1. The symmetric difference of two sets $A$ and $B$ is denoted and defined as $A \Delta B = \{ x : x \in A \lor x \in B \text{ but } x \notin A \cap B \}$. Show that the class of regular languages is closed under symmetric difference.

2. If $L$ is a regular language, prove that $\{ uv : u \in L, v \in L^R \}$ is regular.

3. Give an algorithm that, given a regular language $L$, determines whether $L = L^*$. 

4. Give an algorithm that can decide whether two regular grammars are equivalent.

5. Show that the language $L = \{ a^n b^k c^n : n \geq 0, k \geq n \}$ is not regular.

6. Show that the language $L = \{ w : n_a(w) = n_b(w) \}$ is not regular.

7. Show that $L = \{ a^n : n$ is a not perfect square $\}$ is not regular.

8. Let $\Sigma = \{0, 1\}$
   (a) Let $A = \{ 0^k u 0^k : k \geq 1, u \in \Sigma^* \}$. Show that $A$ is regular.
   (b) Let $B = \{ 0^k 1 u 0^k : k \geq 1, u \in \Sigma^* \}$. Show that $B$ is not regular.

9. Find a CFG for each of the following. Then show the derivation of a string from each language (with length at least 3), along with the associated derivation tree.
   (a) $L = \{ a^n b^n : n \mod 3 \neq 0 \}$.
   (b) $L = \{ a^n b^m : n \leq m + 3 \}$. 