1. (1 point) Decide the following QBF: \( \psi = \forall y_5 \exists x_1 \forall y_2 \exists x_3, x_4 (\neg y_5 \lor x_4) \land (y_5 \lor \neg x_4) \land (\neg x_1 \lor x_3 \lor \neg x_4) \land (\neg y_2 \lor \neg x_3) \). 

2. (1 point) Construct a BDD for \( \neg (x_1 \lor (\neg x_2 \lor \neg x_3)) \)
   
   1. Use reduction from binary decision tree
   2. Use inductive construction

3. (1 point) Let \( f : \{0,1\}^n \rightarrow \mathbb{Z} \) be a non-Boolean function mapping a Boolean vector to an integer. Let \( \{I_1, I_2, \ldots, I_N\} \) where \( N \leq 2^n \) be the set of possible values of \( f \). The function partitions the space \( \{0,1\}^n \) of Boolean vectors to \( N \) sets \( S_1, S_2, \ldots, S_N \) such that for \( i \in \{1,2,\ldots,N\} \) \( S_i = \{\vec{x} \in \{0,1\}^n| f(\vec{x}) = I_i\} \). Suggest a multi terminal binary decision diagram (MTBDD) with \( I_1, I_2, \ldots, I_N \) as its terminal nodes that represents \( f \). Build MTBDD for \( f(x,y) = 2x + 2y \).

4. (1 point) Prove the correctness of universal reduction in QBF solving.

5. (1 point) Prove the correctness of pure literal propagation in QBF solving.