Computer Science 456/656 Fall 2005 First Examination, September 20, 2005

Name:_____

No books, notes, scratch paper, or calculators. Use pen or pencil, any color. Use the rest of this page and the backs of the pages for scratch paper. If you need more scratch paper, it will be provided.

The entire test is 125 points.

1. True or False. [5 points each]

   (a) _____ Every subset of a regular language is regular.

   (b) _____ Let L be the language over $\Sigma = \{a, b\}$ consisting of all strings of the form $a^n b^n$, where $n \geq 0$. Then L is a regular language.

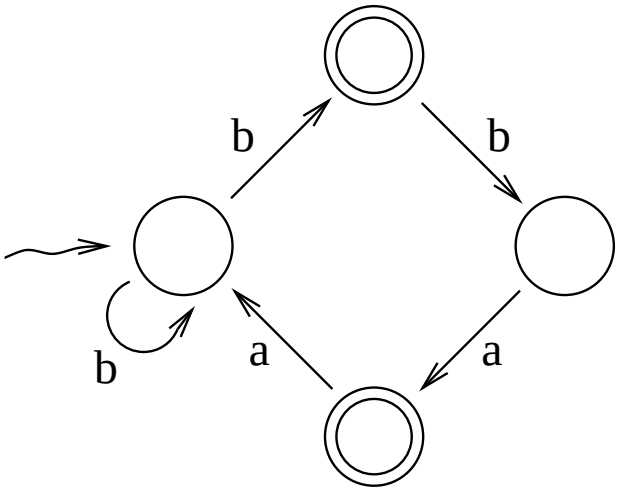
   (c) _____ There is a finite state machine that runs all valid Java programs.

   (d) _____ The union of any two regular languages is regular.

   (e) _____ Suppose that M is a DFA, L is a language, and, for every string $w \in L$, M accepts w. Then, L must be regular.

2. [15 points] Draw a state diagram for an NFA which accepts the language described by the regular expression $(a + b)^* a(a + b)(a + b)(a + b)(a + b)$. It needs only six states.

[15 points] Write a regular expression for the language accepted by the following NFA:



3. (a) [15 points] State the pumping lemma. The space below is enough. If you go over that space, either your writing is extremely large, or you're writing too much.

(b) [25 points] Use the pumping lemma to prove that the language over $\{a, b\}$ consisting of all strings which have the same number of a's and b's is not regular.

4. [30 points] Consider the NFA whose transition diagram is drawn below, where the input alphabet is $\{a, b, c\}$. Draw the transition diagram of an equivalent minimal DFA. Show your steps.

