

Pushdown Automata MCQ Quiz - Objective Question with Answer for Pushdown Automata - Download Free PDF

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Latest Pushdown Automata MCQ Objective Questions

Pushdown Automata Question 1:

Consider the grammar $S \rightarrow SbS \mid a$.

Consider the following statements:

The string abababa has

- (A) two parse trees
- (B) two left most derivations
- (C) two right most derivations

Which of the following is correct?

1. All (A), (B) and (C) are true
2. Only (B) is true
3. Only (C) is true
4. Only (A) is true

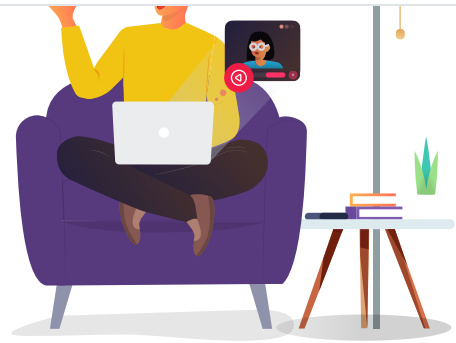
Answer (Detailed Solution Below)

Option 1 : All (A), (B) and (C) are true

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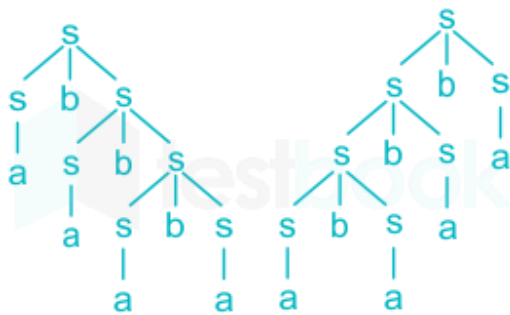
Pushdown Automata Question 1 Detailed Solution

The given grammar is:

$$S \rightarrow SbS \mid a$$

The string abababa can be derived using the:

(A) two parse trees



(B) two left most derivative

First derivative

$$S \rightarrow \underline{\underline{S}}bS$$
$$S \rightarrow \underline{S}bSbS$$
$$S \rightarrow \underline{S}bSbSbS$$
$$S \rightarrow ab\underline{S}bSbS$$
$$S \rightarrow abab\underline{S}bS$$
$$S \rightarrow ababab\underline{S}$$

$S \rightarrow abababa$

Second derivative

$$S \rightarrow \underline{S}bS$$
$$S \rightarrow ab\underline{S}$$

$S \rightarrow abab\underline{S}bS$

$S \rightarrow ababab\underline{S}$

$S \rightarrow abababa\underline{a}$

(C) two right most derivative

First derivative

$S \rightarrow Sb\underline{S}$

$S \rightarrow SbSb\underline{S}$

$S \rightarrow SbSbSb\underline{S}$

$S \rightarrow SbSb\underline{S}ba$

$S \rightarrow Sb\underline{S}baba$

$S \rightarrow \underline{S}bababa$

$S \rightarrow abababa$

Second derivative

$S \rightarrow Sb\underline{S}$

$S \rightarrow \underline{S}ba$

$S \rightarrow Sb\underline{S}ba$

$S \rightarrow \underline{S}baba$

$S \rightarrow Sb\underline{S}baba$

$S \rightarrow \underline{S}bababa$

$S \rightarrow abababa\underline{a}$

Hence, the correct answer is **options 1**.

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Consider the following NPDA = $(\{q_0, q_1, q_f\}, \{a, b\}, \{1, z\}, \delta, q_0, z, \{q_f\})$

$$\delta(q_0, \lambda, z) = \{(q_f, z)\}$$

$$\delta(q_0, a, z) = \{(q_1, 11z)\}$$

$$\delta(q_1, a, 1) = \{(q_1, 111)\}$$

$$\delta(q_1, b, 1) = \{(q_1, \lambda)\}$$

$$\delta(q_1, \lambda, z) = \{(q_f, z)\}$$

Which of the following Language L is accepted by NPDA?

