1. [6 marks]
   Consider the following description logic ontology (TBox):
   
i. \text{Organism} \equiv \text{Animal} \sqcup \text{Plant}
   
ii. \text{Person} \subseteq \text{Animal}
   
iii. \text{Grass} \subseteq \text{Plant}
   
iv. \text{Cow} \subseteq \text{Animal} \sqcap \forall \text{eats.Grass}
   
   v. \text{Carnivore} \equiv \text{Organism} \sqcap \forall \text{eats.Animal}
   
   vi. \text{Rancher} \equiv \text{Person} \sqcap \forall \text{eats.Cow} \sqcap \exists \text{owns.Ranch}
   
   (a) Express the axioms i, iv, and vi in informal English.
   
   (b) Translate the axioms i, iv, and vi into first-order logic formulas.
   
   (c) In the above ontology, what is the relation between Rancher and Carnivore? For example, is every Rancher a Carnivore? How about the other way round? Justify your answer by showing whether the subsumptions hold or not via the tableau algorithm.

2. [2 marks] For the two argumentation networks below, give all admissible sets, preferred extensions and stable extensions.

   (a) \[ \begin{array}{cccc}
   a & \rightarrow & b & \rightarrow & c & \rightarrow & d \\
   \end{array} \]

   (b) \[ \begin{array}{cccc}
   a & \rightarrow & b & \rightarrow & c & \rightarrow & d & \rightarrow & e \\
   \end{array} \]

3. [2 marks] Consider the following assertions
   \[ \{l, l \rightarrow c, x, x \rightarrow \neg l, f, f \rightarrow \neg a, \neg a \rightarrow \neg x\} \]
   with intended interpretations:
\[ l: \text{Levels of CO}_2 \text{ are increasing.} \]
\[ c: \text{Global temperatures are increasing.} \]
\[ l \rightarrow c: \text{Increase in levels of CO}_2 \text{ leads to global temperatures increasing.} \]
\[ x: \text{Study } x \text{ is reliable.} \]
\[ x \rightarrow \neg l: \text{If study } x \text{ is reliable then (it shows that) levels of CO}_2 \text{ are not increasing.} \]
\[ f: \text{Funding for study } x \text{ is provided by AcmeOil.} \]
\[ \neg a: \text{Study } x \text{ is not done at arm’s length (i.e. with no outside interference).} \]
\[ f \rightarrow \neg a: \text{If funding for study } x \text{ is from AcmeOil, it’s not done at arm’s length.} \]
\[ \neg a \rightarrow \neg x: \text{If study } x \text{ is not done at arm’s length, its results are not reliable.} \]

Express this in the Besnard-Hunter framework. That is give

(a) The various relevant arguments, and

(b) provide an argument graph showing whether \( c \) is warranted or not, fully giving all information (such as undercutters, etc). (If no argument graph can be given, explain why not.)