(1) Which of the following are true? Explain: explain why they are (always) true, or give a counterexample and explain why this is a counterexample.
   (a) If the Boolean formulas associated to an NP-complete language over the alphabet $\Sigma = \{T, F\}$ don’t have polynomial size circuits, it follows that $P \neq NP$.
   (b) If the Boolean formulas associated to an NP-complete language over the alphabet $\Sigma = \{T, F\}$ don’t have polynomial size formulas, it follows that $P \neq NP$.
   (c) As of November 2023, we know that PARTITION is NP-complete.
   (d) As of November 2023, it is possible that $a\{a, b\}^*b$ is NP-complete.
   (e) Threshold$_{2,n}$ can be expressed by formulas of size $O(n \log_2 n)$.
   (f) Threshold$_{2,n}$ can be expressed by circuits of size $O(n \log_2 n)$.
   (g) Parity$_n$ can be expressed by formulas of size $O(n \log_2 n)$.
   (h) Parity$_n$ can be expressed by formulas of size $O(n^2)$.

(2) Write a 3CNF formula that is satisfiable for all values of $x_1, \ldots, x_5 = T, F$ iff
   $$(x_1) \land (x_2 \lor x_3 \lor x_4 \lor \neg x_5) = T;$$
   (you may add additional variables).

(3) Is there a 3CNF formula in $x_1, \ldots, x_5$ that is equivalent to $x_2 \lor x_3 \lor x_4 \lor \neg x_5$? Explain.

(4) MORE PROBLEMS MAY BE ADDED LATER.