CS-171, Intro to A.I. — Quiz#3 — Spring Quarter, 2011 — 20 minutes

YOUR NAME AND EMAIL ADDRESS: _____

YOUR ID: _____ ID TO RIGHT: _____ ROW: _____ NO. FROM RIGHT: _____

1. (20 pts total, 2 pts each) Logic concepts.

For each of the following terms on the left, write in the letter corresponding to the best answer or the correct definition on the right. The first one is done for you as an example.

A .	Logic	A	Formal symbol system for representation and inference
	Valid	B	Specifies all the sentences that are well formed
	Complete	C	Defines the truth of each sentence in each possible world
	Semantics	D	The idea that a sentence follows logically from other sentences
	Conjunctive Normal Form	E	True in every possible world
	Sound	F	True in at least one possible world
	Satisfiable	G	False in every possible world
	Syntax	H	Inference system derives only entailed sentences
	Horn Clause	I	Inference system can derive any sentence that is entailed
	Unsatisfiable	K	A sentence expressed as a conjunction of clauses (disjuncts)
	Entailment	L	Clause with at most one positive literal

2. (20 pts total, 5 pts off for each wrong answer, but not negative) Quantifiers.

In this problem, Likes(A, B) means A likes B, and Sister(A, B) means A is a sister of B. Single-argument predicates have their intended meaning; Cat(A) means A is a cat, etc.

Fill in each blank below with Y (= Yes) or N (= No) depending on whether the first order logic sentence correctly expresses the English sentence.

2a. _____ "All cats are mammals." $\forall x\ \text{Cat}(x) \wedge \text{Mammal}(x)$

2b. _____ "Spot has a sister who is a cat." $\exists x\ \text{Sister}(x, \text{Spot}) \wedge \text{Cat}(x)$

2c. _____ "Every person has someone that they like." $\exists x \forall y\ \text{Likes}(x, y)$

2d. _____ "There is someone who likes everyone." $\forall x \exists y\ \text{Likes}(x, y)$

2e. _____ "Everyone likes ice cream." $\neg\ \exists x \neg\ \text{Likes}(x, \text{IceCream})$

2f. _____ "All men are mortal." $\forall x\ \text{Man}(x) \Rightarrow \text{Mortal}(x)$

3. (10 pts total, 5 pts each) Conversion to Conjunctive Normal Form.

Convert the following sentences to Conjunctive Normal Form (i.e., write each as the conjunction of one or more clauses, with each clause the disjunction of a set of literals).

3a. $Q \Rightarrow S$. _____

3b. $P \Leftrightarrow Q$. _____

****** TURN PAGE OVER. QUIZ CONTINUES ON THE REVERSE ******

4. (25 pts total, 5 pts each) Derivation and Entailment.
In each of the following, KB is a set of sentences, {} is the empty set of sentences, and S is a single sentence. Recall that |= is read "entails" and that |- is read "derives."

For each blank below, write in the key below that corresponds to the best term.

Snd = Sound.	U = Unsound.
C = Complete.	I = Incomplete.
Sat = Satisfiable.	Unsat = Unsatisfiable.
V = Valid.	N = None of the above.

The first one is done for you as an example.

4a. Let S be given in advance. Suppose that {} |= S. Then S is **V** .

4b. Let S be given in advance. Suppose that for some KB1, KB1 |= S; but that for some other KB2, KB2 |= ¬S. Then S is _____.

4c. Suppose that for any KB and any S, whenever KB |= S then KB |- S.
Then the inference procedure is _____.

4d. Suppose that for some KB and some S, KB |- S but not KB |= S.
Then the inference procedure is _____.

4e. Suppose that for some KB and some S, KB |= S but not KB |- S.
Then the inference procedure is _____.

4f. Suppose that for any KB and any S, whenever KB |- S then KB |= S.
Then the inference procedure is _____.

5. (25 pts total, 5 pts each) Resolution.
Write the clause that results from resolving each pair of clauses below, or "None" if no resolution is possible. In cases where more than one resolvent is possible, your answer will be deemed correct if you produce any one of the possible resolvents. The first one is done for you as an example.

5a. (A) resolved with (¬A) results in ()

5b. $(A \vee B \vee C)$ resolved with $(\neg A)$ results in _____

5c. $(A \vee B \vee C)$ resolved with $(A \vee B \vee D)$ results in _____

5d. $(A \vee B \vee C)$ resolved with $(\neg A \vee D \vee E)$ results in _____

5e. $(A \vee B)$ resolved with $(\neg A \vee B)$ results in _____

5f. $(\neg P_{2,1} \vee B_{1,1})$ resolved with $(\neg B_{1,1} \vee P_{1,2} \vee P_{2,1})$ results in _____