### Question1

```
1- Transform axioms into clause form: [2mark]
      X \text{ (boy}(X) \text{ v } girl(X) \rightarrow child(X))
             \sim (boy(x) v girl(x)) v child(x)
             (!boy(x) \land !girl(x)) \lor child(x)
             (\sim boy(x) \ v \ child(x)) \ \Lambda \ (\sim girl(x) \ v \ child(x))
             1.1 \sim boy(x) v child(x)
             1.2 \sim girl(x) \ v \ child(x))
     Y (child(Y) -> (gets(Y,doll) v gets(Y,train) v gets(Y,coal)))
      ~child(y) v gets(y,doll) v gets(y,train) v gets(y,coal)
   3 W (boy(W) \rightarrow ets(W,doll))
       ~boy(w) v ~gets(w,doll)
   4 Z \text{ (child(Z) } \land \text{good(Z) } \rightarrow \text{gets(Z,coal))}
   \sim (child(z) \Lambda good(z)) v !gets(z,coal)
   ~child(z) v ~good(z) v ~gets(z,coal)
     boy(mohamed)
Negate the goal
   1- ~ gets(mohamed,train) -> ~ good(mohamed)
      ~ (~ gets(mohamed,train)) v ~ good(mohamed)
      ~ gets(mohamed,train)) Λ good(mohamed)
         6. (a) ~ gets(mohamed,train) (b) good(mohamed)
```

```
\simboy(x) v child(x)
                      \simgirl(x) v child(x)
                      ~child(y) v gets(y,doll) v gets(y,train) v gets(y,coal)
                   3
                      ~boy(w) v ~gets(w,doll)
                      ~child(z) v ~good(z) v ~gets(z,coal)
                      boy(mohamed)
                   ~ gets(mohamed,train)
                   good(mohamed)
                ~child(z) v ~good(z) v ~gets(z,coal)
                                                            good(mohamed)
                                                                                                                5 with goal 2
        -child(mohamed) v ~gets(mohamed,coal)
                                                                                                                 with 3
                                                           -child(y) v gets(y,doll) v gets(y,train) v gets(y,coal)
                                                                                                                 with 1
~child(mohamed) v gets(mohamed,doll) v gets(mohamed,train)
                                                                    \simboy(x) v child(x)
                                                                                                                 with 4
 ~boy(mohamed) v gets(mohamed,doll) v gets(mohamed,train)
                                                                         ~boy(w) v ~gets(w,doll)
                                                                                                                 with 5
  ~boy(mohamed) v gets(mohamed,train)
                                                                    boy(mohamed)
                                                                                                                 with goal1
  gets(mohamed,train)
                                                                    gets(mohamed,train)
                           empty clause
```

```
    ∀ X (boy(X) v girl(X) -> child(X)) // every boy or girl is a child
    ∀ Y (child(Y) -> (gets(Y,doll) v gets(Y,train) v gets(Y,coal))) // every child gets a doll or a train or a lump of coal
    ∀ W (boy(W) -> ~ gets(W,doll)) // no boy gets any doll
    ∀ Z (child(Z) ^ good(Z) -> ~ gets(Z,coal)) // no good child gets any lump of coal
    boy(mohamed) // Mohamed is a boy
```

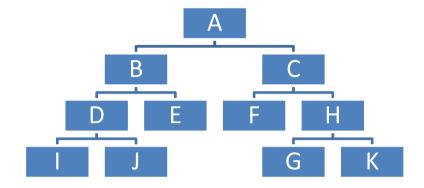
#### Construct a proof by refutation for the following goal:

• ~ gets(mohamed,train) -> ~ good(mohamed) //if Mohamed doesn't get a train, then Mohamed is not a good boy.

```
\begin{array}{l} child(X)\text{:--boy }(X)\text{; }girl(X)\text{.}\\ get(X,train)\text{:--child}(X)\text{.}\\ get(X,doll)\text{:--child}(X)\text{,+-\boy}(X)\text{.}\\ get(X,coal)\text{:--child}(X)\text{,+-\boy}(X)\text{.}\\ boy (mohamed)\text{.} \end{array}
```

# Question2

# [3 marks]



## Limit 0

Ex-node Open list

**CLOSED list** 

**A** {}

**{}** 

## Limit 1

Ex-node	Open list	<b>CLOSED list</b>
Α	{B,C}	{A}
В	{C}	{A,B}
С	{}	{A,B,C}

#### Limit 2

Ex-node	Open list	<b>CLOSED list</b>
Α	{B,C}	{A}
В	{D,E, C}	{A,B}
D	{E,C}	{A,B,D}
E	{C}	{A,B,D,E}
С	{F,H}	$\{A,B,D,E,C\}$
F	{H}	$\{A,B,D,E,C,F\}$
Н	{}	{A,B,D,E,C,F,H}

#### Limit 3

Ex-node	Open list	CLOSED list
Α	{B,C}	{A}
В	{D,E, C}	{A,B}
D	{I,j E,C}	{A,B,D}
i	{j,E, C}	{A,B,D,I}
j	{E,C}	${A,B,D,I,J}$
E	{C}	{A,B,D,I,J,E}
С	{F,H}	{A,B,D,I,J, E,C}
F	{H}	{A,B,D,I,J, E,C,F}
н	{G,K}	{A,B,D,I,J, E,C ,F, H}
G	{K}	{A,B,D,I,J, E,C ,F, H,G}

- B) Consider the following frame system which presents the following: (2 marks)
  - 1 Give the class precedence list for Mohamed [WPI department-AAA-- Washington –AE- UFFF company member]
  - 2 Discount = 40%