Context Free Languages, Context Sensitive Languages, Turing Machine, Recursive and Recursively Enumerable Languages.

1)
S->AB
A->BB| a
B-> AB|b

Choose an incorrect statement?

A. aabbb can be derived from above grammar

B. aabb can be derived from above grammar

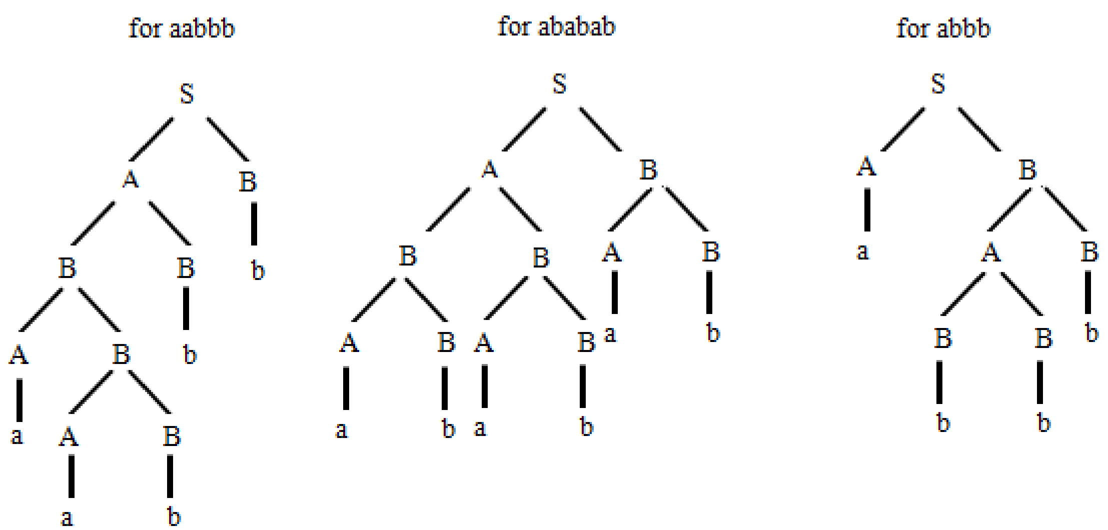
C. ababab can be derived from above grammar

D. abbb can be derived from above grammar

Solution: Option (b)

Explanation:

Check each option by drawing a parse tree.



2) Consider the regular grammar generating the set of all strings ending with ‘00’, with terminals {0,1} and non-terminals {S, A, B}, S being the initial state and B, the final state.

$S \text{->} 1S/\ 0A$

$A \rightarrow 0B$

$B \rightarrow 0B/1S/0$

The production missing is

(a) $A \rightarrow 1S$

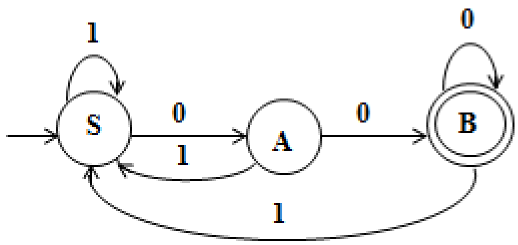
(b) $B \rightarrow \varepsilon$

(c) $A \rightarrow 1B$

(d) $S \rightarrow 1B$

Solution: Option (a)

Explanation:



S →
1S |
0A A
→ 1S
| 0B
B → 1S | 0B | 0

3) Consider the grammar: S->aSbS/ bSaS/ ε,

The smallest string for which the grammar has two derivation trees:

(a) abab

(b) aabb

(c) bbaa

(d) aaabbb

Solution: Option (a)

4) The following CFG, S aB/ bA

A->a/ aS/ bAA

B -> b/ bS/ aBB generates strings with

(a) Odd number of a's & odd number of b’s

(b) Even number of a's & even number of b's

(c) Equal number of a’s & b’s

(d) Odd number of a’s & even number of b’s

Solution: Option (c)

5) What type of grammar is this most accurately described as?

S-> b/aD

D-> a/aDD

(a) A regular grammar
(b) CFG
(c) CSG
(d) Type-0

Solution: Option (b)

Explanation:

(a) This cannot be regular because regular grammars are of the form $A \to a, A \to aB$
(b) It is CFG because all the productions satisfy the constraints, they are of the form $A \to \gamma$ where
γ is a string of terminals and/or non-terminals.
(c) It can be CSG because all the productions are of the form $\alpha A \beta \to \alpha \gamma \beta$, where α, β, γ are strings of terminals and/or non-terminals.
(d) It can be Type – 0 or unrestricted grammar, because all productions are of the form $\alpha \to \beta$ (no restrictions).
But it can be most accurately described as CFG.

6) $L_1 = \{a^m b^n \mid m+n = \text{Even}\}$ $L_2 = \{a^m b^n \mid m-n = 4\}$

(a) L_1 is Regular, L_2 is Not Regular
(b) Both are Regular
(c) Both are Non- Regular
(d) L_2 is Regular, L_1 is Not Regular

Solution: Option (a)

Explanation:
R = (aa)* (bb)* + a(aa)* b(bb)* = L_1

L_2 involves infinite counting and comparison. So it is not regular.

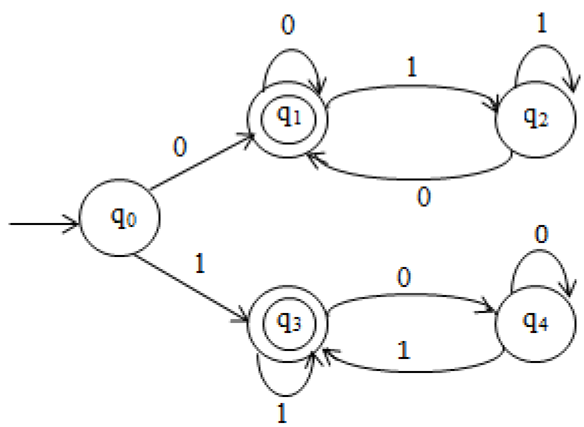
7) L_1= Set of all strings having equal number of 00 and 11. L_2= Set of all strings having equal number of 01 and 10.

Which of the following is true?

(a) Both are Regular
(b) Both are Context-Free
(c) L_1 is regular, L_2 is Context Free
(d) L_1 is CF, L_2 is Regular

Solution: Option (d)

Explanation:
L_2 is important and specific case.



8) Suppose a Language L is accepted by Linear Bounded Automata A. Then,

(a) A always halts on all i/p's as L is decidable.
(b) L maybe undecidable as A need not halt on all i/p
(c) L need not be Context-Sensitive Language
(d) None of the above

Solution: Option (a)

Explanation:
All CSL's are decidable.

9) $L \subseteq \Sigma^*$ is said to be co-finite iff their complement is finite. What can you say?

(a) All co-finite languages are regular
(b) There exist a co-finite language which is not context free
(c) There exist a co-finite language which is not decidable
(d) None of above

Solution: Option (a)

Explanation:
If complement is Finite → L^c is
Regular So, L has to be Regular.

