Note: Problems 50, 51, and 52 ask you to give formal descriptions of turning machines. This means to precisely define each component of $M = (Q, \Sigma, \Gamma, \vdash, \sqcup, \delta, s, t, r)$. This includes providing a transition table for $\delta$. For all other problems requiring you to design turning machines, just provide an algorithm which describes the behavior of the machine. The algorithm should be similar in detail as Example 28.1 on page 211 of your textbook. Problems 49 and 53 through 55 can be found in your textbook Automata and Computability by Dexter Kozen.

Problem 49. Page 325 #41.

Problem 50. Give the formal description for a turning machine that accepts the language $L = \{w \in \Sigma^*| w \text{ starts with a 1 and ends with a 0}\}$ and always halts. The turning machine should use $\Sigma = \{0, 1\}$.

Problem 51. Give the formal description for a turning machine that accepts the language $L = \{w \in \Sigma^*| w \text{ contains the substring 010}\}$ and always halts. The turning machine should use $\Sigma = \{0, 1\}$.

Problem 52. Give the formal description for a turning machine that accepts the language $L = \{w \in \Sigma^*| w \in L(1^*01^*)\}$ and always halts. The turning machine should use $\Sigma = \{0, 1\}$.

Problem 53. Page 309 #1.

Problem 54. Page 340 #96 (Just provide an algorithm that describes the machine’s behavior).

Problem 55. Page 340 #97 (Just provide an algorithm that describes the machine’s behavior).

Problem 56. Prove that if languages $A$ and $B$ are decidable (recursive) then the language $A \cup B$ is also decidable.