1. Prove that $\text{LOGSPACE} \neq \text{TIME}(n^2)$.

2. Prove that every language in $\text{BPP}$ has a circuit family of polynomial size that decides it.
   (Hint: Use the amplification lemma to reduce the error on input $x$ to less than $2^{-|x|}$. Then try to “hardwire” the randomness into the circuit.)

3. Prove that if $\text{PH} = \text{PSPACE}$, then the polynomial time hierarchy has only finitely many distinct levels, i.e., $\text{PH} = \Sigma_k^P$ for some $k \geq 1$.

4. Define $\text{UNIQUESAT} = \{ \langle \phi \rangle \mid \phi$ is a CNF formula that has a unique satisfying assignment$\}$. Prove that $\text{UNIQUESAT} \in \text{P}^{\text{SAT}}$.

5. Prove that if $\text{NP} \subseteq \text{BPP}$, then $\text{NP} = \text{RP}$.

6. Prove that there exists an oracle $C$ for which $\text{NP}^C \neq \text{coNP}^C$. 