Quiz: DPDA, CFG Normal Forms, Pumping Lemma, Closure Properties

1. **Which of the following is true about Deterministic Pushdown Automata (DPDA)?**
   A) DPDA can accept all context-free languages
   B) DPDA can accept some but not all CFLs
   C) DPDA is equivalent to Turing machine
   D) DPDA accepts only regular languages
   Answer: B
2. **What makes a PDA deterministic?**
   Answer: It has at most one possible move for each combination of input symbol, stack symbol, and current state.
3. **Which type of languages are accepted by DPDA?**
   Answer: Deterministic context-free languages
4. **DPDA cannot recognize which of the following?**
   A) Palindromes
   B) $a^n b^n$
   C) (a+b)*
   D) $a^n b^n c^n$
   Answer: A
5. **What is the major difference between DPDA and NPDA?**
   Answer: DPDA has deterministic transitions, while NPDA can have multiple choices.

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6. **Which symbols are considered useless in a CFG?**
   Answer: Symbols that do not lead to a terminal string or are not reachable from the start symbol.
7. **Eliminating useless symbols helps in _____.**
   Answer: Simplifying the grammar and optimizing parsing.
8. **To eliminate unreachable symbols, we must trace from the _____.**
   Answer: Start symbol
9. **If a variable never leads to a terminal string, it is considered _____.**
   Answer: Non-generating
10. **Useless symbols are eliminated in how many passes over the grammar?**
    Answer: Two

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11. **Which of the following is true about ε-productions in CFGs?**
    Answer: They derive the empty string ε.
12. **What is the first step in removing ε-productions?**
    Answer: Identify nullable variables.
13. **After removing ε-productions, the resulting CFG is _____.**
    Answer: ε-free (except possibly for start symbol if $\varepsilon \in L(G)$)
14. **Which CFG rule shows an ε-production?**
    A) $A \rightarrow aB$
    B) $B \rightarrow b$
    C) $C \rightarrow \varepsilon$
    D) $D \rightarrow d$
    Answer: C

15. **Can every ε-production be removed without changing the language?**
    Answer: Yes, except when ε is in the language.

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16. **A unit production is of the form:**
    A) A → a
    B) A → B
    C) A → BC
    D) A → ε
    Answer: B
17. **Unit productions can be removed by _____.**
    Answer: Substituting the productions of the variable on the right-hand side.
18. **Which step is done after eliminating unit productions?**
    Answer: Update the production rules accordingly
19. **Which of the following is a valid result of removing unit production A → B?**
    Answer: A inherits all rules of B
20. **Removing unit productions helps in converting CFG to _____.**
    Answer: Chomsky Normal Form (CNF)

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21. **What is the Chomsky Normal Form (CNF)?**
    Answer: A CFG where all rules are of the form A → BC or A → a or S → ε
22. **Can every CFG be converted to CNF?**
    Answer: Yes
23. **CNF is used in _____ algorithms.**
    Answer: Parsing (e.g., CYK algorithm)
24. **Why convert CFG to CNF?**
    Answer: It simplifies parsing and analysis.
25. **Which of the following rules is in CNF?**
    A) A → aB
    B) A → BC
    C) A → BCD
    D) A → ε
    Answer: B

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26. **The pumping lemma for CFLs is used to prove _____.**
    Answer: That a language is not context-free
27. **How many parts does the string split into in pumping lemma for CFGs?**
    Answer: Five: uvwxy
28. **In the pumping lemma, which parts are pumped?**
    Answer: v and x
29. **If a language fails the pumping lemma for CFLs, then it is _____.**
    Answer: Not context-free
30. **The pumping lemma holds for all _____.**
    Answer: Context-free languages