CS 4804 Midterm Exam

Name:

ID:

1. (10 points) What is the name of the search algorithm that uses $f(n) = -g(n)$ as the node evaluation function? Is this algorithm optimal? Is it complete? Assume path costs are non-decreasing as you go down a path.

2. (30 points) Give an example of a 4-node constraint graph that is arc-consistent but not 3-consistent. For ease of illustration, you can use a graph coloring example. Clearly label the nodes with the variables, identify the domains of each variable, and label the edges in the graph with the constraints. Explain why your graph is not 3-consistent.

3. (20 points) In the 'cute word puzzle,' the goal is to make up five-letter words where four of them are vowels (i.e., 'a,' 'e,' 'i,' 'o,' 'u'). An example cute word is 'queue'; another is 'uigoa.' Even though only the first word makes sense in English, both are considered valid answers to the puzzle.

   Pose the cute word puzzle as a boolean satisfiability (SAT) problem in CNF form, i.e., the boolean expression must be a conjunction of disjunctions of propositional variables. For full credit, state what the variables are, how many there are, and identify the clauses they participate in. Give enough examples of the clauses to convince us that you understand what is going on.

4. (12 points) Given the following:

   > If the unicorn is mythical, then it is immortal, but if it is not mythical, then it is a mortal mammal. If the unicorn is either immortal or a mammal, then it is horned. The unicorn is magical if it is horned.

   Using only propositional logic, attempt to establish the truth/falsehood of the following statements. Simply saying true/false will not fetch any points. Use propositional logic symbols and inference rules (e.g., Modus Ponens, resolution) to make your conclusions.

   - The unicorn is magical.
   - The unicorn is horned.

5. (8 points) Given that P and Q are propositional variables, is $P \wedge Q \models P \Leftrightarrow Q$ true? Irrespective of your answer to the above, attempt to prove it by resolution-refutation. What do you learn?

6. (20 points) Given the two sentences:
   (a) Everybody loves somebody.
   (b) There is a certain somebody who is loved by everybody.
   prove that (b) logically entails (a). You are allowed to use only the predicate:
   - loves(x,y): person x loves person y.

   For full credit, state the two given sentences in first order predicate logic (5 points), convert to clauses suitable for resolution-refutation (10 points), and prove a contradiction (5 points).