Question1	*[5 Marks]*

a) Define, discuss, or describe these terms in a sentence or two
- Conflict Resolution

It is the strategy that are used to select Which rule is chosen to fire when there are many candidate rules for firing. Example: Rule ordering, Recency, Specificity, Refraction, User-defined priority

- State space

The *state-space* is the configuration of the possible states and how they connect to each other e.g. the legal moves between states.

b) Compare:

KR scheme	Frame	Semantic Networks
Knowledge representation elements (Syntax)	1- Frame identification 2- Slots and slot values 3- Relationship to other frames	**1-** nodes (represent concepts) 2- Arcs (represents relationship)
Inference Mechanism	1- Inheritance 2- multiple inheritance construct a class precedence list	1- **Intersection search** 2- Inheritance

c) Consider the following set of rules **:**

- **R1:** if ?X was born in the Egypt THEN ?X is an Egyptian
- **R2:** if ?X received Egyptian citizenship THEN ? X is an Egyptian
- **R3:** if ?X's age >= 18 THEN ? X is an adult
- **R4:** if ?X is Egyptian AND ?x is an adult THEN ? X can vote

Where ?x is a variable and ">=" (represents greater than or equal operator)

The working memory contains the following assertions:

- **F1:** ahmed's age is 16.
- **F2:** amera received Egyptian citizenship.
- **F3:** ahmed was born in the Egypt.
- **F4:** amera's age is 20.

Solve the following problems. Show your work.

1- Use backward chaining to determine whether or not Ahmed can vote. Show the steps followed by backward chaining and how the working memory is updated

```
1.    Ahmed can vote=G1
2.                                    | (Using R4)
3.                                    |
4.                Ahmed is an Egyptian= G2 && Ahmed is an adult =G3
5.                      / (Using R1)      \ (Using R2)
6.                     /                        \
7.   Ahmed was born in the EGYPT        Ahmed receives Egyptian citizenship
8.          | (succeeds!)
9.          | WM <- { Ahmed is an Egyptian }G2 is true
10.       G3= Ahmed is an adult
11.          | (Using R3)
12.          |
13.       Ahmed 's age >= 18
14.
15.          Fails!
16.
17.       So, Ahmed cannot vote!


Rule firing order
R1->R3
Fact added to fact base
F5 Ahmed is an Egyptian
```

2- Use forward chaining determine whether or not Amera can vote. Show the steps followed by forward chaining and how the working memory is updated

```
    Using R1   Ahmed was born in the EGYPT
18.                              |
            Ahmed was born in the EGYPT
19.
20.                      Succeeds!
21.                  WM <- {F5=Ahmed is an Egyptian.}
22.
23.    Using R2
24.                          |        ?x received Egyptian citizenship
25.                          |
26.              Amera received Egyptian citizenship
27.
28.                      Succeeds!
29.                  WM <- { F6= Amera is an Egyptian.}
30.
31.    Using R3
32.                          |        ?x's age >= 18
33.                          |
34.              Amera 's age >= 18
35.
36.                      Succeeds!
37.                  WM <- { F7= Amera is an adult.}
38.
39.    Using R4      ?x is an Egyptian && ?x is an adult
                            Succeeds!
40.
41.                      /            \
42.                  WM <- { F8= Amera can vote.}
Rule firing order
R1->R2-> R3->R4
Fact added to fact base
```
F5   ,F6,F7,F8

Question2

a- You are given the following sentences in Propositional Logic defining a knowledge base.

$(Y \lor \neg Z) \Rightarrow (Y \lor X)$

$Y \Rightarrow Z$

$W \land \neg Y$

$\neg W \lor \neg Z$

I. Convert the premise sentences into conjunctive normal form (CNF)

1- $\sim((Y \lor \neg Z)) \lor (Y \lor X)$

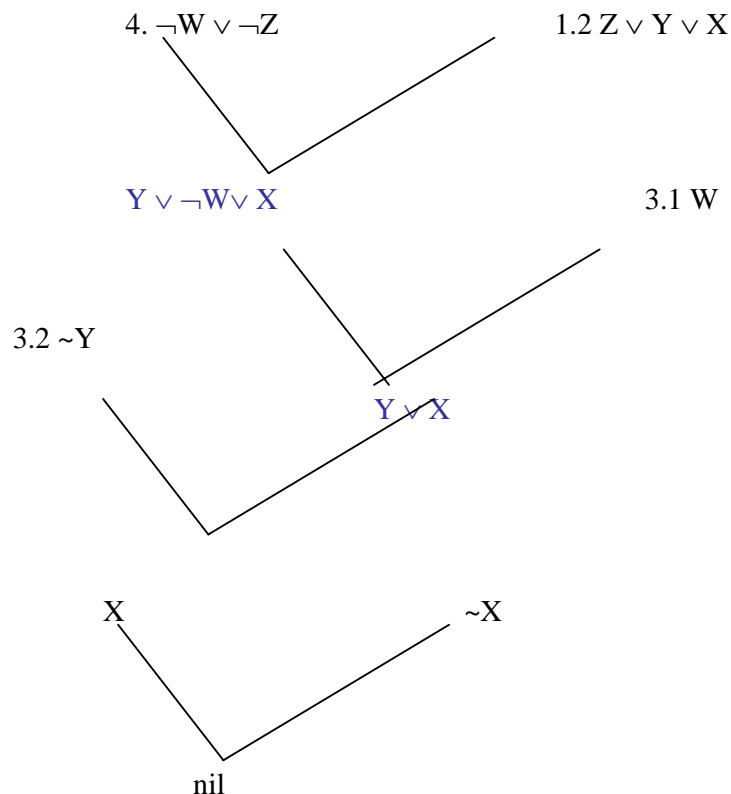$(\sim Y \land Z) \lor (Y \lor X)$

1.1 X

1.2 $Z \lor Y \lor X$

2- $\sim Y \lor Z$

3.1 W

3.2 $\sim Y$

4- $\neg W \lor \neg Z$

II. Prove the sentence X is true given the premises using the **Resolution Refutation algorithm.**

4. $\neg W \lor \neg Z$ 1.2 $Z \lor Y \lor X$

$Y \lor \neg W \lor X$ 3.1 W

3.2 $\sim Y$

$Y \lor X$

X $\sim X$

nil

a- Suppose that we have the following database:
f(0).
f(1) :- !.
f(2).
Write the answers to the following queries:
?- f(X).
X = 0 ;
X = 1 ;
No

b) ?- f(X),f(Y).
X = 0
Y = 0 ;
X = 0
Y = 1 ;
X = 1
Y = 0 ;
X = 1
Y = 1 ;
No

b) Suppose that we have the following predicate:

m(X,Y,X) :- X < Y.
m(X,Y,X) :- X1 is Y-X, m(X1,Y,Z).

Write the answers to the following queries:
   i)   ?-m(16,3,X). No.
   ii) ?-m(12,5,X). No.