CS & IT

Theory of Computation

DPP: 1

Regular Language

Q1 Which of the following language is non-regular?
(A) $L = \{wxw^R \mid x, w \in \{a, b\}^*\}$.
(B) $L = \{wxw \mid w, x \in \{a, b\}^*\}$.
(C) $L = \{wxwx \mid w, x \in \{a, b\}^+\}$.
(D) None of these

Q2 Consider the following grammars G_1 and G_2:

G_1:

$S \rightarrow aAb$
$A \rightarrow aB \mid \in$
$B \rightarrow Ab$

G_2:

$S \rightarrow aABb$
$A \rightarrow aA \mid \in$
$B \rightarrow bB \mid \in$

Which of the following grammar is/are regular?
(A) G_1 only
(B) G_2 only
(C) Both G_1 only G_2
(D) None of these

Q3 Consider the following three languages:
(1) $L = \{a^{n^n} \mid n \geq 1\}$
(2) $L = \{a^{m^n} \mid m = n^2, n \geq 1\}$
(3) $L = \{a^{m^n} \mid n \geq 1, m > n\}$
Total number of regular languages is/are_____.

Q4 Consider the following grammar

G:

G = $S \rightarrow AB \mid CD$
$A \rightarrow aaA \mid \in$
$B \rightarrow bB \mid \in$
$C \rightarrow aaC \mid \in$
$D \rightarrow bD \mid \in$

The language generated by above grammar is:
(A) Finite
(B) Infinite but regular
(C) Non-regular
(D) None of these

Q5 Which of the following language is non-regular?
(A) $L = \{a^{2m} b^n b^n \mid m, n \geq 1\}$
(B) $L = \{a^m b^n X \mid m, n \geq 1, X \in \{a,b\}^*\}$
(C) $L = \left\{\left\{a^{n^2}\right\}^* \middle| n \geq 0\right\}$
(D) None of these

Q6 Regular expression can be used in:
(A) Lexical Analysis
(B) Pattern matching
(C) String matching
(D) Syntax analysis

Q7 Consider the regular expression:
regular expression = $a^*b(a + ba^*)^*$
Above regular expression is equivalent to which of the following below regular expression?
(A) $ba^*(bb)^*$
(B) $ba^*(a + ba^*b)^*$
(C) $(b + aa^*b) + (b + aa^*b)(ba^*b + a)(ba^*b + a)^*$
(D) $a^*b(a + b)^*$

Q8 Which of the following statement will generate finite language?
(A) PDA with finite stack.
(B) Regular expression without kleene star and kleene plus.
(C) Regular expression with unary alphabet.

(D) Regular expression with binary alphabet.

Q9 Consider following regular expressions:

[I] $(ab)^*a = a(ab)^*$

[II] $(bb)^*b^* = b^*$

[III] $(b + \in)^+ = b^*$

Which of the following is correct?

(A) II and III only.

(B) I and II only.

(C) All are correct.

(D) None of these are correct.

Q10 For $L = \{a^n b^m \mid n, m \geq 0\}$

What will be the regular expression ?

(A) $(a^*b^*)^*$ (B) $a^* b^*$

(C) $(ab)^*$ (D) b^*a^*

Q11 Consider the following regular expressions:

(I) $(aa + aaa)^* = aa^+$

(II) $(a^*b\,(a + b)^* + (a^*b^*)^*) = (a + b)^*$

(III) $(\in + aaa\,(aaa)^*)\,(\in + a + aa) = (a + aa + aaa)^*$

Which the following is correct?

(A) (I) and (III) only.

(B) (II) and (III) only.

(C) All are correct.

(D) None of them are correct.

Q12 Which of the following is/are regular expression for the language:

L = { containing ab as a substring}

(A) $b^* aa^*b\,(a^*b^*)^*$

(B) $(a + b)^*\,(ab)^*\,(a + b)^*$

(C) $(a^*\,b^*)^*\,ab\,(a^* + b^*)^*$

(D) $(a + b)^*\,ab\,(a + b)^*$

Q13 What will be the regular expression for $L = \{a^{2n} \mid n \geq 15\}$ over $\Sigma = \{a\}$

(A) $a^{15}(aa)^*$ (B) $(aa)^*\,a^{15}$

(C) $a^{30}\,(aa)^*$ (D) None of these

Q14 Which of the following string does not belong to $(ab^*)^*$?

