Answer ANY TWO of the following three questions:

1. Give the state diagram for a pushdown automaton (PDA) that recognizes the following language over $\Sigma = \{0, 1, \#\}$:

   $\{w_1\#w_2 : w_1, w_2 \in \{0, 1\}^* \text{ and } |w_1| > |w_2|\}$

   In English: two substrings separated by # where the first substring is longer than the second.

2. Give the state diagram for a deterministic Turing machine that decides the following language over $\Sigma = \{0, 1\}$:

   $L = \{w : w \text{ contains both the substrings 011 and 110}\}$

   Use ONLY the following notation to label each of your machine’s transitions:

   ![Transition Diagram]

3. A clique in an undirected graph is a collection of vertices that are fully interconnected by edges. Consider the following language:

   $\text{CLIQUE} = \{G, k : G = (V, E) \text{ is an undirected graph containing a clique of at least size } k\}$

   Prove that $\text{CLIQUE} \in \text{NP}$.

   NOTE THE FOLLOWING:
   You are being asked to prove that $\text{CLIQUE}$ is in $\text{NP}$, and not that $\text{CLIQUE}$ is $\text{NP}$-Complete! No definitions or discussions required, and will earn no points.