1. $L = \{a^{2n}b^n : n \geq 0\}$
2. $L = \{a^n b^{2n} : n \geq 0\}$
3. $L = \{a^{2n}b^n : n > 0\}$
4. $L = \{a^n b^{2n} : n > 0\}$

Answer (Detailed Solution Below)

Option 1 : $L = \{a^{2n}b^n : n \geq 0\}$

Pushdown Automata Question 2 Detailed Solution

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it pushes two 1's on the stack ($\delta(q_0, a, z) = \{(q_1, 11z)\}$). Then, every time it reads another a, it pushes another 1 on the stack ($\delta(q_1, a, 1) = \{(q_1, 111)\}$). This way, the stack stores the number of a's that have been read so far.

- When the NPDA reads a b, it pops one 1 from the stack ($\delta(q_1, b, 1) = \{(q_1, \lambda)\}$). When the stack becomes empty (i.e., when all the a's have been paired with b's), the NPDA transitions to the final state q_f ($\delta(q_1, \lambda, z) = \{(q_f, z)\}$).
- Therefore, the NPDA accepts the language $L = \{a^{2n}b^n : n \geq 0\}$, which consists of strings of a's followed by an equal number of b's. The other options are not accepted by the NPDA.

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Quizzes[Get Started for Free](#) [Download App](#)**Pushdown Automata Question 3:**

The grammar

$G: S \rightarrow SS \mid a \mid b$ is ambiguous.

This indicates that at least some of the strings in its language have more than just the leftmost derivation. However, it's possible that certain language strings have just one source.

i. bbbba (has x leftmost derivation).

ii. aaaa (has y leftmost derivation).

iii. aab (has z leftmost derivation).

What is the value of $x+y+z$?

Answer (Detailed Solution Below) **8**

Pushdown Automata Question 3 Detailed Solution

The correct answer is **8**.

Concept:

Given that the grammar G is ambiguous.

$$S \rightarrow SS \mid a \mid b$$

Now we need to find the string in the given options which has more than two leftmost derivations.

Option 1: bbbba

We can find more than two Leftmost derivatives for the string bbbba.

→ bbS	→ SSSSS	→ bSSS
→ bbSS	→ bSSSS	→ bbSS
→ bbbS	→ bbSSS	→ bbSSS
→ bbbSS	→ bbbSS	→ bbbSS
→ bbbbS	→ bbbbS	→ bbbbS
→ bbbba	→ bbbba	→ bbbba

Option 2: aaaa

We can find more than two leftmost derivations for the string aaaa.

S → SS	S → SS	S → SS
→ SSS	→ aS	→ SSS
→ SSSS	→ aSS	→ aSS
→ aSSS	→ aaS	→ aSSSS
→ ssSS	→ aaSS	→ aaSS
→ aaaS	→ aaaS	→ aaaS
→ aaaa	→ aaaa	→ aaaa

Option 3: aab

There are exactly two leftmost derivations for the string aab.

S → SS	S → SS
→ SSS	→ aS
→ aSS	→ aSS
→ aaS	→ aaS
→ aab	→ aab

x has 3 leftmost derivations.

y has 3 leftmost derivations.

z has 2 leftmost derivations.

$$x+y+z=3+3+2$$

$$x+y+z=8 \text{ derivations}$$

Hence the correct answer is **8**.

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Pushdown Automata Question 4:

$$\{a^n b^n \mid n \geq 1, n \neq 100\}$$

The above-given language is

1. DCFL but not regular
2. Regular
3. CFL but not DCFL
4. DCFL and CFL

Answer (Detailed Solution Below)

Option :

Pushdown Automata Question 4 Detailed Solution

The correct answer is **option 1 and option 4.**

Concept:

The given language is,

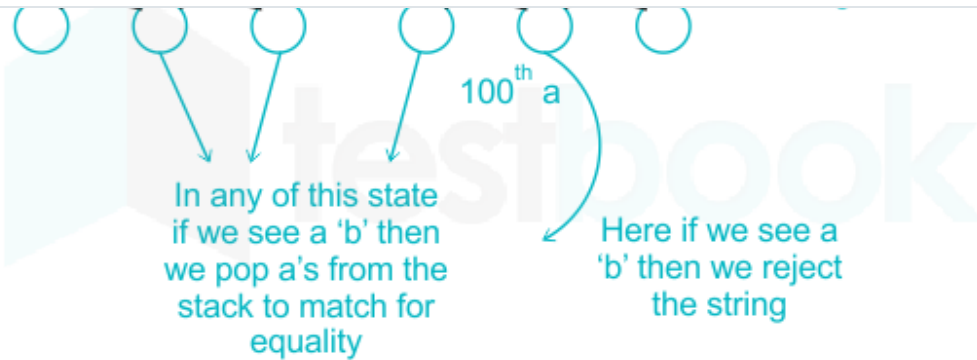
$$\{a^n b^n \mid n \geq 1, n \neq 100\}$$

It accepts the strings like = {ab, aabb, aaabbb, aaaabbbb,...}

The given language is Deterministic context-free language.

