Homework #3: Chapters 7 and 8

The following exercises are due at the beginning of class on Monday, March 1.

1. [25 pts. total] Consider a knowledge base $KB$ that contains the following propositional logic sentences:

   $P \lor R \Rightarrow Q$
   $\neg P \Rightarrow R$
   $Q \lor R$

   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 $Q$? 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 $P \lor Q$? Extend the truth table and use the definition of entailment to justify your answer.

2. [10 pts.] Prove each of the following assertions regarding propositional logic:

   a) $\alpha \models \beta$ if and only if the sentence $(\alpha \Rightarrow \beta)$ is valid.
   
   b) $\alpha \models \beta$ if and only if the sentence $(\alpha \land \neg \beta)$ is unsatisfiable.

3. [50 pts.] Do exercise 8.6 (a - j) from the book (p. 268). 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
   - $Smart(x)$: $x$ is smart
   - $Student(x)$: $x$ is a student
   - $Score(c,s)$: $s$ is a score for course $c$
   - $BornIn(x,c)$: 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 $x$ has parent $y$
   - $Passes(x,c)$: 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 $b$
   - $Shaves(x,y)$: person $x$ shaves person $y$
   - $TakesCourse(x,c,s)$: student $x$ takes course $c$ in semester $s$

4. [15 pts.] Do exercise 8.16 from the book (p. 270). Your axioms should be consistent with those defined on pages 258-260. You may also use any predicates already defined for the Wumpus world.