Instructions: This is a closed book, note and neighbor exam! You must show all work in the space provided on this test.

Name: ________________________________

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Question 1 (25 points) Using the method given in the book construct a deterministic finite automaton which is equivalent to the following non-deterministic automaton:

Note that you need only provide the “reachable part” of the book’s construction.
Question 2 (25 points)

a) For each of the following languages construct a deterministic finite automaton (DFA) that recognizes it:

   i)  $L_1 = \{w \in \{a, b\}^* : w \text{ has an odd number of } a\text{'s}\}$

   ii) $L_2 = \{w \in \{a, b\}^* : w \text{ contains bb as a substring}\}$

b) Using these two machines construct a DFA for the language

   $L_3 = L_1 \cap \overline{L_2}.$
Question 3 (25 points) Using the method given in the book construct a regular expression over the alphabet \( \{a, b\} \) which describes the language recognized by the following finite state automaton:

Be sure to include complete details of your construction.
Question 4 (25 points)

a) State the Pumping Lemma for Regular Languages.
   \[\text{Be sure to include all required quantifiers and components of the statement.}\]

b) Consider the following language over the alphabet \(\{a, b\}\)^* 

\[L = \{a^m b^m : m > n \geq 0\}\]

Prove that \(L\) is not regular by using the Pumping Lemma for Regular Languages.