10) Suppose L is a context-Free Language. Then L

(a) is necessarily context-free
(b) is necessarily non-context free
(c) is necessarily context-sensitive
(d) is necessarily Recursive

Solution: Option

(d) Using closure

properties

11) Let G be grammar in CNF. Let $w_1, w_2 \in L(G)$ such that $|w_1| < |w_2|$

(a) Any derivation of w_1 has exactly same number of steps as any derivation of w_2
(b) Some derivation of w_2 may be shorter than of steps as any derivation of w_1
(c) All derivations of w_1 will be shorter than any derivation of w_2
(d) None

Solution: Option (c)

Explanation:
Derivation always required $2n - 1$ steps in
CNF n = length of string.

12) Consider an ambiguous grammar G and its disambiguated version D. Let the language recognized by them are L(G) and L(D) respectively. Which one is true?

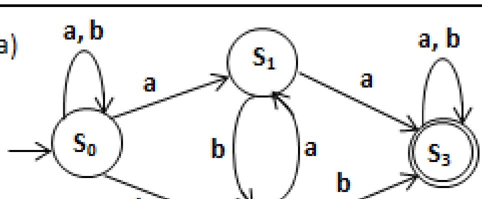
(a) $L(D) \subset L(G)$
(b) $L(G) \subset L(D)$
(c) $L(D) = L(G)$
(d) $L(D)$ is empty

Solution: Option (c)

2. Consider $R = (a + b)^* (aa + bb) (a + b)^*$

Which of the following NFA recognizes the language defined by R?

(a)



13) Consider these 2 statements:

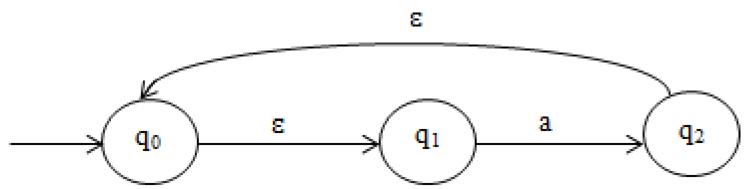
S_1: $L^R = L$, if and only if L is the language of palindromes.
where L^R is obtained by reversing all the strings
of L.
S_2: $| L_1 \cdot L_2 | = | L_1 | \times | L_2 |$

Which of the following is

true?

(a) Both are False
(b) Both are True
(c) $S_1 \rightarrow T, S_2 \rightarrow F$
(d) $S_1 \rightarrow F, S_2 \rightarrow T$

Solution: Option (c



14) $L_1 = \{ a^m \mid m \geq 0\}$ $L_2 = \{ b^m \mid m \geq 0\}$

$L_1 \cdot L_2 = ?$

(a) $\{ a^m b^m, m \geq 0\}$
(b) $\{a^m b^n, m, n \geq 0\}$
(c) $\{a^m b^n, m, n \geq 1\}$
(d) None of the above

Solution: Option (b)

15) $\Sigma = \{0, 1\}$ $L = \Sigma^*$
$R = \{ O^n 1^n$ such that $n > 1\}$

Languages L U R and R are respectively:

(a) Regular, Regular
(b) Regular, Not Regular
(c) Not Regular, Not Regular
(d) Not Regular, Regular

Solution: Option (b)

Explanation:
L U R →
Regular R
→ CFL

16) S_1: L is regular. Infinite union of L will also be regular i.e. ($L^0 \cup L^1 \cup L^2 \ldots$) S_2: L is regular. It's subset will also be regular.

(a) Both are true
(b) Both are false
(c) $S_1 \rightarrow T$, $S_2 \rightarrow F$
(d) $S_1 \rightarrow F$, $S_2 \rightarrow T$

Solution:

Option (b)

Explanation:

For Statement 1:

Regular languages are closed under finite union. They are not closed under infinite union of regular languages.

Consider

$L_1 = \{01\}$
$L_2 = \{0^2 1^2\}$
$L_3 = \{0^3 1^3\}$
.
.
.
So, infinite union of $L_1 \cup L_2 \cup L_3 \cup \ldots = \{(0^n 1^n)/(n > 0)\}$ is CFL but not regular.

For Statement 2:
Subset of regular language may not be regular.

Consider $L = 0^* 1^*$ and $L_1 = \{0^n\ 1^n / n > 0\}$. $L_1$is a subset of L but not regular.

17) Give the strongest correct statement about finite language over finite Σ ?

(a) It could be undecidable
(b) It is Turing-recognizable
(c) It is CSL
(d) It is regular language

Solution: Option (d)

18) Consider the following languages: $L_1 = \{a^n b^n\ (n \geq 0)\}$

L_2= Complement (L_1)

Choose appropriate options regarding languages L_1 and L_2

(a) L_1& L_2 are context free
(b) L_1 is CFL but L_2 is RL
(c) L_1 is CFL and L_2 is CSL
(d) None

Solution: Option (a)

Explanation:

L_1 is CFL and $L_2 = \{a^p b^q / p \neq q \ and \ p, q > 1\}$ which is CFL.

19) The language of primes in unary is:

(a) Regular
(b) CFL
(c) DCFL
(d) Context Sensitive

Solution: Option (d)

Explanation:

The language of primes in unary is $\{1^p / p \ is \ prime\}$. Finite automata cannot recognize this language as it has no memory. PDA also cannot recognize this as there is no pattern in the strings that can be remembered using one stack. LBA can accept this, so it is a context sensitive language.

20) The complement of CFL:

(a) Recursive
(b) Recursive enumerated
(c) Not RE
(d) The empty set

Solution: Option (a)

21) Which of the following is a Regular language?

(a) $L_1 = \{wcw^R \mid w \in \{a, b\}^*\}$
(b) $L_2 = \{wcw^R \mid w,c \in \{a, b\}^*\}$
(c) $L_3 = \{ww^Rc \mid w \in \{a, b\}^*\}$
(d) $L_4 = \{cww^R \mid w \in \{a, b\}^*\}$

Solution: Option (b)

Explanation:

(b) is Regular language

$L_2 = \{wcw^R \mid w,c \in \{a, b\}^*\}$

$= \{\epsilon, a, b, ab, ba, aa, bb, aaa, \ldots\ldots.\}$

$= \Sigma^*$ (When $w = \epsilon$ and $c \in \{a, b\}^*$, we obtain $L_2 \subset \Sigma^*$, which is regular)

$\therefore L_2$ is Regular.

22) Given that a language $L = L_1 \cup L_2$, where L_1 and L_2 are two other languages. If L is known to be a regular language, then which of the following statements is necessarily TRUE?

(a) If L_1 is regular then L_2 will also be regular
(b) If L_1 is regular and finite then L_2 will be regular
(c) If L_1 is regular and finite the L_2 will also be regular and finite
(d) None of

these **Solution:**

Option (b)

Explanation:

(b) is the answer because we cannot make an irregular set 5 regular by adding a finite number of elements to it. This can be paired as follows:

Let $R \cup F = T$ be regular, where F is a finite set. We remove all elements from F which are in R and let the new set is E. Still $R \cup E = T_1$ and E is a finite set (But no strings common between E and R).

