Test 1

First Name: _____

Last Name: _____

Student Number: _____

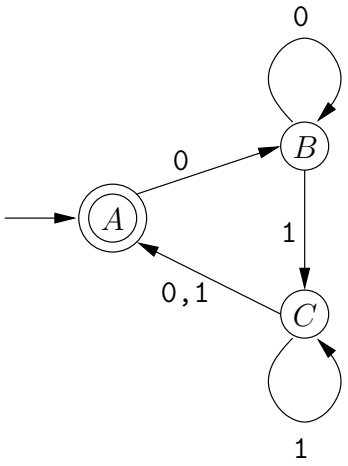
*This test lasts **75 minutes**. No aids allowed.*
Make sure your test has 5 pages, including this cover page.
*Answer in the space provided. (If you need more space, use page 5 and indicate **clearly** which part of your work should be marked.)*
Write legibly.

Question 1	/3
Question 2	/4
Question 3	/4
Question 4	/3
Question 5	/4
Question 6	/4
Question 7	/2
Total	/24

[3] **1.** Consider the alphabet $\Sigma = \{\mathtt{0}, \mathtt{1}\}$. Write down a regular expression for the set of all strings that do *not* contain two consecutive `1`s.

[4] **2.** Draw the transition diagram of a *deterministic* finite automaton for the language described by the regular expression $(\mathtt{ab}^*\mathtt{a})^*(\mathtt{ba}^* \cup \varepsilon)$.

[4] **3.** Draw the transition diagram of a deterministic finite automaton for the language of all strings accepted by the nondeterministic finite automaton shown below.



[3] **4.** Is the following claim true for all languages L and L'?
Claim: If L is regular and $L' \subseteq L$, then L' is regular.
Answer yes or no and prove that your answer is correct.

[4] **5.** Let $L_5 = \{\mathtt{0}^n\mathtt{1}^m\mathtt{0}^n : n \geq 0 \text{ and } m \geq 0\}$. Prove that L_5 is not regular.

[4] **6.** Let Σ be an alphabet. If $L \subset \Sigma^*$ is a language, let $CDR(L)$ be the set of strings that can be formed by dropping the first character of a string in L. More formally, $CDR(L) = \{x \in \Sigma^* : \exists a \in \Sigma \text{ such that } ax \in L\}$.

(a) If $\Sigma = \{\texttt{0}, \texttt{1}\}$ and $L_a = \{\texttt{110}, \texttt{010}, \texttt{0}, \texttt{1000}\}$, list all the strings in the language $CDR(L_a)$.

(b) Suppose $M = (Q, \Sigma, \delta, q_0, F)$ is a DFA for a language L. Describe how to construct an NFA for $CDR(L)$.

[2] **7.** Let L be a regular language. Let $p \geq 1$. Show that if there is no DFA with fewer than p states that accepts L, then there is no NFA with fewer than $\log_2 p$ states that accepts L.

This (nearly) blank page is for additional workspace, if you need it.