$\{a^n b^n \mid n \geq 1, n \neq 100\}$ $a^n b^n \mid n \geq 1$ is CFL and in particular is a DCFL.

$a^n b^n \mid n \geq 1 \text{ \& } n \neq 100$ is also a DCFL Let's understand how to draw the PDA.



The above grammar is DCFL and CFL but not a regular language.

Hence the correct answer is option 1 and option 4.

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Pushdown Automata Question 5:

Which of the following statement is/are true?

1. Pushdown automata = Finite automata + 0 stack
2. Pushdown automata = Finite automata + 1 stack
3. Deterministic pushdown automata is a subset of nondeterministic pushdown automata.
4. Non deterministic Pushdown Automata and Deterministic Pushdown Automata are equivalent in power.

Answer (Detailed Solution Below)

Pushdown Automata Question 5 Detailed Solution

The correct answer is **option 2 and option 3**.

Concept:

Option 1: Pushdown automata = Finite automata + 0 stack

False, Pushdown Automata is a finite automaton with extra memory called stack which helps Pushdown automata to recognize Context-Free Languages.

Pushdown automata = Finite automata + stack (More than one stack)

Option 2: Pushdown automata = Finite automata + 1 stack

True, Pushdown Automata is a **finite automaton** with extra memory called **stack** which helps Pushdown automata to recognize Context-Free Languages.

Pushdown automata = Finite automata + stack (More than one stack)

Option 3: Deterministic pushdown automata is a subset of nondeterministic pushdown automata.

True, Pushdown automata with deterministic behavior are a subset of those with nondeterministic behavior. NPDA is more powerful than DPDA, it can support more languages than DPDA can, although not all languages can be supported by both groups.

Option 4: Non deterministic Pushdown Automata and Deterministic Pushdown Automata are equivalent in power.

False, There is no power equivalence between NPDAs (Non-Deterministic Pushdown Automata) and DPDAs (Deterministic Pushdown Automata). The NPDA is more effective than the DPDA, hence it exists for every language for which a DPDA exists. However, certain languages are accepted by the NPDA but not by the DPDA.

i.e $DPDA < NPDA$

Hence the correct answer is **option 2 and option 3**.

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Top Pushdown Automata MCQ Objective Questions

Which of the following is/are correct?

I. A language is context free if and only if it is accepted by PDA

II. PDA is a finite automata with push down stack

1. Both I and II are true
2. Both I and II are false
3. Only II is true
4. Only I is true

Answer (Detailed Solution Below)

Option 1 : Both I and II are true

Pushdown Automata Question 6 Detailed Solution

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Statement I. A language is context free if and only if it is accepted by PDA

Given statement is correct A language is context free if and only if it is accepted by a push down automata. For a context free grammar, there is an equivalent PDA which accepts that language. If language is not accepted by PDA it means language is not context free.

Statement II. PDA is a finite automata with push down stack

Given statement is correct. A push down automata is like a finite automata having memory (extra component) which is known as stack. Stack helps in recognizing the languages. Symbol are written on the stack for reading and writing purpose.

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Pushdown Automata Question 7

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Let $\langle M \rangle$ denote an encoding of an automaton M . Suppose that $\Sigma = \{0, 1\}$. Which of the following languages is/are NOT recursive?

1. $L = \{ \langle M \rangle \mid M \text{ is a PDA such that } L(M) = \Sigma^* \}$
2. $L = \{ \langle M \rangle \mid M \text{ is a DFA such that } L(M) = \Phi \}$
3. $L = \{ \langle M \rangle \mid M \text{ is a PDA such that } L(M) = \Phi \}$
4. $L = \{ \langle M \rangle \mid M \text{ is a DFA such that } L(M) = \Sigma^* \}$

Answer (Detailed Solution Below)

Option :

Pushdown Automata Question 7 Detailed Solution

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Answer: Option 1

Explanation:

Option 1: $L = \{ \langle M \rangle \mid M \text{ is a PDA such that } L(M) = \Sigma^* \}$

This is **not Recursive**. As completeness Problem is Undecidable for CFL and Hence no algorithm exists to decide whether or not the Language of PDA is Σ^* .