Now, T be regular means we have a DFA for T. We can find all the states in this DFA where each of the strings in F is being accepted. In each of these accepting states, none of the string in R will be accepted as R and E does not have any string in common.
So, if we make all these states non-accepting, what we get is a DFA for R, meaning that R is regular.

We can prove (a) false by considering $L_1 = \{a\}$ and $L_2 = \{a^n \mid$

$n>0\}$. Now, $L_1 \cup L_2$ is regular and L_1 is finite but L_2 is not finite

but Regular.

23) Consider the following statements:

S_1: There doesn't exist FA for every CFL.
S_2: Let $\Sigma = \{a, b\}$ and $L = \{a^n\ w\ a^n \mid n \geq 1, w \in \Sigma^*\}$. Then L is context free but not regular.

(a) Both are True
(b) Both are False
(c) $S_1 \rightarrow$ True, $S_2 \rightarrow$ False
(d) $S_1 \rightarrow$ False, $S_2 \rightarrow$ True

Solution: Option (c)

Explanation:
S_1: Consider $L_1 = \{a^nb^n \mid n \geq 1\}$, is a CFL but not Regular.
S_2: We can consider the language as set of strings starting and ending with a, since w is known to be in Σ^*, considering everything after first a and before last a as w.
So, it is regular.

24) $L = \{a^i\ b^j\ c^k\ d^m\} \mid i+j+k+m$ is multiple of 13} L is ?

(a) Regular
(b) Context-free
(c) Turing-decidable
(d) Turing-Recognizable

Solution: (a)

We just need 13 states to remainders (0, 1, . . . 12). We start by state with 0 remainder and as we visit new character, we change state to next remainder.

25) Language $L = \{a^n\ b^n\ w \mid n \geq 0, w \in \{c, d\}^*, |w| = n\}$ is

(a) Regular
(b) DCFL
(c) NCFL
(d) Not context-free

Solution: Option (d)

Explanation:
Not possible to check for w as stack will be empty after checking for a and b.

26) If L_1 and L_2 are Turing-Recognizable then $L_1 \cup L_2$ will be

(a) Decidable
(b) Turing-recognizable but may not be decidable
(c) May not be Turing recognizable
(d) None of above

Solution: Option (b)

Explanation:
We can build a TM for union but decidability may not always be guaranteed.

27) Which of the following is true for i/p alphabet Σ and tape alphabet Γ of a standard TM?

(a) It is possible for Σ and Γ to be equal
(b) Γ is always a strict superset of Σ
(c) It is possible for Σ and Γ to be disjoint
(d) None

Solution: Option (b)

Explanation:
Γ always contains members of Σ and special Block symbol also, which is not in Σ.

28) Consider the CFG:
$S \rightarrow aSa \mid bSb \mid a \mid b \mid \in$

Which of following strings is NOT guaranteed by grammar?

(a) aaaa
(b) baba
(c) abba
(d) babaaabab

Solution: Option (b)

Explanation:
The grammar generates all palindromes with alphabet {a,b}

29) Let L be CFL and M a regular language. Language $L \cap M$ is always

(a) always regular
(b) never regular
(c) always DCFL
(d) always context free language

Solution: Option (d)

30) Which of the following is accepted by NPDA but Not by DPDA?

(a) $\{a^n b^n c^n \mid n \geq 0\}$
(b) $\{a^n b^n \mid n \geq 0\}$
(c) $\{a^n b^m \mid m, n \geq 0\}$
(d) $\{a^l b^m c^n \mid l \neq m \text{ or } m \neq n\}$

Solution: Option (d)

Explanation:
(a) is CSL.
(b) & (c) are accepted by DPDA.

31) Consider the CFG below:

$S \rightarrow aSAb \mid \varepsilon$
$A \rightarrow bA \mid \varepsilon$

Grammar generates:

(a) $(a + b)^* \cdot b$
(b) $a^m b^n \mid m \leq n$
(c) $a^m b^n \mid m = n$
(d) $a^* b^*$

Solution: (b)

32) Consider regular grammar:

$S \rightarrow bS \mid$
$aA \mid \varepsilon$ A
$\rightarrow aS \mid bA$

Myhill-Nerode equivalence classes for language generated by grammar are

(a) $\{w \in (a + b)^* \mid \#_a (w) \text{ is even}\}$ and $\{w \in (a + b)^* \mid \#_a (w) \text{ is odd}\}$
(b) $\{w \in (a + b)^* \mid \#_b (w) \text{ is even}\}$ and $\{w \in (a + b)^* \mid \#_b (w) \text{ is odd}\}$
(c) $\{w \in (a + b)^* \mid \#_a (w) = \#_b (w)\}$ and $\{w \in (a + b)^* \mid \#_a (u) \neq \#_b (w)\}$
(d) $\{\varepsilon\}$, $\{wa \mid w \in (a + b)^*$ and $wb \mid w \in (a + b)^*\}$

Solution: Option (a)

Explanation:
M – N equivalent classes are actually the number of states in FA.

33) $L \subseteq \Sigma^*$, $\Sigma = \{a, b\}$ Which of the following is True?

(a) L = {x | x has equal a's and b's} is regular
(b) $L = \{a^n b^n \mid n \geq 1\}$ is regular
(c) L = {x | x has more a's than b's} is regular
(d) $L = \{ a^m b^n, m,n \geq 1\}$ is regular

Solution: Option (d)

34) Let $L = \{x \in \{a, b, c\}^* : x$ contains exactly one a and exactly one $b\}$. Which is true?

(a) R. E. = $c^+ a c^+ b c^+ + c^+ b c^+ a c^+$

(b) R.E. = $c^* a c^* b c^* + c^* b c^* a c^*$

(c) Both (a) and (b)

(d) R.E. not possible as L is context-free

Solution: Option (b)

Because Option (a) does not generate *ab* and *ba* which are in L.

35) If L is Turing-recognizable. Then

(a) L and $\bar{L}$ must be decidable.

(b) L must be decidable but $\bar{L}$ need not be.

(c) Either L is decidable or $\bar{L}$ is not Turing recognizable.

(d) None of above.

Solution: Option (c)

36) S_1: $L \leq_m \{0^n 1^n \mid n \geq 0\}$ then L is decidable.

S_2: if L is R.E. and $L' \subseteq L$ then L' is recursively enumerable because enumerator for L also enumerates L'.

(a) Both are True

(b) Both are False

(c) $S_1 \rightarrow T$, $S_2 \rightarrow F$

(d) $S_1 \rightarrow F$, $S_2 \rightarrow T$

Solution: Option (c)

Explanation:

For S_2: Take $L = (0 + 1)^*$ which is R.E. and $L' = L_d$ which is not R.E.

