Q1

We have following propositions:

P1: mythical -> immortal

P2 : $\neg$mythical -> ($\neg$immortal $\wedge$ mammal)

P3 : (immortal $\vee$ mammal) -> horned

P4 : horned -> magical

$\neg$Immortal -> $\neg$mythical

$\equiv$ $\neg$Immortal -> ($\neg$immortal $\wedge$ mammal)

$\equiv$ Immortal $\vee$ ($\neg$immortal $\wedge$ mammal)

$\equiv$ (Immortal $\vee$ $\neg$immortal) $\wedge$ (Immortal $\vee$ mammal)

$\equiv$ (Immortal $\vee$ mammal)

$\equiv$ horned

$\equiv$ magical

Therefore, it is magical and horned. There is no way to justify it is mythical.

Q2

Define vocabulary:

Student(x) : person x is a student

Take(x,y) : Student x take course y

Failed(x,y) : Student x failed course y

Person(x) : x is a person

Vegetarian(x) : x is a vegetarian

Like(x,y) : x likes y

Smart(x) : x is smart

Homework(x,y) : x do homework for y

a. $\neg\forall$x (Student(x) -> (Take(x,history) $\wedge$ Take(x,Biology))
b. $\exists$x (Student(x) $\wedge$ Failed(x,history)) $\wedge$ $\forall$y (Student(y) $\wedge$ Failed(x,history)) -> x = y
c. $\forall$x (Person(x) $\wedge$ ($\forall$y vegetarian(y) -> $\neg$like(x,y)) -> smart(x)
d. $\forall$x$\forall$y (person(x) $\wedge$ vegetarian(y) $\wedge$ smart(y)) -> $\neg$like(x,y)
e. $\exists$x student(x) $\wedge$ $\forall$y homework(x,y) $\equiv$ $\neg$ homework(y,y)

Q3

I. Begin with the rule true -> 1

II. $R_{gpa} = 4/7 = 0.57$ $R_{ust} = 1/3 = 0.33$ $R_{hku} = 2/4 = 0.5$ $R_{cu} = 1/4 = 0.25$ $R_{rec} = 4/8 = 0.5$ $R_{exp} = 3/4 = 0.75$ Generating EXP -> 1
The rule covers negative instance, continue this rule.

III. $R_{gpa} = 3/3 = 1$ $R_{ust} = 0$ $R_{hku} = 2/2 = 1$ $R_{cu} = 1/1 = 1$ $R_{rec} = 3/3 = 1$
Generating EXP $\wedge$ GPA -> 1
This Rule does not cover negative instance, we stop. Eliminate from the samples and continue to another rule

I. Begin with the rule true -> 1

II. R_{gpa} = 1/4 = 0.25 R_{ust} = 1/3 = 0.33 R_{hku} = 0 R_{cu} = 0 R_{rec} = 1/5 = 0.2 R_{exp} = 0
Generating GPA -> 1.
The rule covers negative instance, continue this rule.

III. R_{ust} = 1/2 = 0.5 R_{hku} = 0 R_{cu} = 0 R_{rec} = 1/3 = 0.33 R_{exp} = 0
Generating GPA ∧ UST -> 1.
This rule cover negative instance, continue

IV. R_{hku} = 0 R_{cu} = 0 R_{rec} = 1
Generating GPA ∧ UST ∧ REC -> 1.
This rule does not convers negative instance, stop

(EXP ∧ GPA) ∨ (GPA ∧ UST ∧ REC) covers all of the positive instances, we stop.

Q4

P(A) = .001 * .002 * .95 + .001 * .998 *.94 + .999 * .002 *.29 + .999*.998*.001 = 0.0025
P(¬A) = 1 – P(A) = 0.9975

P(M) = .0025 * .70 + .9975 * .01 = 0.0117

P(J ∧ M) = P(J ∧ M ∧ A) * P(J ∧ M ∧ ¬A)
= P(J ∧ M | A) * P(A) + P(J ∧ M | ¬A) * P(¬A)
= .90 * .70 * .0025 + .05 * .01 * .9975 = 0.0020
P(J | M) = P(J ∧ M) / P(M) = 0.0020 / 0.0117 = 0.1709

Q5

1. Yes
   All undirected paths from Test 1 to Test2:
   (Test1, Disease2, Test2),
   (Test1, Disease2, Symptom3, Disease3, Test3, Disease2, Test2),
   (Test1, Disease1, Symptom2, Disease2, Test2),
   (Test1, Disease1, Symptom2, Disease2, Symptom3, Disease3, Test3, Disease2, Test2).

   For Disease 2, it is type head-to-head, block all the path
2. No
   (Disease1, Test1, Disease2) is not block
3. Yes
   Same as question1, For Disease 2, it is type head-to-head, block all the path
4. All paths from Disease1 to Disease2:
   (Disease1, Test1, Disease2)
   (Disease1, Symptom2, Disease2), which is block

   $Therefore,$ Test1 $\in E$ and Symptom2 $\notin E$.
5. E = {Test1, Disease2, Symptom2, Symptom3}

Q6

The unique Nash equilibrium point is (Pol:Expand, Fed:contract)

Q7:

A set of agents N = (1,2)

A set of actions of both agents: A = (1,2,3,4,5,6)

Utility function: $U_i(x_1,x_2) = 6 – x_i$ if agent I wins ($x_1 > x_2$) else 0

	1	2	3	4	5	6
1	2.5,2.5	0,4	0,3	0,2	0,1	0,0
2	4,0	2,2	0,3	0,2	0,1	0,0
3	3,0	3,0	1.5,1.5	0,2	0,1	0,0
4	2,0	2,0	2,0	1,1	0,1	0,0
5	1,0	1,0	1,0	1,0	0.5,0.5	0,0
6	0,0	0,0	0,0	0,0	0,0	0,0

Therefore three nash quilibria points: (4,4), (5,5), (6,6)