POSTAL Book Package 2023

Computer Science & IT

Objective Practice Sets

Theory of Computation

Contents

MADE EASY Publications

1 CHAPTER Grammars, Languages & Automata

Multiple Choice Questions & NAT Questions

Q.1 Suppose L_1 = {10, 1} and L_2 = {011, 11}. How many distinct elements are there in $L = L_1L_2$.
(a) 4 (b) 3
(c) 2 (d) None of these

Q.2 In a string of length n, how many proper prefixes can be generated
(a) 2^n (b) n
(c) $\frac{n(n+1)}{2}$ (d) $n - 1$

Q.3 Let $u, v, \in \Sigma^*$ where $\Sigma = \{0, 1\}$. Which of the following are TRUE?
1. $|u.v| = |v.u|$
2. $u.v = v.u$
3. $|u.v| = |u| + |v|$
4. $|u.v| = |u|\,|v|$

(a) 1 and 3 (b) 1, 2 and 3
(c) 2 and 4 (d) 1, 2 and 4

Q.4 How many odd palindromes of length 11 are possible with alphabet $S = \{a, b, c\}$
(a) 3^6 (b) 2^5
(c) 2^6 (d) 3^5

Q.5 The number of distinct subwords present in 'MADEEASY' are ________.

Q.6 Consider the following statements:
1. Type 0 grammars generate all languages which can be accepted by a Turing machine.
2. Type 1 grammars generate the languages which can all be recognized by a push down automata.
3. Type 3 grammars have one to one correspondence with the set of all regular expressions.
4. There are some languages which are not accepted by a Turing machine.

Which of the above statements are TRUE?
(a) 1, 2 and 3 (b) 1, 2 and 4
(c) 1, 3 and 4 (d) 2, 3 and 4

Q.7 Consider the following table of an FA:

δ	a	b
start	q_1	q_0
q_0	q_1	q_0
q_1	q_2	q_1
q_2	q_3	q_2
q_3	q_4	q_3
q_4	q_4	q_4

If the final state is q_4, the which of the following strings will be accepted?
1. *aaaaa*
2. *aabbaabbbbb*
3. *bbababababb*

(a) 1 and 2 (b) 2 and 3
(c) 3 and 1 (d) All of these

Q.8 Which of the following statements is correct?
(a) Some finite automata accept non regular languages.
(b) A grammar with recursion always generates infinite languages.
(c) An infinite language can be generated by a non recursive grammar.
(d) A deterministic push down automata cannot generate all context free languages.

Q.9 The grammar with start symbol S over $\Sigma = \{a, b\}$ $S \rightarrow aSbb \mid abb$ belongs to the class
(a) Type 0 (b) Type 1
(c) Type 2 (d) Type 3

Q.10 What is the language generated by the grammer where S is the start symbol and the set of terminals and non terminals is {a} and {A, B} respectively?
$S \rightarrow Aa$
$A \rightarrow B$
$B \rightarrow Aa$
(a) Set of strings with atleast one a
(b) Set of strings with even number of a's
(c) Set of strings with odd number of a's
(d) Empty language

Q.11 How many even palindromes of length atmost 10 are possible with alphabet $\Sigma = \{0, 1, 2\}$?

(a) $\frac{3^5 - 1}{2}$ (b) $3^5 - 1$

(c) $\frac{3^6 - 1}{2}$ (d) $3^6 - 1$

Q.12 Consider the languages $L_1 = \phi$ and $L_2 = \{1\}$. Which one of the following represents $L_1^* U L_2^* L_1^*$?

(a) $\{\lambda\}$ (b) $\{\lambda, 1\}$

(c) ϕ (d) 1^*

Q.13 Given language, $L_1 = \{a^n b^n\}$ and $L_2 = \{a^{2n} b^{2n}\}$. Identify the statements which are TRUE.

1. The language obtained by intersection of languages L_1 and L_2 is same as L_2.
2. The language obtained by performing $L_1 - L_2$ is given by $L_3 = \{a^{2n+1} b^{2n+1}\}$
3. The language obtained by union of L_1 and L_2 is same as L_1.
4. The language obtained by performing $L_2 - L_1$ is empty.

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1 and 3

(c) 3 and 4 (d) All are correct

Q.14 Let, $L_1 = \{a^n b^n c^n \mid n \geq 0\}$

$L_2 = \{a^{2n} b^{2n} c^{2n} \mid n \geq 0\}$

$L_3 = \{a^{2n} b^{2n} c^n \mid n \geq 0\}$

(a) $L_1 \subseteq L_2$ and $L_3 \subseteq L_2$

(b) $L_2 \subseteq L_1$ and $L_2 \subseteq L_3$

(c) $L_2 \subseteq L_1$ but $L_2 \not\subset L_3$

(d) $L_1 \subseteq L_2$ and $L_2 \subseteq L_3$

Q.15 Let $L = \{ab, aa, baa\}$. How many of the following strings are in L^*?

(a) abaabaaabaa (b) baaaaabaa

(c) baaaaabaaaab (d) aaaabaaaa

Q.16 The prefix of a language is defined as

prefix $(L) = \{x : xy \in L$ for some $y \in \Sigma^*\}$

and the suffix is defined as

suffix $(L) = \{y : xy \in L$ for some $x \in \Sigma^*\}$

Which of the following statements is always correct?