Enumerator for L outputs all strings in L' but also outputs strings that may not be in L', So it is not enumerator for L'.

37) Which of the following CFG is not producing the same language as others?

(a) $S \rightarrow aS \mid bS \mid a \mid b \mid \varepsilon$
(b) $S \rightarrow Sa \mid Sb \mid a \mid b \mid \varepsilon$
(c) $S \rightarrow a \mid b \mid SS \mid \varepsilon$
(d) $S \rightarrow aS$
$\mid b A$ A
$\rightarrow bA \mid$
ε

Solution: Option (d)

Explanation:
Options (a), (b), (c) produce $(a + b)^*$

38) $L_1 = \{a^m b^n c^p \mid m \geq n \text{ or } n = p\}$ $L_2 = \{a^m b^n c^p \mid m \geq n \text{ and } n = p\}$

(a) Both are NCFL's
(b) L_1 is DCFL and L_2 is NCFL
(c) L_1 is NCFL and L_2 is not context-free
(d) Both are not context-free

Solution: Option (c)

Explanation:
L_2 is CSL.

39) Consider the following Grammar:

$$S \rightarrow aS \mid Sb \mid SS \mid \varepsilon$$

I. G is ambiguous
II. Language is a^*b^*
III. G can be accepted by DPDA
IV. $r = (a+b)^*$

Which are true?
(a) i, ii, iii only
(b) i, iii only
(c) iii, iv only
(d) i, iii, iv only

Solution: Option (d)

Explanation:
Language is $(a + b)^*$

40) $L_1 = \{ca^n b^n\} \cup \{da^n b^{2n}\}$ $L_2 = \{a^n b^n c\} \cup \{a^n b^{2n} d\}$

(a) Both are DCFL's
(b) Both are NCFL's
(c) L_1 is DCFL, L_2 is NCFL
(d) L_1 is NCFL, L_2 is DCFL

Solution: Option (c)

Explanation:
Because of c & d at starting, we can decide how much to pop and push in stack.

41) Consider this language $L = \{a^n bc^m \mid n > 1, m \leq n\}$ over $\Sigma = \{a, b, c\}$, the L is

(a)Not decidable
(b) Language is unambiguous
(c)Language is NCFL
(d) Language is DCFL

(e) Both (b) and (d)

Solution: Option (e)

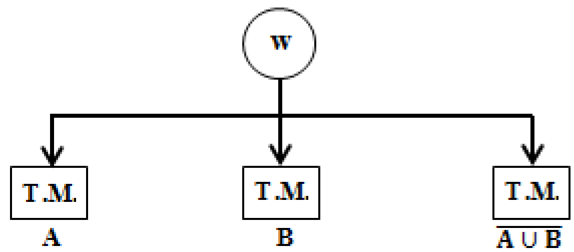
Explanation:
Push and pop operations are defined for the given language L. So, it is DCFL and all DCFL's are unambiguous languages.

42) Let A and B be disjoint, R.E. languages. Let AUB also be recursive enumerable. What can you say about A and B?

(a) Neither A nor B is decidable is possible
(b) At least one among A and B is decidable
(c) Both A and B are decidable
(d) None of above

Solution: Option (c)

Explanation:



w can be either in A or B or in neither of them. Build 3 TM's of A, B, $\overline{A \cup B}$

Surely in finite time, one of them would say yes, which identifies where w is.

43)

1. Following language:

$L = \{a^n b^n c^n d^n, n \geq 1\}$ is

(a) CFL but nor regular
(b) CSL but not CFL
(c) Regular
(d) Type 0 language but not Type 1

Solution: Option (b)

44) onsider these languages:

$L_1 = \{S \in (0+1)^* \mid n_0(S) + n_1(S) \leq 4\}$ $L_2 = \{S \in (0+1)^* \mid n_0(S) - n_1(S) \leq 4\}$

(a) Both are regular
(b) Both are non-regular
(c) L_1 is regular but L_2 is not
(d) L_1 is not regular but L_2 is regular

Solution: Option (c)

Explanation:
L_1 will contain finite number of strings.
L_2 will contain infinite strings and involves comparison also.

45) Which of the following is True for any Language L?

(a) $L^* = \bigcup^{\infty} L^i$
(b) $L^* = L^+ \cup \{\varepsilon\}$
(c) $L^* = L^+$
(d) $L^* = L^+ \cap \{\varepsilon\}$

Solution: Option (b)

46) Concept of Grammar is used in which part of compiler?

(a) Lexical analysis
(b) Parser
(c) Code generation
(d) Code optimization

Solution: Option (b)

47) Consider the Language:

$L = \{a^n b^n c^k,\ n,k \geq 1\} \cup \{a^n b^k c^k,\ n,k \geq 1\}$

Which is True?

(a) All the Grammars generating L will be ambiguous.
(b) There exists a G which is unambiguous.
(c) Language L is unambiguous
(d) None of the above

Solution: Option (a)

Explanation:
L is inherently ambiguous.

G will be of type:
$S \rightarrow S_1 \mid S_2$

abc abc

Common string abc will be derived either using S_1 or S_2.

48) Let R be Regular set. Let S be set consisting of all strings in R which are identical with their own reverses. What can you say about S?

(a) S is regular
(b) S is non-regular
(c) S may or may not be regular
(d) None of the above

Solution: Option (c)

Explanation:
Case 1: Let the regular set R be 0* and S be 0* which is regular.
Case 2: Let the regular set R be 0*10* and S be a subset of R such that the strings are identical with their own reverses.
S = $\{0^n10^n \mid n \geq 0\}$ which is CFL but not Regular.

49) uppose L is a context-free language over $\Sigma = \{a\}$ i.e. only one alphabet. What can you say about L?

(a) L is always regular
(b) L need not be regular
(c) L is always DCFL
(d) L is always NCFL

Solution: Option (a)

Explanation:
The language $\Sigma = \{a\}$ is regular. And every Regular is a CFL. Given L is CFL which implies L is regular. So, CFL over one alphabet will always be regular.

50) Let L be a Context Free Language. Even(L) is the set of all strings w in L such that |w| is even. What can you say about Even(L)?
(a) It will be regular
(b) It will be context-free
(c) It is not decidable
(d) None of the above

Solution: Option (b)

Explanation:
Given that L is a CFL, we cannot decide whether L is a regular or not without knowing the language itself. And Even(L) is a subset of L such that length of each string in Even(L) is even. Thus, Even(L) is definitely a CFL but cannot decide upon regularity.

i.e., Even(L) is the intersection of L with the DFA that accepts even length strings
i.e. Even (L) = CFL ⋂ Regular
= CFL
So, Even (L) is a closed operation.

51) Consider this grammar:

$$S \rightarrow bF,\ S \rightarrow aS,\ F \rightarrow \varepsilon\ ,\ F \rightarrow bF \mid aF$$

Regular Expression for this grammar is?

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

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

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

(d) All of the above

Solution: Option (d)

Explanation:
All regular expression represents the language containing at least 1 b.

