

Test 1**First Name:** _____**Last Name:** _____**Student Number:** _____

This test lasts 75 minutes. No aids allowed.

Make sure your test has 5 pages, including this cover page.

*Answer in the space provided. (If you need more space, use the reverse side of the page and indicate **clearly** which part of your work should be marked.)*

Write legibly.

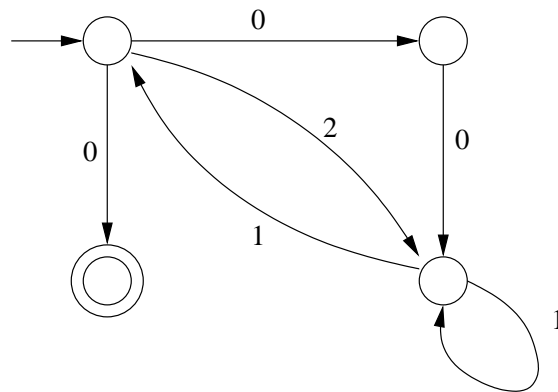
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1. [3 marks] Give a high-level description of how a non-deterministic finite automaton can be transformed into a deterministic finite automaton that accepts the same language. Your answer must fit inside the box below. Anything written outside the box will be ignored.

2. [4 marks] Draw the transition diagram of a deterministic finite automaton that accepts the language of binary strings whose last 3 characters are 101. (You do *not* have to prove your answer is correct.)

3. [3 marks] List all strings of length 7 in the language represented by the regular expression $(ac)^*(bba \cup aa \cup \varepsilon)^*$.

4. [3 marks] Write down a regular expression for the language accepted by the following non-deterministic finite automaton. (You do *not* have to prove your answer is correct.)



5. [4 marks] For any language L over the alphabet Σ , let $DROP(L)$ be the language containing all strings that can be obtained from any string in L by deleting exactly one character. More precisely,

$$DROP(L) = \{xy : x, y \in \Sigma^* \text{ and for some } a \in \Sigma, xay \in L\}.$$

Given a deterministic finite automaton $(Q, \Sigma, \delta, q_0, F)$ for L , provide a precise definition of a non-deterministic finite automaton $(Q', \Sigma, \delta', q_0, F')$ for $DROP(L)$.

6. [4 marks] Let L be the language of binary strings of odd length whose middle character is a 1. In other words, $L = \{x1y : x, y \in \{0, 1\}^* \text{ and } |x| = |y|\}$. Prove that L is not regular.