

You have to use the designated spaces for your answers. No extra pages will be provided.

Problem 1: Designing Context-Free Grammar (10 points)

Let $\Sigma = \{0, 1\}$. Consider the following pair of languages. Recall that for a string w , $|w|$ denotes the length of w .

$$L_1 = \{w \in \Sigma^* : w \text{ contains } 00\}$$

$$L_2 = \{x\#y : x \in L_1, y \in \Sigma^*, |x| = |y|\}$$

- (a) Write down a seven-letter string in L_2 . _____ (1 point)
- (b) Give a context-free grammar for L_1 . (2 points)
- (c) Give the state diagram for a pushdown automaton that recognizes L_2 . (4 points)
- (d) Give a context-free grammar for L_2 . (3 points)