52) Let L be a regular language. Consider $L' = \{xy: x \in L \text{ and } y \notin L\}$

L' is

(a) Always regular

(b) Need not be regular

(c) Context-free

(d) Depends on L

Solution: Option (a)
Explanation:

L' is concatenation of 2 regular languages basically L and $\bar{L}$. Regular are closed under concatenation.

53) Consider two statements:

S_1: Every regular language has regular proper subset.
S_2: If L_1 and L_2 are non-regular, then $L_1 \cup L_2$ is also not-regular.

(a) Both are True

(b) Both are False

(c) $S_1 \rightarrow$ True, $S_2 \rightarrow$ False

(d) $S_1 \rightarrow$ False, $S_2 \rightarrow$ True

Solution: Option (b)
Explanation:
$S_1 \rightarrow L = \{\varphi\}$
$S_2 \rightarrow \{a^n b^m \mid n \leq m\} \cup \{a^n b^m \mid n \geq m\}$

54) $L_1 = \{a^m b^n c^{\max(m,n)} : m,n > 1\}$
$L_2 = \{a^{2n}, n > 1\} \cup \{a^m, m>1\}$

(a) Both are regular

(b) Only L_2 is regular

(c) Only L_1 is regular

(d) None of the above

Solution: Option (b)

Explanation:
L_1 is not regular as the language is either $\{a^m b^n c^m : m,n > 1\}$ if $m > n$ or $\{a^m b^n c^n : m,n > 1\}$ if $n > m$, in which case both are context free but not regular.

$L_2 \rightarrow a^*$

55) Consider this Context-Free Grammar:

$$S \rightarrow aSa \mid bSb \mid aSb \mid bSa \mid \varepsilon$$

(a) L(G) is regular
(b) L(G) is DCFL
(c) L(G) is NCFL
(d) L(G) is ambiguous

Solution: Option (a)

Explanation:
G is producing all even length strings which is a regular language.

56) Ambiguous grammar is NOT accepted by

(a) Regular language
(b) DCFL
(c) CFL
(d) Recursive language

Solution: Option (b)

Explanation:

a) Regular language can accept Ambiguous grammar
b) DCFL- does not accept Ambiguous grammar
c) CFL – may or may not accept Ambiguous grammar
d) Recursive language- may or may not accept Ambiguous

grammar So, Ans is (b).

57) $L = \{0^{n+m} 1^{n+m} 0^m \mid n, m \geq 0\}$

The above language is

(a) CFL but not regular
(b) CSL but not CFL
(c) RE but not CSL
(d) none of the above

Solution: Option (c)

Explanation:

L = $\{0^{n+m}\ 1^{n+m}\ 0^m \mid n, m \geq 0\}$

↳ This language is not CFL as one-stack can't do this.
↳ Not CSL as it doesn't accept null string.
↳ RE can do and capture this.

58) $L_1 = \{(xy)^m\ (yz)^m, m \geq 1\}$
$L_2 = \{a^m b^n c^k \mid m>n$ or

$m<n\}$ Which of the

following is True?

(a) L_1 is CFL, L_2 is DCFL
(b) L_1 is DCFL, L_2 is CFL
(c) Both L_1, L_2 are CFLs
(d) Both L_1, L_2 are DCFLs

Solution: Option (b)
Explanation:

$L_1 = \{(xy)^m\ (yz)^m, m \geq 1\}$
↳ DCFL → Push Pop defined

$L_2 = \{a^m b^n c^k \mid m>n \text{ or } m<n\}$
↳ CFL → Push Pop not defined

59) $L = \{x^a y^a : a \geq 1\}$

I. L^3 is context free.
II. $\lceil\sqrt{L}\,\rceil$ is not context

free. Which of the following

is correct?

(a) I only
(b) II only
(c) Both I and II
(d) None of the above

Solution: Option (a)

Explanation:

$L = \{x^a y^a : a \geq 1\}$

I. L^3 is context free → True

II. $\lceil \sqrt{\overline{L}} \rceil$ is not context free → False

60) onsider the following statements.

(i) Kleen closure of an empty language is non-empty.

(ii) Some infinite languages are regular.

(iii) $L = \{a^P$ / P is a prime number$\}$ is a regular language.

(a) Only (i) is true

(b) Only (ii) & (iii) are true

(c) Only (i) & (ii) are true

(d) All are true

Solution: Option (c)

Explanation:

(i) Kleen closure of an empty language has the only string ∈. So, it is non-empty. $\phi^* = \{\in\}$

(ii) Some infinite languages are regular
Eg: $L = \{a^n / n \geq 0\}$ is regular

∴ (iii) is not true.

61) Consider the following grammar which of the following is/are ambiguous?

(i) S → y | Sxs

(ii) S → E | Exs and E → y

(iii) S → Sxy | y

(a) i only

(b) ii only

(c) iii only

(d) None of these

Solution: Option (d)

Explanation:

All are ambiguous.

62) Which of the following is not decidable problem?

(a) A sting is generated by C.N.F or Not?
(b) A given non-terminal A in a given grammar CFG is ever used in the generation of word
(c) Given context-free Grammar generates an infinite language or a finite language
(d) None of

the above

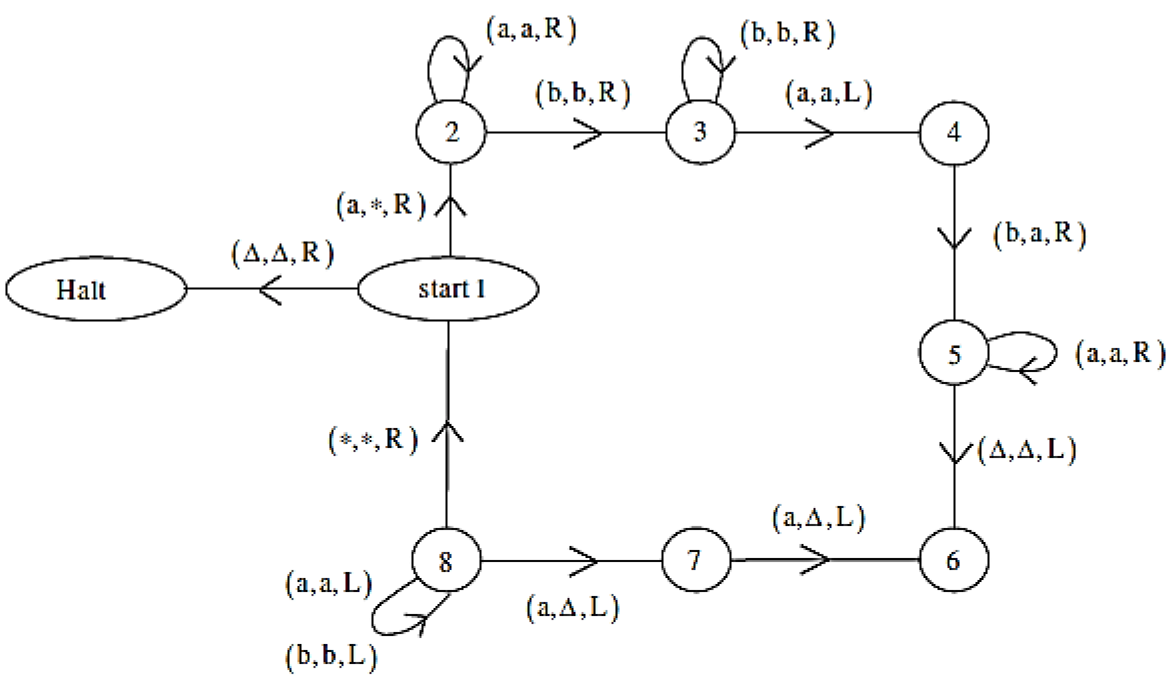
Solution: Option

(d) **Explanation:**

All the three statements are decidable.

