

## Regular Languages & Non Regular Languages

DPP-04

**[MCQ]**

1. Consider alphabet  $\Sigma = \{a, b\}$ , the empty string  $\epsilon$  and the set of strings  $S$ ,  $P$ ,  $Q$  and  $R$  generated by the corresponding non-terminals of a regular grammar.  $S$ ,  $P$ ,  $Q$  and  $R$  related as follows ( $S$  is a start symbol):

$$S \rightarrow aP \mid bQ \mid \epsilon$$

$$P \rightarrow bR \mid aS$$

$$Q \rightarrow aR \mid bS$$

$$R \rightarrow aQ \mid bP$$

- (a)  $L = \{w : n_a(w) \text{ and } n_b(w) \text{ both are even}\}$ .  
 (b)  $L = \{w : n_a(w) \text{ and } n_b(w) \text{ both are odd}\}$ .  
 (c)  $L = \{w : n_a(w) \text{ or } n_b(w) \text{ are even}\}$ .  
 (d) None of these.

**[MSQ]**

2. Consider the following language  $L$  on alphabet  $\Sigma = \{a, b\}$

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

The correct regular grammar of above language is/are possible?

- (a)  $S \rightarrow aAa \mid bAb$   
 $A \rightarrow aA \mid bA \mid a \mid b$   
 $B \rightarrow aA \mid bA \mid a \mid b$
- (b)  $S \rightarrow aAa \mid bAb \mid \epsilon$   
 $A \rightarrow ab$
- (c)  $S \rightarrow aA \mid bB$   
 $A \rightarrow aA \mid bA \mid a$   
 $B \rightarrow bB \mid aB \mid b$
- (d)  $S \rightarrow Aa \mid Bb$   
 $A \rightarrow Aa \mid Ab \mid a$   
 $B \rightarrow Bb \mid Ba \mid b$

**[MCQ]**

3. Consider the following statements:

$S_1$ : If language is regular then, grammar must be regular.

$S_2$ : If grammar is regular then, language can't be regular.

Which of the following is correct?

- (a)  $S_1$  is true.  
 (b)  $S_2$  is true.  
 (c) Both  $S_1$  and  $S_2$  are true.  
 (d) None of these

**[MCQ]**

4. Consider the following grammar  $G$ :

$G$ :

$$S \rightarrow A B C$$

$$A \rightarrow aA \mid a$$

$$B \rightarrow bc$$

$$C \rightarrow cC \mid \epsilon$$

The language generated by above grammar is?

- (a)  $L = \{a^* bc c^*\}$   
 (b)  $L = \{a^+ b c^+\}$   
 (c)  $L = \{a^* b c^*\}$   
 (d) None of these

**[NAT]**

5. For language  $\{a^*bb^*a^+b^* \cup b a^*b\}$  the minimum pumping length will be \_\_\_\_.

**[NAT]**

6. Consider some regular expression:

$$r_1: a^*bb^*c(ab)^*$$

$$r_2: a^*b^*ab \cup (bb)^*$$

If minimum pumping length of  $r_1$  is  $P_1$  and minimum pumping of  $r_2$  is  $P_2$  then the value of  $P_1 * P_2$  will be \_\_\_\_.

**[MCQ]**

7. Suppose, a language  $L$  has finite automata  $M$  with  $N$  states. The language generated by FA is  $L(M)$  is an infinite if and only if  $\exists w \in L$  such that
- (a)  $N \geq |w| \leq 2N$
  - (b)  $N \leq |w| \leq 2N-1$
  - (c)  $N \leq |w| \geq 2N-1$
  - (d) None of these

**[MCQ]**

8. Consider the following grammars  $G_1$  and  $G_2$ :

$G_1: S \rightarrow aS \mid S \mid A$

$A \rightarrow aA \mid abA \mid \epsilon$

$G_2: S \rightarrow aS \mid a$

Which of the following grammar is/are regular?

- (a)  $G_1$  only
- (b)  $G_2$  only
- (c) Both  $G_1$  and  $G_2$
- (d) None of these



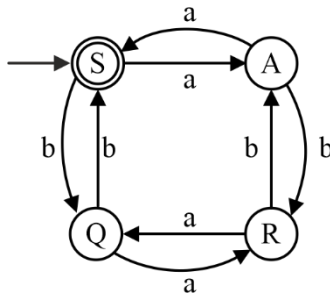
## Answer Key

- |           |        |
|-----------|--------|
| 1. (a)    | 5. (3) |
| 2. (c, d) | 6. (6) |
| 3. (d)    | 7. (b) |
| 4. (b)    | 8. (c) |



## Hints and Solutions

1. (a)



$$L = (aa + ab + ba + bb)^*$$

Hence, option (a) is correct.

2. (c, d)

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

$$a(a+b)^+a \mid b(a+b)^+b$$

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

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

$$aa(a+b)^+aa$$

$$bb(a+b)^+bb$$

$L = \text{Regular}$

$$\text{Regular expression} = a(a+b)^+a + b(a+b)^+b$$

(a) False: Given grammar is not regular.

(b) False: Given grammar is not regular.

(c) True:  $a(a+b)^+a + b(a+b)^+b$  RLRG

(d) True:  $a(a+b)^+a + b(a+b)^+b$  LLRG

Hence, (c, d) are correct.

3. (d)

- False: Grammar may/may not be regular.
- False: If grammar is regular, then language must be regular.

4. (b)

$$S \rightarrow ABC = aa^*bcc^*$$

$$A \rightarrow aA \mid a = aa^*$$

$$B \rightarrow bc = bc$$

$$C \rightarrow cC \mid \epsilon = c^*$$

$$\text{Regular expression} = aa^*bcc^*$$

$$= a^+bc^+$$

Hence, option (b) is correct.

5. (3)

$$L = \{a^*bb^*a^*b^* \cup ba^*b\}$$

Minimal string (w) = ba, bb

$$\text{Pumping length} = |w| + 1$$

$$= 2 + 1$$

$$= 3$$

6. (6)

$$r_1 = a^*bb^*c^*(ab)^*$$

$$p_1 = 2$$

$$r_2 = a^*b^*ab \cup (bb)^*$$

$$p_2 = 3$$

$$p_1 * p_2 = 6$$

7. (b)

$$N \leq |w| \leq 2N-1$$

Option (b) is correct.

8. (c)

$$G_1: S \rightarrow aS \mid S \mid A$$

$$A \rightarrow aA \mid abA \mid \epsilon$$

Regular grammar

**Regular grammar**

$$\bullet V \rightarrow T^*V \mid T^* \text{ RLRG}$$

$$\bullet V \rightarrow VT^* \mid T^* \text{ LLRG}$$

$$G_2: S \rightarrow aS \mid a$$

Regular grammar.



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