Test 1

First Name: _____

Last Name: _____

Student Number: _____

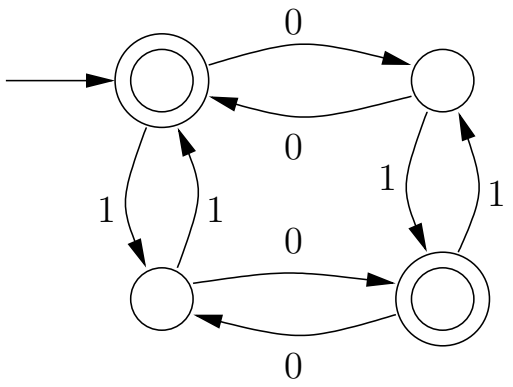
This test lasts 75 minutes. *No aids allowed.*
Make sure your test has 5 pages, including this cover page.
Answer in the space provided. (If you need more space, use the reverse side of the page and indicate ***clearly*** *which part of your work should be marked.)*
Write legibly.

Question 1	/2
Question 2	/6
Question 3	/3
Question 4	/3
Question 5	/3
Question 6	/2
Question 7	/5
Question 8	/5
Total	/29

1. [2 marks] Is there any regular expression R such that $L(R^*)$ is finite? Show your answer is correct.

2. [6 marks] Describe, in plain but precise English, the languages defined by each of the following.

(a)



(b) $(0+1)^*0(0+1)(0+1)0(01^*)^*$

3. [3 marks] Write a regular expression for all strings over the alphabet $\{a, b, c\}$ that contain at least one a and at least one b.

4. [3 marks] Draw a DFA for the language of all strings that contain 0101 as a substring. (Your answer should be as simple as possible.)

5. [3 marks] Draw an NFA for the language containing all binary strings whose first and last character are different from each other.

6. [2 marks] Assume L_1 is a non-regular language over the alphabet Σ.

(a) Give a language L_2 such that $L_1 \cap L_2$ is regular.

(b) Give a language L_2 such that $L_1 \cap L_2$ is not regular.

7. [5 marks] Suppose you are given a DFA $M = (Q, \Sigma, \delta, q_0, F)$. Write a description of an NFA M' for the language $L = \{x \in \Sigma^* \mid \exists y \in L(M) \text{ such that } |x| = |y|\}$.

Write down a claim that you would prove by induction to show that your construction is correct. (You do not have to prove the claim.)

8. [5 marks] Is the language $\{a^i b^j \mid i, j \in \mathbb{N}, i < j\}$ regular?

Circle the correct answer: YES NO

Prove your answer is correct.