Please write solutions very carefully. The grade you receive depends not only on the fact that you SOLVE the problem, but also (20%) on elegance of your solution. Use examples from the book as a learning material of how to write solutions properly.

**QUESTION 1** (5pts) Describe a difference between logical and semantical paradoxes.

**QUESTION 2** (20pts)

1. Write the following natural language statement:

   *From the fact that it is possible that Chris is not a boy we deduce that it is not possible that Chris is not a boy or, if it is possible that Chris is not a boy, then it is not necessary that Anne is pretty.*

   as a formula

   (2pts) \( A_1 \in \mathcal{F}_1 \) of a language \( \mathcal{L}_{\{\neg, \land, \lor, \Rightarrow\}} \).

   (2pts) \( A_2 \in \mathcal{F}_2 \) of a language \( \mathcal{L}_{\{\neg, \land, \lor, \Rightarrow\}} \).

2. (1pts) Degree of the formula \( A_1 \) is: , degree of the formula \( A_2 \) is:

3. (2pts) All proper, non-atomic sub-formulas of \( A_1 \) are:
4. (2pts) All proper, non-atomic sub-formulas of $A_2$ are:

5. (3pts) Find a model (restricted) and a restricted counter-model for $A_2$ (classical semantics). Use short-hand notation. Show work.
   A Restricted Model:
   Evaluation:

   A Restricted Counter-Model:
   Evaluation:

6. (2pt) There are possible counter-models restricted to $A_2$.

7. (2pts) There possible models restricted to $A_2$. (Don’t need to list them, just justify your answer).
8. (2pts) List 3 models and 3 counter-models for $A_2$ by extending the restricted model and the counter-model you have found in 4. to the set $VAR$ of all variables.

9. (2pts) There are possible models for $A_2$.
   There are possible counter-models for $A_2$.

**QUESTION 3** (EXTRA 5pts) Show that

\[ \models (\neg((a \cap \neg b) \Rightarrow ((c \Rightarrow (\neg f \cup d)) \cup e)) \Rightarrow ((a \cap \neg b) \cap \neg(c \Rightarrow (\neg f \cup d)) \cap \neg e))). \]