Problem 1
Show that there is an oracle $A$ and a language $L \in \text{NP}^A$ such that $L$ is not polynomial time reducible to 3SAT even when the machine computing the reduction is allowed access to $A$.

Problem 2
Prove that $\text{EXP} \cap \text{P/poly} \subsetneq \text{P}$.

Problem 3
Show that if $P = \text{NP}$, then there is a language in $\text{EXP}$ that requires circuits of size $2^{n^{10}}$.

Problem 4
Show that $\text{Size}(O(n^{\log n})) \not\subseteq \text{BPP}$.

Problem 5
$P^{\text{NP}[k]}$ is the set of languages decidable by a polynomial time TM that makes $k$ adaptive queries to an NP oracle. $P_{||}^{\text{NP}[k]}$ is the set of languages decidable by a polynomial time TM that makes $k$ parallel queries to an NP oracle. (The TM does some computation, writes down $k$ queries, queries the oracle, receives $k$ responses, does some more computation, and terminates.)

Prove: $P^{\text{NP}[k]} \subseteq P_{||}^{\text{NP}[2^k-1]}$ and $P_{||}^{\text{NP}[2^k-1]} \subseteq P^{\text{NP}[k+1]}$.