**Question 1 [12 Points]**
**Express each of the following English sentences in FOPC**

1. a student will pass an exam if the student study and does not cheat in the exam

$\forall x \forall y (student(x) \wedge exam(y) \wedge \neg cheat(x,y) \rightarrow pass(x,y))$

2. only yellow birds, that like cats, sing

$\forall x \forall y (sing() \rightarrow birds(x) \wedge yellow(x) \wedge cats(y) \wedge like(x,y))$

3. In every IT-course there are some students who wrote some good programs

$\forall x \exists y \exists z (course(x) \wedge student(y) \wedge program(z) \wedge good(z) \wedge wrote(y,z))$

4. Sami does not have a small shop in Amman

$\forall x (shop(x) \wedge small(x) \wedge in(x, Amman) \rightarrow \neg have(sami, x))$

5. a student, who does not go to the lab L, has a computer

$\forall x \exists y \exists z (student(x) \wedge lab(y) \wedge computer(z) \wedge \neg go(x,y) \rightarrow has(x,z))$

6. some small dogs are afraid of all big cats

$\exists x \forall y (dog(x) \wedge small(x) \wedge cat(y) \wedge big(y) \rightarrow afraid(x,y))$

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**Question 2 [4 Points]**
Indicate whether each of the following statements is true (T) or false (F)

1. F 2. F 3. F 4. T

2

1. $\neg(\forall x)(A(x) \rightarrow (B(x) \vee C(x))$ is equivalent to $(\exists x)(A(x) \wedge \neg B(x) \rightarrow \neg C(x))$

2. $\neg(\exists x)(A(x) \rightarrow (B(x) \wedge C(x))$ is equivalent to $(\forall x)(A(x) \wedge (B(x) \rightarrow \neg C(x))$

3. $(\forall x)(A(x) \rightarrow (B(X) \rightarrow C(x)))$ is equivalent to $(\forall x)(A(x) \wedge (\neg C(X) \rightarrow \neg B(x)))$

4. $(\forall x)(A(x) \wedge D(X) \rightarrow B(X))$ is equivalent to $(\forall x)(\neg B(x) \rightarrow (A(X) \rightarrow \neg D(x))))$

**Question 3 [8 Points]**
what is the answer to each of the following queries

a. ?- A = [], B = [[5]|A].

B = [[5]]

b. ?- C = [25|[5]].

C = [25, 5]

c. ?- [[[50], 25, 5]] = [H|Tail].

H = [[50], 25, 5]

Tail = []

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~~A ∧ B~~
~~¬(A ∧ B) ∨ B~~
~~¬A ∨ ¬B ∨ B~~
~~B ∨ (¬A ∨ ¬B)~~

d. ?- X = [2,3,[4,5]], X = [2,3|Y].

y = [[4,5]]

e. ?- X = 5+7, X = 7+5.

false

f. ?- X = 5+7, Y = X-1.

y = 5+7-1

g. ?- X = 2, Y = 3, Z = X+Y, V = Z*22.

v = 2+3*22

h. ?- X is 5, Y = 4, X = X*Y.

false

**Question 4 [6 Points]**

Write in prolog the following clauses:

a. dellast(**L, L1**) , that deletes the last element in L to return L1.

**Example**: ?- dlast([1,3,22,56],R)should returns R = [1, 3, 4, 22]

```
dlast([],[]).
dlast([X|Y],K):- dlast([Y],K1)
                 .
                 .
                 .
                 K=[X|K1]
```

2.5

**b.** addeven(L,K) where L is a list of integer numbers and K is the result of summing up all the even integer numbers of L.

Example: addeven([1,2,3,4,5,6,7,8], V) returns V = 20

```
addeven([],0)
addeven([X|Y],R):-
        N is X%10
        addeven(N,R1)
        K is X+R1
```

2