Option 2: $L = \{ \langle M \rangle \mid M \text{ is a DFA such that } L(M) = \Phi \}$

This is **Recursive**. for DFA accept empty language Algorithm exists

Option 3: $L = \{ \langle M \rangle \mid M \text{ is a PDA such that } L(M) = \Phi \}$

This is also **Recursive**. for a CFL to checking for empty language problem is decidable. Hence there exists an algorithm to decide whether a PDA accepts empty language or not.

Option 4: $L = \{ \langle M \rangle \mid M \text{ is a DFA such that } L(M) = \Sigma^* \}$

This is also **Recursive**. Completeness problem for regular language is decidable.

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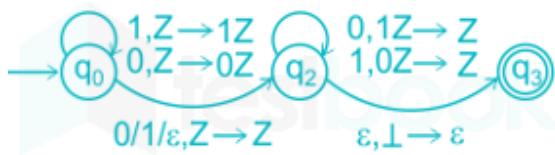
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Pushdown Automata Question 8

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Consider the NPDA $\langle Q = \{q_0, q_1, q_2\}, \Sigma = \{0, 1\}, \Gamma = \{0, 1, \perp\}, \delta, q_0, \perp, F = \{q_2\}\rangle$, where (as per usual convention) Q is set of states, Σ is the input alphabet, Γ is the stack alphabet, δ is the state transition function, q_0 is the initial state, \perp is the initial stack symbol, and F is the set of accepting states. The state transition is as follows:



Which one of the following sequences must follow the string 101100 so that the overall string is accepted by the automaton?

1. 10110
2. 10010
3. 01010
4. 01001

Answer (Detailed Solution Below)

Option 2 : 10010

Pushdown Automata Question 8 Detailed Solution

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0/1/ ϵ , $Z \rightarrow Z$ $\epsilon, \perp \rightarrow \epsilon$

In this Z represents the top of the stack.

1, $Z \rightarrow 1Z$ means, on input symbol 1, if stack top is Z then it changes to 1.

Here, in q_0 state, for a 1, a '1' is pushed into the stack and for a '0' a '0' is pushed into stack. In q_1 stack, for a '0' a '1' is popped and for a '1' a '0' is popped. It means when it finds a complement of input character on top of stack then it pop one element from top of stack.

Given string is 101100 having 6 letters, but in options we have to append 5 length string so one bit is ignored to transit between state.

Only option 2) matches with this PDA.

String will be like 10110010010

At state q_0 , input is 1, push 1 (remain at q_0 state)

At state q_0 , input is 0, push 0 (remain at q_0 state)

At state q_0 , input is 1, push 1 (remain at q_0 state)

At state q_0 , input is 1, push 1 (remain at q_0 state)

At state q_0 , input is 0, push 0 (remain at q_0 state)

At state q_0 , input is 0, ignore (move to q_1 state)

At state q_1 , input is 1, stack top 0, pop (remain at q_1 state)

At state q_1 , input is 0, stack top 1, pop (remain at q_1 state)

At state q_1 , input is 0, stack top 1, pop (remain at q_1 state)

At state q_1 , input is 1, stack top 0, pop (remain at q_1 state)

At state q_1 , input is 0, stack top 1, pop (remain at q_1 state)

At state q_1 , input is null, stack top null, accepted.

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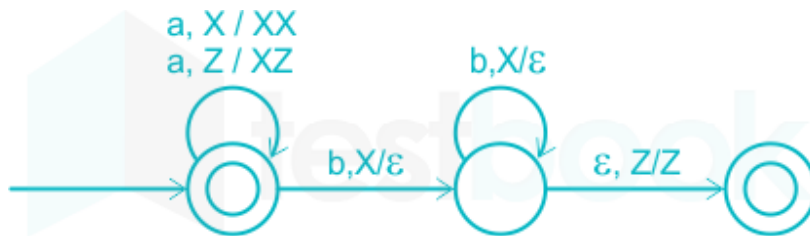


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Pushdown Automata Question 9

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Consider the transition diagram of a PDA given below with input alphabet $\Sigma = \{a, b\}$ and stack alphabet $\Gamma = \{X, Z\}$. Z is the initial stack symbol. Let L denote the language accepted by the PDA.