63) Consider the following T.M.

{Note Σ ={a,b}
⌈ = {*,a,b}
Δ = empty cells of Tape.



Which of the following string does not accepted by T.M. ?

(i) aabbaa
(ii) ∊
(iii) aabb

(a) i & ii
(b) ii, iii and iv
(c) iii and iv
(d) iv only

Solution: Option (c)

Explanation:

The T.M. accept the language.

$L = \{a^n b^n a^n / n \geq 0\}$ so string iii and iv does not generated by the language.

64) Consider the PDA $M = \{\{q_0, q_1\}, \{0,1\}\}, \{0,1, z_0\}, \{q_0, z_0, q_F\}$

$\delta = \{((q_0, 0, z_0), (q_0, 0z_0)), ((q_0, 0,0), (q_0, 00)) ((q_0, 1,0), (q_0, 10))$

$((q_0, 1,1), (q_0, 11), (q_0, 0,1), (q_1, \in))$

$((q_1, 0,1), (q_1, t)), ((q_1, 0,0), (q_1, \in))$

$((q_1, \in, z_0), (q_F, \in))$

The language corresponding to above PDA is

(a) $L = \{0^n 1^n 0^n / n \geq 1\}$
(b) $L = \{0^n 1^n 0^{m+n} / n \geq 1\}$
(c) $L = \{0^n 1^{n+m} 0^m / m, n \geq 1\}$
(d) $L = \{0^n 1^n 0^m / m, n \geq 1\}$

Solution: Option (b)

Explanation:

Suppose string $0100 \in \{0^n 1^n 0^{n+m} / m, n \geq 1\}$

$(q_0, 0100, z_0) \vdash (q_0, 100, 0z_0) \vdash (q_0, 00, 10z_0) \vdash (q_1, 0, 0z_0) \vdash (q_1, \in, z_o) \vdash (q_F, \in)$ accept

65) Which of the following does not perform with the help of Turing Machine?

(i) Addition of two Numbers i.e., f(m,n) = m+n
(ii) Multiplication of two numbers i.e., f(m,n) = m+n
(iii) Acceptance of language $L = \{W/W \notin (a, b)^*\}$
(iv) Acceptance of language $L = \{a^n b^n c^n d^n e^n / n \geq 1\}$

(a) i and ii
(b) iii and iv
(c) iii only
(d) None of these

Solution: Option (c)

Explanation:

$L = \{W/W \notin (a, b)^*\}$
we cannot identify the boundary of Language So cannot be accepted by T.M.

66) Which of the following is a context free language

(i) $L = \{a^m b^m c^k : n = m \text{ or } n \leq k\}$
(ii) $L = \{a^n b^n c^n \mid n \geq 0\}$
(iii) $L = \{a^n b^m c^k : n = m \text{ or } m \neq k\}$
(iv) $L = \{a^n b^m c^k \mid n, m, k \geq 0\}$

(a) iv only
(b) i, ii & iv only
(c) ii & iii only
(d) iv & iii only

Solution: Option (b)

Explanation:

(i) Is a union of two C.F.G, because in condition n = m or n ≤ k
(ii) Is also union of two CFG because in condition n = m or m ≠ k
(iv) Is regular language so also CFL

67) Let Σ = {a, b} and $L = \{a^n w a^n : n \geq 1, w \in \Sigma^*\}$ consider the following statement

(i) L has regular expression a * (a + b) * a *
(ii) L is Non-Regular language
(iii) L has CFG S→ aSa | aS | bS | aa where S is variable
(iv) L has CFG S → aSa | axa where
S, X are variable X → aX | bX | λ

Which of the following is/are true?

(a) i only
(b) ii and iii only
(c) i and iv only
(d) iv only

Solution: Option (d)

Explanation:

L generates minimum
2 a's. So (iv) is only
true.

68) Based on the accepting power, which of the following is true?

(a) Type 0 $\subset$ Type 1 $\subset$ Type 2 $\subset$ Type 3

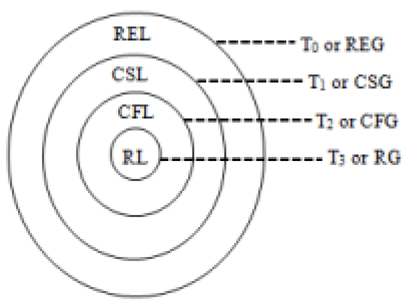
(b) Type 0 $\subset$ Type 2 $\subset$ Type 1 $\subset$ Type 3

(c) Type 0 $\supset$ Type 1 $\supset$ Type 2 $\supset$ Type 3

(d) Type 0 $\supset$ Type 2 $\supset$ Type 1 $\supset$ Type 3

Solution: Option (c)

Explanation:



$$\therefore T_3 \subset T_2 \subset T_1 \subset T_0$$

69) Which of the following is true?

(i) Automata is a recognizing device or an accepting device.
(ii) Grammar is a generating device.

(a) only (i) (b) only (ii)
(c) both (i) & (ii) (d) none of these

Solution: Option (c)

70) Expressive power of automata is the number of languages accepted by the automata. What is the expressive power of Finite Automata (FA), Push Down Automata (PDA), Linear Bounded Automata (LBA) and Turing Machine (TM), respectively.

(a) FA – 1, PDA – 1, LBA – 1, TM – 1

(b) FA – 1, PDA – 2, LBA – 3, TM – 4

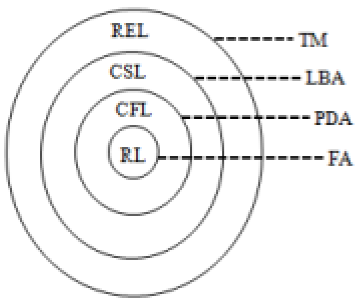
(c) FA – 4, PDA – 3, LBA – 2, TM – 1 (

d) FA – 1, PDA – 4, LBA – 3, TM – 2

1

Solution: Option (b)

Explanation:



Finite Automata can accept Regular Language (RL) only
PDA can accept Regular and Context Free Languages (CFL)
LBA can accept Regular, Context free and Context Sensitive Languages (CSL) Turing Machine can accept Regular, Context Free, Context Sensitive and Recursive Enumerable Languages (REL)

71) Which of the following is/are true about expressive power of automata?

