1. Find a regular expression for the language accepted by the finite automaton in Figure (missing). Show your work.

2. Construct a nondeterministic finite automaton accepting the language denoted by the regular expression $\alpha = (a^*b)^*$. Show your work. Give your answer as a state diagram.

3. Find a deterministic finite automaton accepting the same language as the nondeterministic finite automaton given in Figure (missing). Give your answer as a state diagram.

4. Find a regular grammar for the language accepted by the finite automaton shown in Figure (missing). Specify all the components of the grammar.

5. (a) Find a context-free grammar G such that $L(G) = \{a^i b^j c^k \ : \ i, j, k \geq 0 \text{ and } i = j\}$.

   (b) Find a context-free grammar G such that $L(G) = \{a^i b^j c^k \ : \ i, j, k \geq 0 \text{ and } i = k\}$.

6. Construct a pushdown automaton that accepts the language $L = \{a^n c b^{2n} \ : \ n \geq 0\}$. Give your answer as a state diagram.

7. (a) Prove that for any languages L_1, L_2, and L_3, $L_1(L_2 \cap L_3) \subseteq (L_1 L_2) \cap (L_1 L_3)$.

   (b) Show, using a counterexample, that $(L_1 L_2) \cap (L_1 L_3)$ is not necessarily a subset of $L_1(L_2 \cap L_3)$. Try to make your counterexample as simple as possible.

8. Prove that $L_3 = \{a^n b^m : m \neq n, m, n \geq 0\}$ is not regular.

9. Find a regular expression for the language L over the alphabet $\{a, b\}$, where $L = \overline{\{a, ab\}}$.