Which one of the following is TRUE?

1. $L = \{a^n b^n \mid n \geq 0\}$ and is not accepted by any finite automata
2. $L = \{a^n \mid n \geq 0\} \cup \{a^n b^n \mid n \geq 0\}$ and is not accepted by any deterministic PDA
3. L is not accepted by any Turing machine that halts on every input
4. $L = \{a^n \mid n \geq 0\} \cup \{a^n b^n \mid n \geq 0\}$ and is deterministic context-free

Answer (Detailed Solution Below)

Option 4 : $L = \{a^n \mid n \geq 0\} \cup \{a^n b^n \mid n \geq 0\}$ and is deterministic context-free

Pushdown Automata Question 9 Detailed Solution

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Concept:

Acceptance of given string by a push down automata in two ways either by

- Acceptance by final state: if machine at the end of the string enters to one of the final states then string is accepted.
- Acceptance by Empty state: if at the end of the string, stack is empty then string is accepted.

Explanation:

In this PDA, initial state is also the final state it means null string is accepted by the given push down automata (PDA). Consider the states as q_1 , q_2 and q_3 where q_1 is the final state.

Transition of given PDA are:

$$3) (q_1, b, X) \Rightarrow (q_2, \epsilon)$$

$$4) (q_2, b, X) \Rightarrow (q_2, \epsilon)$$

$$5) (q_2, \epsilon, Z) \Rightarrow (q_3, Z)$$

First two transition show that after giving input a at transition state remains same. With every input 'a' we push X into stack. It means a^n is always accepted for $n \geq 0$. Transition 3 and 4 shows that for every b input a X is popped out of the stack until stack symbol is Z and string becomes empty. It means 'b' occurred same number of times as 'a'. It represents language of the form $\{a^n b^n \text{ for } n \geq 0\}$. It is a DCFL.

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Pushdown Automata Question 10

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Consider the grammar $S \rightarrow SbS \mid a$.

Consider the following statements:

The string abababa has

- (A) two parse trees
- (B) two left most derivations
- (C) two right most derivations

Which of the following is correct?

1. All (A), (B) and (C) are true
2. Only (B) is true

4. Only (A) is true

Answer (Detailed Solution Below)

Option 1 : All (A), (B) and (C) are true

Pushdown Automata Question 10 Detailed Solution

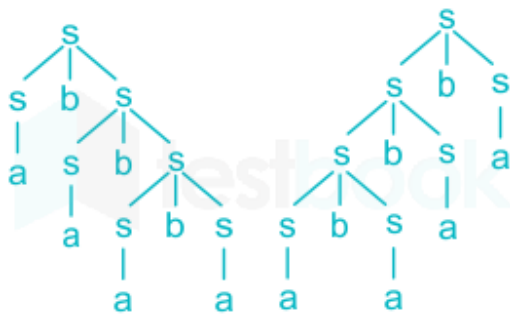
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The given grammar is:

$$S \rightarrow SbS \mid a$$

The string abababa can be derived using the:

(A) two parse trees



(B) two left most derivative

First derivative

$$S \rightarrow \underline{\underline{S}}bS$$
$$S \rightarrow \underline{\underline{S}}bSbS$$
$$S \rightarrow \underline{\underline{S}}bSbSbS$$
$$S \rightarrow ab\underline{S}bSbS$$
$$S \rightarrow abab\underline{S}bS$$
$$S \rightarrow ababab\underline{S}$$

$S \rightarrow abababa$

Second derivative

$$S \rightarrow \underline{S}bS$$
$$S \rightarrow ab\underline{S}$$
$$S \rightarrow ab\underline{S}bS$$

$S \rightarrow ababab\underline{S}$

$S \rightarrow abababa\underline{a}$

(C) two right most derivative

First derivative

$S \rightarrow Sb\underline{S}$

$S \rightarrow SbSb\underline{S}$

$S \rightarrow SbSbSb\underline{S}$

$S \rightarrow SbSb\underline{S}ba$

$S \rightarrow Sb\underline{S}baba$

$S \rightarrow \underline{S}bababa$

$S \rightarrow abababa$

Second derivative

$S \rightarrow Sb\underline{S}$

$S \rightarrow \underline{S}ba$

$S \rightarrow Sb\underline{S}ba$

$S \rightarrow \underline{S}baba$

$S \rightarrow Sb\underline{S}baba$

$S \rightarrow \underline{S}bababa$

$S \rightarrow abababa\underline{a}$

Hence, the correct answer is **options 1.**

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Consider the following NPDA = $(\{q_0, q_1, q_f\}, \{a, b\}, \{1, z\}, \delta, q_0, z, \{q_f\})$

