1. (6 points) a Show the values of the different $T_{ij}, 1 \leq i \leq j \leq 3$ when using the CKY algorithm to test if the string 001 can be generated by the grammar

$$S \rightarrow SA|1|AB$$
$$A \rightarrow 0|SA$$
$$B \rightarrow SA$$

b Show the values of the different $T_{ij}, 1 \leq i \leq j \leq 3$ when using the CKY algorithm to test if the string 101 can be generated by the grammar

$$S \rightarrow SA|1|AB$$
$$A \rightarrow 0|SS|SA$$
$$B \rightarrow SA|0|1$$

and show a parse tree.

2. (10 points) Which one of the following two sets is r.e.? Justify your answer by giving a proof that it is r.e.

$$\{M \mid L(M) \text{ contains at least 42 elements}\}$$
$$\{M \mid L(M) \text{ contains at most 42 elements}\}$$
1. \( a \)

\[
T_{11} = \{A, B\} \quad T_{22} = \{A, B\} \quad T_{33} = \{S, B\} \\
T_{12} = \{S\} \quad T_{23} = \{S\} \\
T_{33} = \emptyset
\]

\( b \)

\[
T_{11} = \{S, B\} \quad T_{22} = \{A, B\} \quad T_{33} = \{S, B\} \\
T_{12} = \{S, A, B\} \quad T_{23} = \{S\} \\
T_{33} = \{S, A\}
\]

2. \( \{ M \mid L(M) \text{ contains at least 42 elements} \} \) is r.e. To enumerate it, we dovetail over all the machines

\[
\begin{align*}
M_0 & \quad \{1, 2, 4, 7, 11\} \\
M_1 & \quad \{3, 5, 8, 12\} \\
M_2 & \quad \{6, 9, 13\} \\
M_3 & \quad \{10, 14\}
\end{align*}
\]

For the \( t \) steps of the simulation of \( M_i \), we dovetail over the inputs

\[
\begin{align*}
y_0 & \quad \{1, 2, 4, 7, 11\} \\
y_1 & \quad \{3, 5, 8, 12\} \\
\Sigma y_2 & \quad \{6, 9, 13\} \\
y_3 & \quad \{10, 14\}
\end{align*}
\]

If we determine that \( M_i \) accepts 42 inputs, we list it.