Problem 1

Convert the following NFA to an equivalent DFA, using the method outlined in class and the book. Be sure to show all of your steps.

![NFA Diagram]

Problem 2

Sipser, 1.14:

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

   Hint: Use the definition of how a DFA computes. Under what conditions does it accept?

b. Show by giving an example that if $M$ is an NFA that recognizes language $C$, swapping the accept and nonaccept states in $M$ 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.

   Hint: You do not need a long proof to show that NFAs are or are not closed under complement.

Problem 3

Give regular expressions for the following languages over $\Sigma = \{a, b\}$:

a. $L = \{ w \in \Sigma^* \mid w \text{ ends with } aa \text{ or } bb \}$

b. $L = \{ w \in \Sigma^* \mid w \text{ does not end with } aa \}$

c. $L = \text{all strings containing a number of } a \text{ that is a multiple of } 3$. 
Problem 4

Are the regular expressions over $\Sigma = \{a, b, c\}$ in each pair equivalent? Explain your answer. If the two are not equivalent, show a string that is in one language and not the other.

a. $((a \cup b)c)^* \text{ and } (ac \cup bc)^*$

b. $(a \cup b)^*a^* \text{ and } ((a \cup b)a)^*$

c. $b(ab \cup ac) \text{ and } (ba \cup ba)(b \cup c)$

Problem 5

Let $L$ be the language denoted by the regular expression $((ba)^* \cup bb)(\varepsilon \cup b)$. Construct an NFA that recognizes $L$ using the procedure outlined in class and in the textbook.