1. Let $D = \{ w \mid w$ contains an even number of $a$'s and an odd number of $b$'s and does not contain the substring $ab \}$. Give a DFA with five states that recognizes $D$. (Suggestion: Describe $D$ more simply.)

2. Give state diagrams of NFAs with the specified number of states recognizing the following languages. In all parts the alphabet is $\{0, 1\}$.
   
   (a) The language $\{ w \mid w$ ends with $00 \}$ with three states.
   
   (b) $\{ w \mid w$ contains the substring $0101$, i.e., $w = x0101y$ for some $x$ and $y \}$ with five states.
   
   (c) $\{ w \mid w$ contains an even number of $0$'s, or contains exactly two $1$'s \} with six states.
   
   (d) The language $\{ 0 \}$ with two states.

3. Prove that every NFA can be converted to an equivalent one that has a single accept state.

4. (a) Show that, if $M$ is a DFA that recognizes language $B$, swapping the accept and nonaccept states in $M$ yields a new DFA that recognizes the complement of $B$. Conclude that the class of regular languages is closed under complement.

   (b) Show by giving an example that, if $N$ is an NFA that recognizes language $C$, swapping the accept and nonaccept states in $N$ doesn’t necessarily yield a new NFA that recognizes the complement of $C$. Is the class of languages recognized by NFAs closed under complement? Explain your answer.

5. Use the construction given in Theorem 1.39 to convert the following NFA to equivalent DFA.

   ![Diagram 1](image1)

6. Use the construction given in Theorem 1.39 to convert the following NFA to equivalent DFA.

   ![Diagram 2](image2)