ECE4010 Homework 2

Q1. [20 pts] Write down all the steps of converting $(A \vee B) \leftrightarrow (C \vee D)$ to conjunctive normal form. For each step, write down which rule is being used.

Q2, [15 pts] Consider a world with 6 logical propositions: P, A, T, R, O, and X. How many different models of (P, A, T, R, O, X) satisfy each of the following knowledge bases?

Knowledge Base	Number of Models
$P \vee A$	
$(A \wedge \neg R) \vee (O \leftrightarrow \neg P)$	
$P \wedge A \wedge T$, $R \wedge O \wedge X$	

Q3. [15 pts] The relationship in the Wumpus world between pits and breezes can be expressed as a biconditional. Write down the biconditional for $B_{3,1}$ and $P_{*,*}$ in a $4 * 4$ wumpus world then convert the biconditional to conjunctive normal form.

Biconditional:

Steps:
Conjunctive Normal Form:

Q4. [15 pts] Given the following propositional logic clauses, show D must be true by adding ¬D and using only the resolution inference rule to derive a contradiction. Your answer should be in the form of a graph, where each resolvent is connected by lines to its two parent clauses. Use the clauses below as the initial set of nodes in the graph.
Note: You do not need to use all the nodes, and you may use a node more than once.

¬B ∨ ¬C ¬B A ∨ ¬B D ∨ ¬A ∨ B C A

Q5. [35 pts] Consider a vocabulary with the following symbols:
Occupation(p, o): Predicate, Person *p* has occupation *o*
*Customer(p*1,*p*2*)*: Predicate, Person *p*1 is a customer of person *p*2
*Boss(p*1, *p*2*)*: Predicate, Person *p*1 is a boss of person *p*2
Doctor, Surgeon, Lawyer, Actor: Constants denoting occupations
Emily, Joe: Constants denoting people

Use these symbols to write the following assertions in first-order logic:

a) [5 pts] Emily is either a surgeon or a lawyer
b) [5 pts] Joe is an actor, but he also holds another job
c) [5 pts] All surgeons are doctors
d) [5 pts] Joe does not have a lawyer (i.e., is not a customer of any lawyer)
e) [5 pts] Emily has a boss who is a lawyer
f) [5 pts] There exists a lawyer all of whose customers are doctors
g) [5 pts] Every surgeon has a lawyer