General Instructions: Homework must be typeset in \LaTeX, and is due at 11:55pm on the due date. No late work is accepted.

1. (35 Points) Prove that the Post Correspondence Problem is undecidable over the binary alphabet \( \Sigma = \{0, 1\} \).

2. (35 Points) Consider the problem of determining whether a DFA and a regular expression are equivalent. Express this problem as a language and write a proof showing that it is decidable.

3. (35 Points) Read the description of Rice’s Theorem in question 5.28. Read and understand the proof to Rice’s Theorem that was provided as a solution for question 5.28. Consider \( M_{abc} = \{ \langle M \rangle \mid M \text{ is a TM and } abc \in L(M) \} \). Use Rice’s Theorem to prove the undecidability of \( M_{abc} \).

4. (35 Points) Call graphs \( G \) and \( H \) isomorphic if the nodes of \( G \) may be reordered so that it is identical to \( H \). Let \( ISO = \{ \langle G, H \rangle \mid G \text{ and } H \text{ are isomorphic graphs} \} \). Prove that \( ISO \in \text{NP} \).

5. (25 Points) Show that the following is either TRUE or FALSE:

   a. \( 3^n = 2^{O(n)} \)

   b. \( 2n = o(n^2) \)

   c. \( n = o(\log n) \)

   d. \( 1 = o\left(\frac{1}{n}\right) \)

   e. \( 2^{2^n} = O(2^{2^n}) \)