(i) E(DFA) = E(NFA)
(ii) E(DPDA) ≠ E(NPDA)
(iii) E(DTM) = E(NTM)

(a) Only (i) & (iii) (b) Only (i) & (ii)
(c) Only (ii) & (iii) (d) All are true

Solution: Option (d)

Explanation:

Expressive power of Deterministic Push Down Automata & Non-deterministic PDA is not equal because NPDA can accept some of the CFL(s) which cannot be accepted by DPDA. The CFLs accepted by DPDA are called Deterministic Context Free Languages.

E(DFA) = E(NFA) because, every language accepted by DFA can also be accepted by NFA and vice-versa. The same holds with DTM and NTM, E(DTM) = E(NTM).

72) For which of the following language L, modes can be constructed in both deterministic and non-deterministic mode to accept L?

(i) Regular Language
(ii) Context Free Language
(iii) Recursive Enumerable Language

(a) Only (i) & (ii) (b) Only (i) & (iii)
(c) Only (ii) & (iii) (d) All of the above

Solution: Option (b)

Explanation:

The deterministic & non-deterministic automata for both Regular Language & Recursive Enumerable Language interconvertible (expressive power are equal). That is, every DFA can be converted to an equivalent NFA, so we can construct a model that can be accepted by both deterministic and non-deterministic mode to accept a regular language.

The same explanation holds with the RELs also, that every DTM can be converted to an equivalent NTM.

But for CFLs, there exists some languages which are accepted by NPDA but not DPDA. Remember that NPDA is more powerful than DPDA, the expressive power of deterministic and non-deterministic automata is not equal, and so option (ii) is not a right answer.

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73) Which of the following statements is false?

(a) DFA & NFA are of same capability (b) DPDA & NPDA are of same capability (c) DTM & NTM are of same capability (d) None

Solution: Option (b)

Explanation:

NPDA can accept some CFLs which cannot be accepted by DPDA and expressive powers are different

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74) Which of the following statements is wrong?

(a) PDA is more powerful than FA
(b) TM is more powerful than PDA
(c) FA+3 Stacks is more powerful than FA+2 Stacks

(d) None

Solution: Option (c)

Explanation:

Option (c) is wrong because,

FA = FA + 0 Stack (memory)

PDA = FA + 1 Stack

TM = FA + 2 Stacks = PDA + 1 Stack
= FA + 3 Stacks

= FA + n Stacks($n \geq 2$)

∴ Power of FA+3 Stacks is equal to that of FA+2 Stacks because both represents Turing machine.

75) Consider the language $L_1 = \{a^p \cdot b^q \cdot c^r \mid p, q, r > 0\}$ and $L_2 = \{a^p \cdot b^q \cdot c^r \mid p, q, r \geq 0 \text{ and } p = r\}$, then which of the following statements are true.

(1) $L_1 \cup L_2$ is a context free language
(2) $L_1 \cap L_2$ is a context free language
(3) $L_1 - L_2$ is not regular
(4) L_1 and L_2 both are regular languages

(a) Only 1 and 2 statements are true (b) Only 3 and 4 statements are true (c) Only 1, 2, 3 statements are true (d) Only 1, 2, 4 statements are true

Solution: Option (c)

Explanation:

For the given language of L_1 and L_2,
L_1 is regular and L_2 is context free

Consider the statements:

(1) The union of L_1 and L_2 i.e., union at Regular and context free is context free language. Statement 1 is true.

1

(2) The intersection of L_1 and L_2 i.e., intersection of Regular and context free is context free language. Statement 2 is true.

(3) $L_1 - L_2 = \{a^p b^q c^r / p!=r,\ p,q,r>0\}$ which is clearly cannot be accepted by DFA. Its

DCFL. (4) L_1 is regular and L_2 is not regular. Therefore statement 4 is false

76) Below is the grammar then find the language generated by given grammar

S → ABC Xb → bx
AB → aAx |bAy | ∊ Ya → ay
C → ∊ Yb → by
XC → BaC aB → Ba
YC → BbC bB → Bb
Xa → aX

(a) $L = \{w|w \in (a, b)^*$, and $x_a(w) = x_b(w)\}$
(b) $L = \{w|w \subseteq (a, b)^+$, and w is a palandrom string
(c) $L = \{w|w \subseteq (a, b)^*$, and $w = xx$, where $X = (a, b)^*\}$
(d) None of the above

Solution: Option (c)

Explanation:

Given grammar is
S → ABC Xb → bx
AB → aAx |bAy | ∊ Ya → ay

10

C → ∊ Yb → by
XC → BaC aB → Ba
YC → BbC bB → Bb
Xa → aX

Generate same string randomly

$S \rightarrow \underline{A}BC$
$\rightarrow a\underline{Ax}C$
$\rightarrow a\underline{AB}aC$
$\rightarrow a \cdot \in \cdot a \cdot \in$
$\rightarrow a \cdot a$

(2) $S \rightarrow \underline{AB}C$

$S \rightarrow aA\underline{xC}$
$S \rightarrow a\underline{ABa}C$
$\rightarrow abA\underline{ya}C$
$\rightarrow abAa\underline{yC}$
$\rightarrow abA\underline{aB}bC$
$\rightarrow ab\underline{AB}abC$
$\rightarrow ab\in \cdot ab \cdot \in$
$\rightarrow ab \cdot ab$

$S \rightarrow \underline{AB}C$
$\rightarrow bA\underline{yC}$
$\rightarrow b\underline{AB}bC$
$\rightarrow bbA\underline{yb}C$
$\rightarrow bbAb\underline{yC}$
$\rightarrow bbA\underline{bB}bC$
$\rightarrow bb\underline{AB}bbC$
$\rightarrow bbaA\underline{xb}bC$
$\rightarrow bbaAb\underline{xb}C$
$\rightarrow bbaAbb\underline{xC}$
$\rightarrow bbaAb\underline{bB}baC$
$\rightarrow bbaA\underline{bB}baC$
$\rightarrow bba\underline{AB}bbaC$
$\rightarrow bba \cdot \in \cdot bba \cdot \in$
$\rightarrow bba \cdot bba$

See above all strings which are generated from out grammar, those are in the form of

$w \cdot w | w \in (a, b)^*$

$\therefore$ Consider option (c)

i. e. , $L = \{w | w \subseteq (a, b)^*$ and $w = x \cdot x$ and $x \in (a,$

$b)^*\}$ $\therefore$ Option (c) is right answer.

77) A PDA behaves like an FSA when the number of auxiliary memory it has, is ____

Solution: From 0 To 0

Explanation: There is no need of auxiliary memory required for an FSA to accept a language. And every language which is accepted by a finite automata is accepted by push down automata but the vice versa is not true.

