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
E	Valid	B	Specifies all the sentences that are well formed
I	Complete	C	Defines the truth of each sentence in each possible world
C	Semantics	D	The idea that a sentence follows logically from other sentences
K	Conjunctive Normal Form	E	True in every possible world
H	Sound	F	True in at least one possible world
F	Satisfiable	G	False in every possible world
B	Syntax	H	Inference system derives only entailed sentences
L	Horn Clause	I	Inference system can derive any sentence that is entailed
G	Unsatisfiable	K	A sentence expressed as a conjunction of clauses (disjuncts)
D	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. __N__ "All cats are mammals." $\forall x$ Cat(x) $\wedge$ Mammal(x) **$\forall x$ Cat(x) $\Rightarrow$ Mammal(x)**

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

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

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

2e. __Y__ "Everyone likes ice cream." $\neg \exists x \neg$ Likes(x, IceCream)

2f. __Y__ "All men are mortal." $\forall$x Man(x) $\Rightarrow$ 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. __$\neg$ Q $\vee$ S__

3b. P $\Leftrightarrow$ Q. __(P $\vee$ $\neg$ Q) $\wedge$ ($\neg$ P $\vee$ Q)__ ***This is equivalent to* (P $\wedge$ Q) $\vee$ ($\neg$ P $\wedge$ $\neg$ Q)**

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 **Sat** .

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

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

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

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

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 ($\neg$A) results in () ***equivalent to False, also OK***

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

5c. (A $\vee$ B $\vee$ C) resolved with (A $\vee$ B $\vee$ D) results in None

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

5e. (A $\vee$ B) resolved with ($\neg$A $\vee$ B) results in (B) ***(B $\vee$ B) is also OK***

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 ($\neg B_{1,1} \vee P_{1,2} \vee B_{1,1}$)
also results in ($P_{1,2} \vee P_{2,1} \vee \neg P_{2,1}$) ***which is also OK***
Both of these sentences also are equivalent to True, which is also OK.