1) Let $L$ be language over $\Sigma$. Let $L'$ be the set of all permutations of all strings of $L$. Consider the following statements.

S1: If $\Sigma = \{0, 1\}$ then for every regular language $L$, $L'$ is also regular.

S2: If $\Sigma = \{0, 1, 2\}$ then for every context free language $L$, $L'$ is also context free.

Which of the following is correct?

- S1 is true but S2 is false.
- S1 is false but S2 is true.
- S1 and S2 both are true.
- S1 and S2 both are false.

2) Let

\[
L_1 = \{a^i b^{2i} c^j \mid i, j \geq 0\}
\]
\[
L_2 = \{a^i b^j c^{2i} \mid i, j \geq 0\}
\]
\[
L_3 = \{a^{2i} b^j c^i \mid i, j \geq 0\}
\]

Which of the following statements are correct?

- $L_1$ is context free.
- $L_2$ is context free.
- $L_1 \cup L_2$ is context free.
- $L_1 \cap L_2 \cap L_3$ is context free.
3) Let \( L_1 \) be a context free language and \( L_2 \) be a regular language. Define

\[
\text{Div}(L_1, L_2) = \{ w \mid wx \in L_1 \text{ and } x \in L_2 \}
\]

\[
\text{Prefix}(L_1) = \{ w \mid wx \in L_1 \text{ for some string } x \}
\]

Which of the following statement is true?

\[ \text{Div}(L_1, L_2) \text{ is context free but } \text{Prefix}(L_1) \text{ is not context free.} \]

\[ \text{Div}(L_1, L_2) \text{ is not context free but } \text{Prefix}(L_1) \text{ is context free.} \]

\[ \text{Div}(L_1, L_2) \text{ and } \text{Prefix}(L_1) \text{ both are context free.} \]

\[ \text{Div}(L_1, L_2) \text{ and } \text{Prefix}(L_1) \text{ both are not context free.} \]
4) The complement of which of the following languages are NOT context-free?

\[ \{0^n1^n \mid n \geq 0\} \]

Set of binary strings with equal number of 0s and 1s.

\[ \{0, 1\}^* \setminus \{ww \mid w \in \{0, 1\}^*\} \]

\[ \{a^n b^n c^n \mid n \geq 0\} \]

5) Consider the following PDA

Which of the following is the correct language of the above PDA?

- Set of binary strings with at least one 0.
- Set of binary strings of odd length.
- Set of binary strings of odd length with 0 as middle element.
- Set of binary strings where the no. of 0's is one more than the no. of 1's.
6) Consider the following PDA

Which of the following is the language of the PDA?

- Set of strings of a and b such that number of a's is equal to the number of b's.
- Set of strings of a and b such that number of a's is twice the number of b's.
- Set of strings of a and b such that number of a's is at least the number of b's.
- Set of strings of a and b such that number of a's is half the number of b's.
7) Consider the following CFG $G$

\[
S \rightarrow SS \mid T
\]

\[
T \rightarrow aTb \mid a
\]

Which of the following statements are true about $G$?

- $aaabbaabbb \in L(G)$

- $aaabbbabbb \in L(G)$ and has more than one parse tree.

- $abaabbaabbb \in L(G)$ and has more than one parse tree.

- $abaabbbabbb \in L(G)$ and has 5 parse trees.

8) Consider the language $L = \{ w_1w_2 \mid w_1, w_2 \in \{0, 1\}^*, |w_1| = |w_2| \text{ and } w_2 \text{ has at least a single } 1 \}$ which of the following PDAs accept $L$?
9) Consider the following languages.

\[ L_1 = \{ wcw^R \mid w \in \{0, 1\}^* \text{ and } c \text{ is a symbol not equal to 0 or 1} \} \]
\[ L_2 = \{ wxw^R \mid w, x \in \{0, 1\}^* \} \]

Which of the following statements is correct?

- Only \( L_1 \) is DCFL.
- Only \( L_2 \) is DCFL.
- Both \( L_1 \) and \( L_2 \) are DCFL.
- Neither \( L_1 \) nor \( L_2 \) are DCFL.

10) Which of the following statements are true?

- A PDA can store infinite amount information.
- A PDA can store only finite amount information.
- Every context-free language has a deterministic PDA.
- A PDA in which we either push or pop in every step but not both, is equivalent to a general PDA.