Assignment 5
Name: Guanqun Mao
UCLA ID: 204777289

1.
P⇒¬Q, Q⇒¬P

P	Q	¬P	¬Q	¬P∨¬Q [P⇒¬Q]	¬Q∨¬P [Q⇒¬P]
T	F	F	T	T	T
T	T	F	F	F	F
F	F	T	T	T	T
F	T	T	F	T	T

P⇔¬Q, ((P∧¬Q)∨(¬P∧Q))

P	Q	¬P∨¬Q [P⇒¬Q)]	Q∨P [¬Q⇒P]	(¬P∨¬Q)∧(QVP) [P⇔¬Q]	P∧¬Q	¬P∧Q	((P∧¬Q)∨(¬P∧Q))
T	T	F	T	F	F	F	F
T	F	T	T	T	T	F	T
F	T	T	T	T	F	T	T
F	F	T	F	F	F	F	F

2.
(Smoke ⇒ Fire) ⇒ (¬Smoke ⇒ ¬Fire)
It's neither. (satisfiable)
It's not valid because there exists a M(Smoke ⇒ Fire) that doesn't belong to M(¬Smoke ⇒ ¬Fire).
It's not unsatisfiable because M((Smoke ⇒ Fire) ⇒ (¬Smoke ⇒ ¬Fire)) != ∅.

Smoke	Fire	Smoke ⇒ Fire [¬Smoke ∨ Fire]	¬Smoke ⇒ ¬Fire [Smoke ∨ ¬Fire]	(Smoke ⇒ Fire) ⇒ (¬Smoke ⇒ ¬Fire)
T	T	T	T	T

T	F	F	T	T
F	T	T	F	F
F	F	T	T	T

(Smoke ⇒ Fire) ⇒ ((Smoke ∨ Heat) ⇒ Fire)
It’s neither. (satisfiable)
It’s not valid because there exists a M(Smoke ⇒ Fire) that doesn’t belong to M((Smoke ∨ Heat) ⇒ Fire).
It’s not unsatisfiable because M((Smoke ⇒ Fire) ⇒ ((Smoke ∨ Heat) ⇒ Fire)) != ∅.

Smoke	Fire	Heat	(Smoke ⇒ Fire)	(Smoke ∨ Heat)	((Smoke ∨ Heat) ⇒ Fire)	(Smoke ⇒ Fire) ⇒ ((Smoke ∨ Heat) ⇒ Fire)
T	T	T	T	T	T	T
T	T	F	T	T	T	T
T	F	T	F	T	F	T
T	F	F	F	T	F	T
F	T	T	T	T	T	T
F	T	F	T	F	T	T
F	F	T	T	T	F	F
F	F	F	T	F	T	T

((Smoke ∧ Heat) ⇒ Fire) ⇔ ((Smoke ⇒ Fire) ∨ (Heat ⇒ Fire))
It’s valid because M(((Smoke ∧ Heat) ⇒ Fire) ⇔ ((Smoke ⇒ Fire) ∨ (Heat ⇒ Fire))) = whole set.

S	F	H	S∧H	S⇒F	H⇒F	(S∧H)⇒F	(S⇒F)∨(H⇒F)	((S∧H)⇒F)⇒((S⇒F)∨(H⇒F))	((S⇒F)∨(H⇒F))⇒((S∧H)⇒F)	((S∧H)⇒F)⇒((S⇒F)⇔(H⇒F))

T	T	T	T	T	T	T	T	T	T	T
T	T	F	F	T	T	T	T	T	T	T
T	F	T	T	F	F	F	F	T	T	T
T	F	F	F	F	T	T	T	T	T	T
F	T	T	F	T	T	T	T	T	T	T
F	T	F	F	T	T	T	T	T	T	T
F	F	T	F	T	F	T	T	T	T	T
F	F	F	F	T	T	T	T	T	T	T

3.
(a)
Define variables: mythical, mortal, mammal, horned.
mythical ⇒ ¬mortal
¬mythical ⇒ (mortal ∧ mammal)
¬mortal ∨ mammal ⇒ horned
horned ⇒ magical

(b)
KB = (¬mythical ∨ ¬mortal) ∧
(mythical ∨ (mortal ∧ mammal)) ∧
(¬(¬mortal ∨ mammal) ∨ horned) ∧
(¬horned ∨ magical)
= (¬mythical ∨ ¬mortal) ∧ (mythical ∨ mortal) ∧ (mythical ∨ mammal) ∧
((mortal ∧ ¬mammal) ∨ horned) ∧ (¬horned ∨ magical)
= (¬mythical ∨ ¬mortal) ∧ (mythical ∨ mortal) ∧ (mythical ∨ mammal) ∧
(mortal ∨ horned) ∧ (¬mammal ∨ horned) ∧ (¬horned ∨ magical)

(c)
Use the knowledge base to prove that the unicorn is mythical:
KB:
1. (¬mythical ∨ ¬mortal)
2a. (mythical ∨ mortal)
2b. (mythical ∨ mammal)
3a. (mortal ∨ horned)
3b. (¬mammal ∨ horned)
4. (¬horned ∨ magical)

Assuming unicorn is not horned, adding to KB:
5. ¬horned
We can get following:
6. ¬mammal (3b+5)
7. mortal (3a+5)
8. mythical (2b+6)
9. ¬mythical (1+7)
10. empty set (8+9)
Therefore, a unicorn is horned is proved by contradiction.

Now that we have proved that unicorn is horned, we can add horned to KB.
1. (¬mythical ⋁ ¬mortal)
2a. (mythical ⋁ mortal)
2b. (mythical ⋁ mammal)
3a. (mortal ⋁ horned)
3b. (¬mammal ⋁ horned)
4. (¬horned ⋁ magical)
5. horned

Similarly, assuming unicorn is not magical, adding to KB:
6. ¬magical
7. ¬horned (4+6)
8. Empty set (5+7)
Therefore, a unicorn is magical is proved by contradiction.

We cannot prove a unicorn is mythical because no resolution can be made.