You have 60 minutes.

You may cite without proof any theorem proved in class, in the assigned sections of the textbook, or in the assigned homework. You may not cite other results without proof.

If your solution to a problem is a straightforward application of a procedure discussed in class, then it may need no explanation. On the other hand, if it is novel, difficult to understand, or incomplete then it probably requires explanation. If you are unsure, then err on the side of explaining too much.

When there are multiple answers to a problem, it is understood that a simpler or more efficient answer may earn more credit.

Good luck.

1A. Execute the subset construction on the following NFA to produce an equivalent DFA. Do not optimize or take shortcuts.

1B. Minimize the DFA.

1C. Based on your minimized DFA, write a regular expression equivalent to the original NFA.

2A. Let $\Sigma = \{a\}$. Let $A = \{a^n : n \text{ is a multiple of 3 or 5}\} \subseteq \Sigma^*$. Draw an NFA that accepts A.

2B. Write a regular expression whose language is A.

2C. Write a Myhill-Nerode relation on Σ^* for A. You may need to explain.

3. Let $\Sigma = \{0, 1, +, =\}$. Let $A \subseteq \Sigma^*$ be the set of all strings of the form $x = y + z$, where $x, y, z \in \{0, 1\}^*$ are base-2 numerals and the equation $x = y + z$ is true. Prove that A is not regular.

4. Let $\Sigma = \{a, b, c\}$. Using any method you like, write a regular expression that describes the same language as the pattern $\tilde{\ }(ab + ac)^*$. You may need to explain.