(a) prefix(L) $\cap$ suffix (L) $= \phi$

(b) prefix(L) $\cap$ suffix (L) $\supseteq (\Sigma, L)$

(c) prefix(L) $\cap$ suffix (L) $\subseteq (\Sigma, L)$

(d) prefix(L) $\cap$ suffix (L) $= (\Sigma, L)$

Q.17 Let, L_1 = (Strings with any number of a's followed by any number of b's) and $L_2 = (ba)$. L_3 = Prefix $(L_1^* \cap L_2)$. The number of strings in L_3. will be ________.

Q.18 What language does the grammar with these productions generate?

$S \rightarrow aaA$

$A \rightarrow aA | \varepsilon$

(a) strings with even number of a' s

(b) strings with odd number of a' s

(c) strings with atmost 2 a' s

(d) strings with atmost 2 a' s

Q.19 Let, $L_1 = \{a^* b^*\}$ and $L_2 = \{b^* a^*\}$. The language $L = L_1 \, n \, L_2$ is represented by

(a) ϕ (b) $a^* + b^*$

(c) $a^* b^*$ (d) $(a + b)^*$

Q.20 Let $L_1 = \{a^n | \, n \geq 0$ and $L_2 = \{b^n | \, n \geq 0\}$. Then L is given by $L_1 L_2$. Which of the following statement(s) is/are true about L?

1. L is the language of strings with equal number of a's followed by an equal number of b's.
2. L is a context free language but not regular.
3. L is regular.
4. $L = \{a^n b^n \mid n \geq 0\}$

(a) 1, 2 and 4 (b) 1, 3 and 4

(c) 1 and 4 (d) 3 only

Q.21 How many of the following statements are correct?

1. Both L and $\overline{L}$ can be finite
2. $\left(\overline{L^*}\right) = \left(\overline{L}\right)^*$
3. $(L_1 L_2)^R = (L_2)^R (L_1)^R$
4. $(L^*)^* = L^*$

(a) Only 1 (b) Only 2

(c) 1 and 2 (d) All of the above

Q.22 Given $L = \{a^n \, \text{l} n \geq 0\}$ over $\Sigma = \{a\}$. What is the language represented by L^2?

(a) Set of all strings over Σ with odd length

(b) Set of all strings over Σ with even length

(c) Set of all strings over Σ

(d) None of these

Q.23 Let, $L = \{\lambda, 0, 01, 10\}$. Which of the following strings does not belong to L^5?

(a) 110 010 (b) 101001001

(c) 100100 (d) 01101001

Q.24 Which of the following conversions is not possible?
(a) Regular grammar to context free grammar
(b) NFA to DFA
(c) Non deterministic PDA to deterministic PDA
(d) Non deterministic Turing machine to deterministic Turing machine

Q.25 If $S = \{ab, ba\}$, which of the following is true?
(a) S^* contains finite no of strings of infinite length.
(b) S^* has no strings having 'aaa' or 'bbb' as substring.
(c) S^* has no strings having aa as substring.
(d) If $T = \{a, b\}$, then $S^* \not\subseteq T^*$,

Multiple Select Questions (MSQ)

26. Given the language $L = \{ab, aa, baa\}$, which of the following strings are in L^*?
(a) abaabaaabaa
(b) aaaabaaaa
(c) baaaaabaaaab
(d) baaaabaa

Answers — Grammars, Languages & Automata

1. (b)	2. (b)	3. (a)	4. (a)	5. (34)	6. (c)	7. (a)	8. (d)	9. (c)
10. (d)	11. (c)	12. (d)	13. (d)	14. (c)	15. (c)	16. (b)	17. (3)	18. (d)
19. (b)	20. (d)	21. (b)	22. (c)	23. (a)	24. (c)	25. (b)	26. (a, b, d)	

Explanations — Grammars, Languages & Automata

1. (b)

$$L_1 = \{10, 1\},$$
$$L_2 = \{011, 11\}$$

By concatenation of L_1 and L_2 we get

$$L_1 \cdot L_2 = \{10011, 1011, 1011, 111\}$$

Hence, 3 distinct elements are there.

2. (b)

Suppose, $S = aaab$, $|s| = 4$. The prefixes are $S_p = \{\lambda, a, aa, aaa, aaab\}$. Here aaab is not a proper prefix.

Note: The proper prefix of string S is a prefix, which is not same as string S.

A string of length 4 has 4 proper prefixes. A string of length 5 has 5 proper prefixes. For a string of length n, therefore we can have 'n' proper prefixes.

3. (a)

Let, $u = 1001$ and $v = 001$

$u.v = 1001001$ and $v.u = 001\ 1001$

$|u, v| = |v, u| = |u| + |v|$

But $u.v \neq v.u$

4. (a)

Palindromes can be represented by $\{WW^R \mid W \in \{a, b, c)^*\}$ U
$\{WxW^R \mid W \in (a, b, c)^*, x \in (a, b, c)\}$

Since, we need to count the number of odd palindromes of length 11, the number of possible W's of length 5 are $|\Sigma|^5$ i.e. 3^5

Number of possible ways for $x = 3$

$\therefore$ Number of odd palindromes of length 11 = $3^5 \times 3$ = 3^6

Number of odd palindromes of length,

$$n = |\Sigma|^{\frac{n-1}{2}} \times |\Sigma| = |\Sigma|^{\frac{n+1}{2}}$$

5. (34)

Distinct subwords of

Length 1 = 6	Length 5 = 4
Length 2 = 7	Length 6 = 3
Length 3 = 6	Length 7 = 2
Length 4 = 5	Length 8 = 1

$\therefore$ Total = 34