1. (15%) Please apply the **pumping lemma** to show that the language $E=\{\, 0^i 1^j \mid i>j \,\}$ is not regular.

2. (10%) Is it true that **"if B is NP-complete and B is polynomial time reducible to C, then C is NP-complete"**? If so, please prove it. Otherwise, please give a counter example.

3. (15%) Is it true that **"every multi-tape Turing machine has an equivalent single tape Turing machine"**? If so, please prove it. Otherwise, please give a counter example.

4. (10%) Is it true that **"if A is mapping reducible to B and A is decidable, then B is decidable"**? If so, please prove it. Otherwise, please give a counter example.

5. (20%) Let L_1 be a context-free language and L_2 be a regular language. Show that $L_1 \cap L_2$ is context-free.

6. (20%) Show that a language is in **NP** iff it is decided by some nondeterministic polynomial time Turing machine.

7. (10%) Proof that if $A \leq_p B$ and $B \in \mathbf{P}$, then $A \in \mathbf{P}$.