the set {1, 2, 3, 4}.

**14**. Graph an example of an Onto function that is NOT One-To-One.

**15**. Prove one of the following theorems by Induction:

<u>Theorem</u>: For all Integers $n \geq 0$ and $a \neq 0,1$, $\sum_{i=0}^{n} a^i = \frac{a^{n+1} - 1}{a - 1}$.

<u>Theorem</u>: Every integer greater than 1 is divisible by a prime number.

**16**. Prove one of the following theorems by Contradiction:

<u>Theorem</u>: $\sqrt{2}$ is irrational.

<u>Theorem</u>: The sum of a rational and an irrational number is irrational.

**17**. Prove one of the following theorems:

<u>Theorem</u>: If $f(x) = 5x + 7$, then R = $\{(x,y) \mid x,y \in \mathbf{R}$ and $f(x) = f(y)\}$ is an Equivalence Relation.

<u>Theorem</u>: If $f(x) = 5x + 7$, then $f$ is a Bijection from **R** to **R**.