Homework #3: Chapters 7 and 8

The following exercises are due at the beginning of class on Monday, February 25. Note, there is a question on the reverse of this sheet.

1. [20 pts. total] Consider a knowledge base $KB$ that contains the following propositional logic sentences:
   
   $P \lor R \Rightarrow Q$
   
   $P \Rightarrow \neg Q$
   
   $Q \vee R$

   a) Construct a truth table that shows the truth value of each sentence in $KB$ and indicate the models in which the $KB$ is true.
   b) Does $KB$ entail $R$? Use the definition of entailment to justify your answer.
   c) Does $KB$ entail $R \Rightarrow P$? Use the definition of entailment to justify your answer.
   d) Does $KB$ entail $\neg Q \land R$? Extend the truth table and use the definition of entailment to justify your answer.

2. [10 pts.] In propositional logic, does an empty knowledge base (i.e., a knowledge base containing only the sentence $true$) entail anything? Explain your answer.

3. [50 pts.] Do exercise 8.24 (a - j) from the book (p. 319). Use the following constants and predicates (and no others):

   - $F$: a constant representing French
   - $G$: a constant representing Greek
   - $S$: a constant representing Spring 2001
   - $UK$: a constant representing the U.K.
   - $Agent(x)$: $x$ is an agent
   - $Barber(x)$: $x$ is a barber
   - $Expensive(x)$: $x$ is expensive
   - $Insured(x)$: $x$ is insured
   - $LocalMan(x)$: $x$ is a man living in the town
   - $Person(x)$: $x$ is a person
   - $Policy(x)$: $x$ is a policy
   - $Semester(x)$: $x$ is a semester
   - $Smart(x)$: $x$ is smart
   - $Student(x)$: $x$ is a student
   - $BornIn(x,c)$: person $x$ is born in country $c$
   - $Buys(x,y)$: person $x$ buys item $y$
   - $CitizenByBirth(x,c)$: person $x$ is a citizen by birth in country $c$
   - $CitizenByDescent(x,c)$: person $x$ is a citizen by descent in country $c$
   - $CitizenOf(x,c)$: person $x$ is a citizen of country $c$
   - $GreaterThan(x,y)$: $x > y$. You may assume that the standard mathematical semantics apply to this predicate.
   - $Parent(x,y)$: person $x$ is the parent of $y$
   - $Passes(x,c)$: student $x$ passes course $c$
   - $ResidentOf(x,c)$: person $x$ is a resident of country $c$
   - $Sells(s,x,b)$: person $s$ sells item $x$ to person $b$
   - $Score(x,c,s,n)$: student $x$ received a score of $n$ when taking course $c$ in semester $s$.
   - $Shaves(x,y)$: person $x$ shaves person $y$
   - $TakesCourse(x,c,s)$: student $x$ takes course $c$ in semester $s$.
4. [20 pts.] Represent the following sentences in first order logic, assuming that the domain consists only of people. The only predicates you may use are loves(x,y), knows(x,y), and avoids(x,y), where a predicate of form Predicate(x,y) means that “x Predicate y.” Choose meaningful constants where appropriate.

a) Somebody knows and loves Tim.
b) Everybody who knows Sue avoids Sue.
c) There is somebody that everybody loves.
d) Nobody knows everybody.
e) There are some people who love nobody but themselves.