1. (10 points) Formally define a DFA that accepts the following language over the alphabet \{a,b\}: \( L = \{a^m b^n : m,n > 0 \} \).

2. Let \( L = \{w : w \) has even length, starts with 1, and ends with 01\} be a language over alphabet \{0,1\}.
   (a) (10 points) Show that \( L \) is regular by giving a regular expression generating the language.
   (b) (10 points) Convert the regular expression obtained in (a) to an NFA using the procedure described in class.

3. Let \( A = (Q, \Sigma, \delta, q_0, F) \) be an NFA, where
   • \( Q = \{q_0, q_1, q_2, q_3\} \)
   • \( \Sigma = \{a, b\} \)
   • \( F = \{q_3\} \)
   • \( \delta \) is defined below:
   \[
   \begin{array}{c|cc}
   \delta & a & b & \varepsilon \\
   \hline
   q_0 & \{q_0, q_1\} & \{q_0, q_2\} & \\
   q_1 & \{q_3\} & & \\
   q_2 & & \{q_3\} & \\
   q_3 & & \{q_1, q_2\} & \\
   \end{array}
   \]
   (a) (15 points) Find the regular expression for the language accepted by \( A \).
   (b) (15 points) Convert \( A \) to an equivalent DFA \( A' \).

4. (20 points) Let \( L \) be a regular language over alphabet \( \Sigma \). Let \( L' \) be a language defined over \( \Sigma \) such that \( L' = \{xy : x \) is in \( L \) and \( y \) is not in \( L \} \). Is \( L \) regular? Prove the correctness of your answer.

5. (20 points) Let \( L = \{0^n1^{2n} : n > 0 \} \). Prove that \( L \) is not regular.