$$\delta(q_0, \lambda, z) = \{(q_f, z)\}$$

$$\delta(q_0, a, z) = \{(q_1, 11z)\}$$

$$\delta(q_1, a, 1) = \{(q_1, 111)\}$$

$$\delta(q_1, b, 1) = \{(q_1, \lambda)\}$$

$$\delta(q_1, \lambda, z) = \{(q_f, z)\}$$

Which of the following Language L is accepted by NPDA?

1. $L = \{a^{2n}b^n : n \geq 0\}$
2. $L = \{a^n b^{2n} : n \geq 0\}$
3. $L = \{a^{2n}b^n : n > 0\}$
4. $L = \{a^n b^{2n} : n > 0\}$

Answer (Detailed Solution Below)

Option 1 : $L = \{a^{2n}b^n : n \geq 0\}$

Pushdown Automata Question 11 Detailed Solution

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The language accepted by the NPDA is $L = \{a^{2n}b^n : n \geq 0\}$.

Explanation:

- The NPDA starts in the initial state q_0 with the stack symbol z . When it reads the first symbol a , it pushes two 1's on the stack ($\delta(q_0, a, z) = \{(q_1, 11z)\}$). Then, every time it reads another a , it pushes another 1 on the stack ($\delta(q_1, a, 1) = \{(q_1, 111)\}$). This way, the stack stores the number of a 's that have been read so far.
- When the NPDA reads a b , it pops one 1 from the stack ($\delta(q_1, b, 1) = \{(q_1, \lambda)\}$). When the stack becomes empty (i.e., when all the a 's have been paired with b 's), the NPDA transitions to the final state q_f ($\delta(q_1, \lambda, z) = \{(q_f, z)\}$).
- Therefore, the NPDA accepts the language $L = \{a^{2n}b^n : n \geq 0\}$, which consists of strings of a 's followed by an equal number of b 's. The other options are not accepted by the NPDA.

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Pushdown Automata Question 12

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What language is accepted by the pushdown automation

$$M = (\{q_0, q_1, q_2\}, \{a, b\}, \{a, b, z\}, \delta, q_0, z, \{q_2\})$$

with $\delta(q_0, a, a) = \{(q_0, aa)\}$; $\delta(q_0, b, a) = \{(q_0, ba)\}$

$$\delta(q_0, a, b) = \{(q_0, ab)\}$$
; $\delta(q_0, b, b) = \{(q_0, bb)\}$

$$\delta(q_0, a, z) = \{(q_0, az)\}$$
; $\delta(q_0, b, z) = \{(q_0, bz)\}$

$$\delta(q_0, \lambda, b) = \{(q_1, b)\}$$
; $\delta(q_0, \lambda, a) = \{(q_1, a)\}$

$$\delta(q_1, a, a) = \{(q_1, \lambda)\}$$
; $\delta(q_1, b, b) = \{(q_1, \lambda)\}$

$$\delta(q_1, \lambda, z) = \{(q_2, z)\}?$$

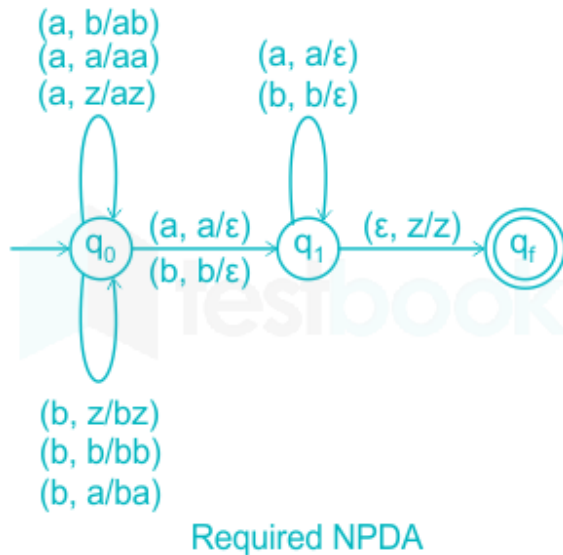
1. $L = \{w \mid n_a(w) = n_b(w), w \in \{a, b\}^+\}$
2. $L = \{w \mid n_a(w) \leq n_b(w), w \in \{a, b\}^+\}$
3. $L = \{w \mid n_b(w) \leq n_a(w), w \in \{a, b\}^+\}$
4. $L = \{ww^R \mid w \in \{a, b\}^+\}$