(A) aaabbaa (B) baaaabb

(C) aaabbb (D) ababa

Answer Key

Q1	(C)
Q2	(B)
Q3	1~1
Q4	(B)
Q5	(D)
Q6	(A, B)
Q7	(D)
Q8	(B)
Q9	(A)
Q10	(B)
Q11	(B)
Q12	(A, C, D)
Q13	(C)
Q14	(B)

Hints & Solutions

Q1 Text Solution:

(a) $L = \{wxw^R \mid x, w \in \{a, b\}^*\}$

Minimal string = $\in \cdot (a + b)^* \in$

$= (a + b)^*$

Regular

(b) $L = \{wx\, w \mid w, x \{a, b\}^*\}$

$L = \in \cdot (a + b)^* \cdot \in$

$= (a + b)^*$

Regular

(c) $L = \{wxwx \mid w, x \in \{a, b\}^+\}$

non-regular

Hence option (c) is correct.

Q2 Text Solution:

Only G2 is regular because regular expression is possible a^+b^+.

Q3 Text Solution:

(1) $L = \{a^{n^n} | n \geq 1\}$

$L = \{a, a^4, a^{27}, ...\}$ Non-regular

(2) $L = \{a^{m^n} | m = n^2, n \geq 1\}$

$L = \{a^{1^1}, a^{4^2}, a^{9^3} ....\}$

$= \{a, a^{16}, a^{43} ....\}$

Non-regular

(3) $L = \{a^{m^n} | n \geq 1, m > n\}$

$L = \{a^{2^1}, a^{3^1}, a^{4^1} ....\}$

$= \{a^2, a^3, a^4 ....\}$

$= aa(a)^*$

Regular

Q4 Text Solution:

$S \rightarrow AB \mid CD = (aa)^*b^* + (aa)^*b^*$

$A \rightarrow aaA \mid \in = (aa)^*$

$B \rightarrow bB \mid \in = (b)^*$

$C \rightarrow aaC \mid \in = (aa)^*$

$D \rightarrow bD \mid \in = b^*$

L = Regular (infinite regular)

Hence, option (b) is correct.

Q5 Text Solution:

(a) $L = \{a^{2m} b^n b^n \mid m, n \geq 1\}$

$= (aa)^+ b^{2n}$

$= (aa)^+ (bb)^+$ Regular

(b) $L = \{a^m b^n X \mid X \in \{a, b\}^* m, n \geq 1\}$

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

= Regular

(c) $L = \left\{\left\{a^{n^2}\right\}^* \middle| n \geq 0\right\}$

$L = \{\in, a, aa, aaa ...\}$

$= a^*$

= Regular

Hence, option (d) is correct.

Q6 Text Solution:

Regular expression can be used in pattern matching, lexical analysis, text editing etc.

Q7 Text Solution:

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

Put $a^* = \in$

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

Q8 Text Solution:

- PDA with finite stack is same as DFA, and DFA can generate finite and infinite language.
- Regular expression without kleene star(*) always generate finite language.

Note: Kleene plus(+) is an expansion of kleene star(*).

- a^* = infinite
- $(0 + 1)^*$ = infinite

Q9 Text Solution:

- $(ab)^*a = a(ab)^*$ False
- $(bb)^* b^* = \{\in, b, bb, bbb, bbbb ....\}$

$= b^*$

- $(b + \in)^+ = (b^+ + \in) = b^*$ True

Q10 **Text Solution:**

Regular expression for L = $\{a^n b^m \mid n,m \geq 0\} = a^*b^*$

Q11 **Text Solution:**

False: $(aa + aaa)^* = (aa)^*$

True: $(a^*b\ (a + b)^* + (a^*b^*)^*) = (a + b)^*$

True: $(e + aaa\ (aaa)^*)\ (e + a + aa) = (a + aa + aaa)^*$

Q12 **Text Solution:**

- $b^*\ aa^*b\ (a^*b^*)^*$ will generate all the strings which content ab as substring.
- $(a^*\ b^*)^*\ ab\ (a^* + b^*)^*$ will generate all the strings which content ab as substring.
- $(a + b)^*\ ab\ (a + b)^*$ will generate all the strings which content ab as substring.

Q13 **Text Solution:**

Regular expression for L = $\{a^{2n} \mid n \geq 15\} = (aa)^*\ a^{30} = a^{30}\ (aa)^*$

Q14 **Text Solution:**

baaaabb is not present in $(ab^*)^*$.