Steve Harman
CIS 630 HW #3

1)

i. $Q \rightarrow P$

ii. $R \lor S$

iii. H = Harry has a car; J = Jim has a car.

$H \land \sim J$

2) (1) $P \rightarrow (\sim Q \land S)$; (2) $S \land \sim W$; (3) $P \lor R$; (4) $S \rightarrow (\sim Q \land T)$; (5) $R \rightarrow W$

i. Derive: $\sim W \land \sim Q$

6. $\sim W$	by AND elimination, 2
7. $S \rightarrow (\sim Q \land T)$, S	4, by AND elimination and 2
8. $\sim Q \land T$	by Modus Ponens
9. $\sim Q$	by AND elimination and 8
10. $\sim W \land \sim Q$	by 7, 9 AND introduction

ii. Derive: $\sim P$

6. $\sim W$	by AND elimination and 2
7. $R \rightarrow W$, $\sim W$	5, 6
8. $\sim R$	by Modus Tolens
9. $P \lor R$, $\sim R$	3, 8
10. P	Unit Resolution.

iii. Derive: $\sim(Q \land S)$

6. $\sim S \lor (\sim Q \land T)$	4, implication elimination
7. S	by AND elimination and 2
8. $(\sim Q \land T)$	by 6, 7, AND elimination
9. $\sim Q$	by AND elimination and 8
10. $\sim Q \lor \sim S$	9, 7
11. $\sim(Q \land S)$	10, De Morgan

3) Green{Frog, Pine Needle}; Frog{GEORGE, FREDDY}; Croaks{Frog, Reds fans}; Lives_in_BuckeyeCreek{HEF, GEORGE}

i. Green(Frog(FREDDY))

ii. $\forall$ x Frog(x) $\rightarrow$ Croaks(x)

iii. $\exists$ x Frog(x) $\land$ Lives_in_BuckeyeCreek(x)

4) By stating P(a) and P(b) in the KB, this means that 'a' exists in P, and 'b' exists in P. Therefore, all that is known for the KB model is that both 'a' and 'b' exist in P. Then the KB can state that for all 'x', 'x' exists in P, since the KB model only has two instances, both that make sense with this claim.

5) 8.6 – Vocabulary:

Student(x) = x is some student

Took_French_SP_01(x) = x took French in spring 2001

Took_Greek_SP_01(x) = x took Greek in spring 2001

Takes_French(x) = x takes a French class

Passes_French(x) = x passes a French class
Only_Student_in_Class(x) = x was only student in the class
Top_in_Greek(x) = x had best score in Greek
Top_in_French(x) = x had best score in French
Higher(x1, x2) = x1 is higher than x2
Policy_Buyer(x) = x buys a policy
Smart(x) = x is smart
Barber_Shaved(x) = x is a man in town shaved by the barber
Doesn't_Shave_Self(x) = x is a man in town who doesn't shave himself
Born_in_UK(x) = x is a person born in the UK
Parents_UK(x) = x has parents who are UK citizens by birth
UK_Citizen_by_Birth(x) = x is a UK citizen by birth

a) Some students took French in spring 2001.
∃ x Student(x) Λ Took_French_SP_01(x)
b) Every student who takes French passes it.
∀ x (Student(x) Λ Takes_French(x)) ↔ Passes_French(x)
c) Only one student took Greek in Spring 2001.
∃ x Student(x) Λ Took_Greek_SP_01(x) Λ Only_Student_in_Class(x)
d) The best score in Greek is always higher than the best score in French.
∃ x, y Higher(Top_in_Greek(x), Top_in_French(y))
e) Every person who buys a policy is smart.
∀ x Policy_Buyer(x) → Smart(x)
h) There is a barber who shaves all men in town who does not shave themselves
∀ x Doesn't_Shave_Self(x) → Barber_Shaved(x)
i) A person born in the UK, each of whose parents is a UK citizen by birth, is a UK citizen by decent.
∀ x (Born_in_UK(x) Λ Parents_UK(x)) → UK_Citizen_by_Birth(x)

6) If we define the *Spouse(x,y)* relationship to include a person from both the male and female subsets, then since we know Jim is from the male subset by the *Male(Jim)* statement, then we can infer that *Female(Laura)* since this is needed to fulfill the *Spouse(x,y)* relationship.

7) a)

- BREEZE(x,y) means that a breeze is sensed in square x,y
- PIT(x,y) means that square x,y contains a pit
- GLITTER(x,y) means that glitter is sensed in square x,y
- GOLD(x,y) means that square x,y contains the gold
- WUMPUS(x,y) means that square x,y contains the wumpus
- STENCH(x,y) means that a stench is sensed in square x,y
- ARCHER(x,y) means that the archer is in square x,y
- hasArrow(ARCHER) means that the archer has his arrow (in other words, he hasn't shot the arrow yet).

BREEZE(2,1)
BREEZE(4,1)
BREEZE(3,2)
BREEZE(2,3)
BREEZE(4,3)
BREEZE(3,4)
STENCH(1,2)
STENCH(2,3)
STENCH(1,4)
GLITTER(2,3)
GOLD(2,3)
PIT(3,1)
PIT(3,3)
PIT(4,4)
WUMPUS(1,3)
ARCHER(1,1)
hasArrow(ARCHER(1,1))

If you have a perception GLITTER(x,y), then you are in a square with the gold, so you have GOLD(x,y).

If you perceive ~BREEZE(x,y) and ~STENCH(x,y) then you know that the neighboring squares are OK.

If you perceive a BREEZE(x,y) then you know that there must be a pit in a neighboring square, however we also know that the pit can’t be in any square marked OK.

If you perceive a STENCH(x,y) then you know that there must be a Wumpus in a neighboring square, however we also know that the Wumpus can’t be in any square marked OK.

b) Since we didn't detect a breeze nor a stench in square (2,2) then we know that each of it's adjacent squares (above, below, left, and right) are OK. Because (2,3) is above (2,2), we know that it is OK, and therefore ~PIT(2,3).