Answer (Detailed Solution Below)

Option 4 : $L = \{ww^R \mid w \in \{a, b\}^+\}$

The language accepted by the pushdown automation M is the set of all strings that can be generated by the transitions defined in the transition function δ , starting from the initial state q_0 , and eventually reaching the accepting state q_2 . The input alphabet for the language is $\{a, b\}$. The stack alphabet for the language is $\{a, b, z\}$.

The language accepted by the M is $L = \{ww^R \mid w \in \{a, b\}^+\}$ and the transition diagram is given below.


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Pushdown Automata Question 13

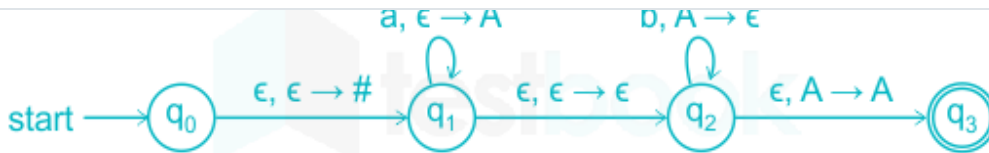
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In a pushdown automaton $P = (Q, \Sigma, \Gamma, \delta, q_0, F)$, a transition of the form,



where $p, q \in Q$, $a \in \Sigma \cup \{\epsilon\}$, and $X, Y \in \Gamma \cup \{\epsilon\}$, represents

$(q, Y) \in \delta(p, a, X)$.



The number of strings of length 100 accepted by the above pushdown automaton is _____

Answer (Detailed Solution Below) **50**

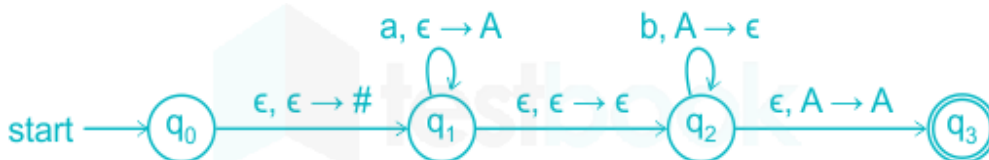
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Answer: 50 to 50

Explanation:

According to given pushdown automata



the language accepted is $\{ a^n b^m \mid n > m \text{ or } |a| > |b| \}$

Number of Strings of length 100 accepted = ?

Let's take Assume small length = 10

Only 5 Strings of length 10 will be accepted

aaaaaaaaaa
aaaaaaaaab
aaaaaaaabb
aaaaaaabbb
aaaaaabbbb

when length = 100

Strings accepted will be a^{100} to $a^{51}b^{49}$;

a's will be (51 , 52 , 53 , ..., 100) Hence total 50 strings.

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Pushdown Automata Question 14

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A pushdown automaton behaves like a Turing machine when the number of total memory is:

1. 0
2. 1
3. 1 or more
4. 2 or more

Answer (Detailed Solution Below)

Option 4 : 2 or more

Pushdown Automata Question 14 Detailed Solution[Download Solution PDF](#)**Concept:**

A push down automata is like a finite state machine but with one auxiliary memory such as stack so that it can recognize the strings.

Explanation:

- A push down automata if contains more than one stack i.e. two or more stack or auxiliary memory than it is known as Turing machine.
- Push down automata can only access top of its stack, it cannot access an infinite tape whereas Turing machine can be used to access an infinite tape. Turing machine can move backward or

tinal state, reject state, transition function).

- A language is known as Turing recognizable if there is a Turing machine that accepts it.
- If Turing machine halts on every input of the language, then it is known as recursive.

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Pushdown Automata Question 15

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The best data structure to check whether an arithmetic expression has balanced parenthesis is a

1. Queue
2. Stack
3. Tree
4. List

Answer (Detailed Solution Below)

Option 2 : Stack

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It will require a push down automata which uses a stack. Also if there is only single type of parenthesis a counter can also be used.

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