1- General Concepts:

1- T   2- T   3- F   4-F   5-F   6-F   7-F   8- T   9- F   10-T   11-F   12- T

13-part of   14- does not infer false statements   15- derives any sentence that is entailed

16- valid   17- a ∧¬b   18- horn   19- backward   20-tautology

2- Truth tables:

a)

A	B	C	A ∧ B	α = (A ∧ B) ∨ C	¬C	A ∨ ¬C	B ∨ C	KB= (A ∨ ¬C) ∧ (B ∨ C)
T	T	T	T	T	F	T	T	T
T	T	F	T	T	T	T	T	T
T	F	T	F	T	F	T	T	T
T	F	F	F	F	T	T	F	F
F	T	T	F	T	F	F	T	F
F	T	F	F	F	T	T	T	T
F	F	T	F	T	F	F	T	F
F	F	F	F	F	T	T	F	F

Rubrics: each row one point.

b) No, in the colored row, the KB is true but α is not. So KB does not entail α.

Rubrics: no partial credit.

3- Propositional logic

a) ¬((A ⇒ B) ⇒ (((P^B) ⇒ Q) v R))

¬(¬(A⇒B) v (¬(P^B) v Q v R))

¬ (¬(¬A v B) v (¬P v ¬B v Q v R))

(¬A v B) ∧ P ∧ B ∧ ¬Q ∧ ¬R

b)

● Modus tollens on 3,4 ⇒ ¬study   (2 points)

● And Introduction on 6,7 ⇒ HomewvkDueNextWeek ∧ HighWeightageOfHomewvk (11)

Modus Ponens on 2,11 ⇒ WvkOnHW (4 points)

● Modus tollens on 1,8 ⇒ ¬ExamNextWeek (12)

Modus tollens on 5,12 ⇒ ¬StudyBreak   (4 points)

Rubrics: every method except using inference rules got half points. Not mentioning the name of the inference rule is -1 in each part.

c) To prove W, we add ¬W to the KB :

KB : ¬W , P , ¬Q, ¬P v R , ¬Q v W , ¬W v P , ¬R v W
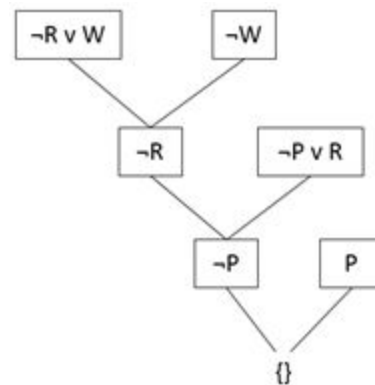
Rubrics: other solutions also exist.

4- First Order Logic

1- (blue texts are the answer with this assumption that fails(x,y,z) also implies that takes(x,y,z)

a) ∀ x,z ((Student(x) ∧ Semester(z)) ⇒ ∃ y,t (Course(y) ∧ Course(t) ∧ Takes(x,y,z) ∧ Takes(x,t,z) ∧ y≠t))

b) ∃ x (Student(x) ∧ takes(x,History,S2015) ∧ Failed(x, History,S2015) ∧ ∀ y (Student(y) ∧ takes(y,History,S2015) ∧ Failed(y, History,S2015) ⇒ x = y))

∃ x (Student(x) ∧ Failed(x, History,S2015) ∧ ∀ y (Student(y) ∧ Failed(y, History,S2015) ⇒ x = y))

∃ x (Student(x) ∧ Failed(x, History,S2015) ∧ ∀ y (x≠y ∧ Student(y) ⇒ ¬Failed(y, History,S2015)))

c) ¬ ∃ x (Student(x) ∧ takes(x,Chemistry,S2015) ∧ Failed(x, Chemistry,S2015)) ∧ ∃ y (Student(y) ∧ takes(y,History,S2015) ∧ Failed(y, History,S2015))

¬ ∃ x (Student(x) ∧ Failed(x, Chemistry,S2015)) ∧ ∃ y (Student(y) ∧ Failed(y, History,S2015))

d) ∀ x,z (Student(x) ∧ Semester(z)∧ Takes(x, Analysis,z) ⇒ Takes(x, Geometry,z))

∀ x,z (Student(x) ∧ Semester(z)∧ Takes(x, Analysis,z) ⇒ ∃ y (Semester(y) ∧Takes(x, Geometry,y)))

e) ¬ ∃ x,z (Student(x) ∧ Semester(z)∧ takes(x, Analysis,z) ∧ takes(x,History,z))

Rubrics:Every subquestion is 3 pts. Making at most 1 error in predicate or parameter or quantifier or logical connectives, especially Student() Course() Semester(), can only get 1 pt. (more than 1 error will get 0 since it's required basic knowledge of FOL)

2-
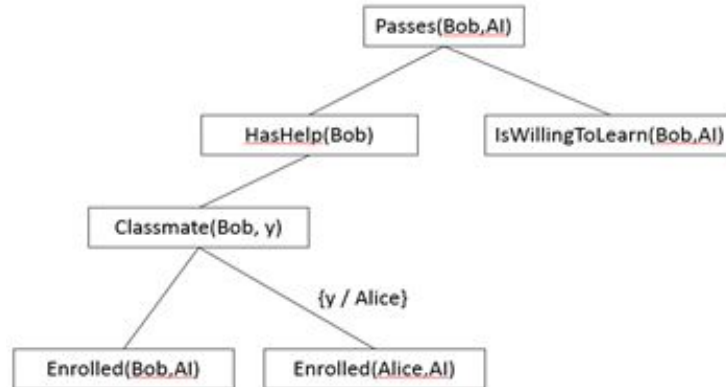
Rubrics:Didn't use backward chaining method -4. Missing unification -2. Missing any box -2. Parameter error -1. Up to -10.

3- not complete due to infinite loops. When a loop is detected, suspend the loop branch and try other branches until getting this subgoal or no solution.

Rubrics:NO is 1pt. Explain 2pts. You can get full points if you explain it right without say No.

4- Algorithms exist that return YES to every entailed sentence, but no algorithm exists that also returns NO to every nonentailed sentence

Rubrics:no partial

5-Planning

1- 4

2- E, F

3- E

4- If we add an ordering constraint to F, so that it occurs before B. (Multiple possible answer, like add one more B between EC, but no change order of BEC and no remove any steps)

Rubrics:no partial Q1-Q4

5- No, For example if we go to finish from F, g will not be true.

Rubrics:NO is 1pt. Good justification 1pt