TUTORIAL QUESTIONS AND ANSWERS

1) Let X be the set of all students at a university. Let A be the set of students who are first year students, B the set of students who are second-year students, C the set of students who are in a discrete mathematics course, D the set of students who are international relations majors, E the set of students who went to a concert on Monday night, and *F* the set of students who studied until 2 AM on Tuesday. Express in set theoretic notation the following sets of students:
   i. All second-year students in the discrete mathematics course.
   ii. All first-year students who studied until 2 AM on Tuesday.
   iii. All students who are international relations majors and went to the concert on Monday night.
   iv. All first-year students who are international relations majors or went to a concert on Monday night.
   v. All first- and second-year students who did not go to the concert on Monday night but are international relations majors.
   vi. All students who are first-year international relations majors or who studied until 2 AM on Tuesday.
   vii. All students who are first- or second-year students who went to a concert on Monday night.
   viii. All first-year students who are international relations majors or went to a concert on Monday night.

2) Let $X=\{0,1,2,3,4,5,6,7,8,9\}$, $A=\{0,1,2,3\}$,

   $B=\{0,2,4\}$ and $C=\{0,3,6,9\}$.

   i. Find $A \cup B, A \cap B$, $\overline{A}, \overline{(A \cap B)}$, and $(B \cup C)-A$.
   ii. Find $\mathcal{P}(A)$, $\mathcal{P}(B)$, $\mathcal{P}(A \cap B)$, $\mathcal{P}(A) \cap \mathcal{P}(B)$.

3) Consider the statement,

   "If George is a horse, then George is an animal."

   Write the following

   a) Inverse of the statement
   b) Contrapositive statement
   c) Contradictory statement

4) Let A = {0, 3) and B = {x, y, z}. Find the following:
   (a) A *x B*
   (b) A *x A x B*
   (c) *B x* A
   (d) *B x A x B*

5) $A = \{n : n = 2j \; for\; some\; j \in N\}$ and
$$B = \{n : n = 2k + 2 \; for\; some\; k \in Z \wedge k \geq -1\}$$
   Prove that $A = B$.

6) Given *U = {1,2,3,4,5,6,7}*
   A = {1,3,4}

   B = {1,2,34,5}

   Prove that *A* ⊆ *B*

   a) *By Direct Method*
   b) *By Contraposition*
   c) *By Contradiction*

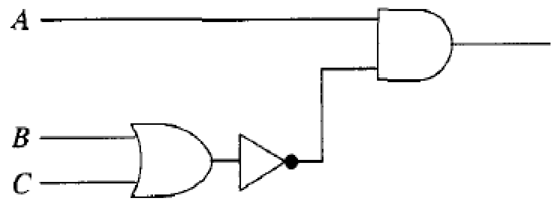
7) Given a proposition $P(n): 1 + 3 + 5 + \ldots + (2n - 1) = n^2$
   Prove by Mathematical Induction that $P(n)$ is true for all natural numbers n.

8) Prove by the Principle of Mathematical Induction that
   $1 \times 1! + 2 \times 2! + 3 \times 3! + \ldots + n \times n! = (n + 1)! - 1$ for all natural numbers n.

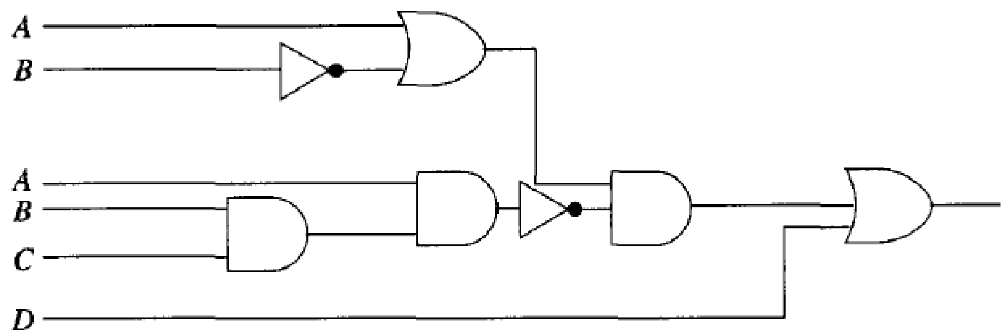
9) Let p denote "Henry eats halibut" and q denote "Catherine eats kippers." Write the proposition that reads the following:
   a) "Henry does not eat halibut."
   b) "Henry eats halibut, and Catherine eats kippers."
   c) "If Henry eats halibut, then Catherine eats kippers."
   d) "Henry eats halibut if and only if Catherine eats kippers."
   e) "Henry does not eat halibut, or Catherine does not eat kippers."
   f) "Henry eats halibut if and only if Catherine does not eat kippers."

10) Find a boolean expression to represent the following combinatorial circuits:

(a)



(b)



11) Draw a combinatorial circuit for each of the following boolean expressions:

(a) (x A y) V -'Z
(b) *(x* **A** *y) V (-x* **A** *y)*
(c) -(-x *V* y) *V* (x **A** Z)
(d) ((x **A** y) *V* (y **A** Z)) V -Z
(e) (x *V -(x V* y)) *V (-x* ***A -y)***