78) The statement "A Turing machine can't solve halting problem" is

(a) True (b) False

(c) Still an open question (d) False when P!= NP

Solution: Option (a)

Explanation:

Halting problem is an undecidable problem

79) Consider PDA = M = $(\{q_0, q_1\}, \{a, b\}, \{a, z_0\}, \delta, q_0, z_0, \varphi)$ which accepts by empty stack

δ: $(q_0, a, z_0) = (q_0, az_0)$

$(q_0, a, a) = (q_0, aa)$

$(q_0, b, a) = (q_1, a)$

$(q_1, b, a) = (q_1, a)$

$(q_1, a, a) = (q_1, \in)$

$(q_1, \in, z_0) = (q_1, \in)$

Which one of the following strings is accepted by the above PDA?

(s1) aaa

(s2) aabbaa

(s3) aba

(s4) aaab

(a) Only s2, s3 and s4 (b) Only s1
(c) Only s2 and s3 (d) Only s2

Solution: Option (c)

80) Which of the following is true for the following grammar?

E → E + E
E → E * E
E → id

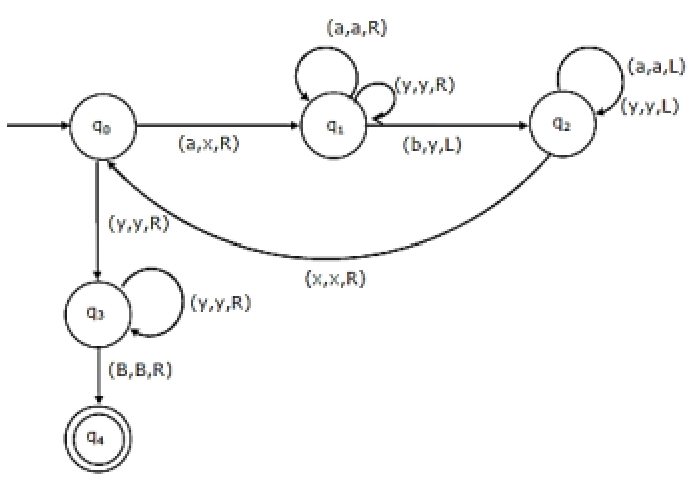
(a) * has precedence over + (b) + has precedence over * (c) Both are of same precedence (d) None of these

Solution: Option (c)

Explanation:

Given grammar is ambiguous over E → E + E → E * E, because of which both * and + have equal precedence.

81) The transition diagram for Turing machine is given below:



Which one of the following strings is accepted by the above TM?

(a) aabbb (b) aabb
(c) abbb (d) None of these

Solution: Option (b)

82) Which of the following is TRUE?

(a) The equality problem ($L_1 = L_2$) of CFLs is decidable
(b) The emptiness of CSL's is decidable
(c) Finiteness of CFL is decidable
(d) Is $L_1 \cap L_2 = \phi$ is decidable for CSL's

Solution: Option (c)

83) Consider three decision problems P_1, P_2 and P_3. It is known that P_1 is decidable and P_2 is undecidable. Which one of the following is true?

(a) P_3 is decidable if P_1 isreducible to P_3
(b) P_3 is undecidable if P_3 isreducible to P_2
(c) P_3 is undecidable if P_2 isreducible to P_3
(d) P_3 is decidable if P_3 isreducible to P_2's complement

Solution: Option (c)

84) Consider the following grammar:
S → Aa | b
A → Ac | Sd | c

The resulting grammar after eliminating left recursion is
(a)
A → SdA′| CA′ A′ → cA′| ϵ
S → Aa | b
(b)
A → bdA′| cA′
A′ → cA′| adA′| bA′| ϵ

(c)
A → bdA′| cA′ A′ → cA′| adA′| ϵ
(d) None of these

Solution: Option (c)

85) Consider the following languages:

$L_{ne} = \{\langle M\rangle \mid L(M) \neq \phi\}$
$L_e = \{\langle M\rangle \mid L(M) = \phi\}$

where $\langle M\rangle$ denotes encoding of a Turning machine

M Then which one of the following is true?

(a) L_{ne} is r.e. but not recursive and L_e is not r.e. (b) Both are not r.e.
(c) Both are recursive
(d) L_e is r.e. but not recursive and L_{ne} is not r.e. **Solution:** Option (a)

Explanation:

L_{ne} is r.e., since we can accept M, if M accepts a string.

86) etermine the minimum height of parse tree in CNF for terminal string of length w, which is constructed by using CFG G

(a) $\log_2|w| + 1$ (b) $\log_2|w|$

(c) $\log_2|w| - 1$ (d) None of these

Solution: Option (a)

87) Let G and G_1 be a CFG with productions

G: $S \rightarrow S + S \mid S{*}S \mid (S) \mid a$
G_1: $S \rightarrow S + T \mid T$
$T \rightarrow T{*}F \mid F$
$F \rightarrow (S) \mid a$

Then which of the following is true?

(a) $L(G) \neq L(G_1)$ (b) $L(G_1) \subseteq L(G)$

(c) $L(G) \subset L(G_1)$ (d) $L(G) = L(G_1)$

Solution: Option (d)

Explanation:
G_1 is the unambiguous expression of G.

88) The intersection of a CFL and a regular language

(a) Need not be regular (b) Need not be context free (c) Is always regular (d)

Is always CFL

Solution: Option (d)

89) Let $\Sigma = \{a, b\}$ and let L = {w | w contains an equal number of occurrences of substrings "ab" and "ba"}. Thus aba ∈ L since "aba" contain one occurrence of "ab" and one occurrence of "ba" but abab ∉ L. Then which of the following is true?

(a) L is regular (b) L is a DCFL but not regular (c) L is a CFL but not regular (d)

L is recursive but not a CFL **Solution:** Option (a)

Explanation:
We can write a DFA that accepts the given language L.

90) $L_1 = \{a^n b^n a^m / n, m = 1,2,3, \dots\}$
$L_2 = \{a^n b^m a^m / n, m = 1,2,3, \dots\}$
$L_3 = \{a^n b^n a^n / n = 1,2,3, \dots\}$

Which of the following is true?

(a) $L_3 = L_1 \cap L_2$

(b) L_1 is context free language (CFL) but L_2 and L_3 are not CFL's

(c) L_1 and L_2 are not CFL's but L_3 is a CFL

(d) Both (a) and (b)

Solution: Option (a)

Explanation:

L_1 and L_2 are CFLs but L_3 is not CFL as we need to have two instances of memory to accept

L_3.

91) Which one of the following is a DCFL?

(a) $L = \{a^n b^n c^n \mid n > 1000\}$ (b) L = set of all balanced parenthesis (c) $L = \{WW^R \mid W \in \{a, b\}^*\}$ (d) All of these

Solution: Option (b)

Explanation:

Option (a) is not CFL at all because we need two stacks to accept the strings of the language.

Option (c) is not deterministic CFL, because we need to guess the mid of the string for every string in the language.

Option (b) is deterministic CFL, because we know push and pop operations deterministically.