Q.1 $A = (0+1)^*00(0+1)^*, B = (0+1)^*11(0+1)^*$. Which of the following regular expressions represent(s) $A \cap B$.

(A) $(0+1)^*0011(0+1)^* + (0+1)^*1100(0+1)^*$

(B) $(0+1)^*(00(0+1)^*11 + 11(0+1)^*00)(0+1)^*$

(C) $(0+1)^*00(0+1)^* + (0+1)^*11(0+1)^*$

(D) $00(0+1)^*11 + 11(0+1)^*00$

Q.2 Which of the following regular expressions represent the set all binary strings with odd number of 1s ?

(A) $((0+1)^*1(0+1)^*)^*10^*$

(B) $(0^*10^*10^*)^*0^*1$

(C) $10^*(0^*10^*10^*)^*$

(D) $(0^*10^*10^*)^*10^*$

Q.3 Consider the following statements

I. If $L_1 \cup L_2$ is regular, then both L_1 and L_2 must be regular.

II. The class of regular languages is closed under infinite union.

Which of the above statements is/are TRUE?

(A) I only

(B) II only

(C) Both I and II

(D) Neither I nor II

Q.4 A is a regular language and B is not a regular language. Which of the following languages is/are necessarily regular ?

(A) A \ B
(B) A / B
(C) A* \ B
(D) A* / B

Q.5 If L is regular over $\Sigma = \{a, b\}$, which of the following is/are necessarily regular ?

(A) $L \cdot L^R = \{xy \mid x \in L, y^R \in L\}$
(B) $\{ww^R \mid w \in L\}$
(C) Prefix $(L) = \{x \in \Sigma^* | \exists y \in \Sigma^*$ such that $xy \in L\}$
(D) Suffix $(L) = \{y \in \Sigma^* | \exists x \in \Sigma^*$ such that $xy \in L\}$

Q.6 Language L_1 is defined by the grammar: $S_1 \rightarrow aS_1b|\varepsilon$
Language L_2 is defined by the grammar: $S_2 \rightarrow abS_2|\varepsilon$

Consider the following statements:

P: L_1 is regular
Q: L_2 is regular

Which one of the following is **TRUE**?

(A) Both P and Q are true

(B) P is true and Q is false

(C) P is false and Q is true

(D) Both P and Q are false

Q.7 Let $\mathcal{L}$ = The set of all languages over $\{a\}$
Let $\mathcal{R}$ = The set of all regular languages over $\{a, b\}$

Which of the following is/are correct ?

(A) Both $\mathcal{L}$ and $\mathcal{R}$ are countable.
(B) Only $\mathcal{R}$ is countable.
(C) Only $\mathcal{L}$ is countable.
(D) None of the above.

Q.8 L is an ϵ-free language over $\{a, b\}$. Consider following statements :

P : The exists a Mealy machine M with output alphabet $\{0, 1\}$ s.t. on input x, M outputs a string in $(0+1)^*1$ if and only if $x \in L$.

Q : L is regular.

Which of following is/are correct ?

(A) P implies Q.
(B) Q implies P.
(C) P if and only if Q.
(D) None of the above.

Q.9 Which one of the following regular expressions represents the language: *the set of all binary strings having two consecutive* 0*s and two consecutive* 1*s*?

(A) $(0+1)^*0011(0+1)^* + (0+1)^*1100(0+1)^*$

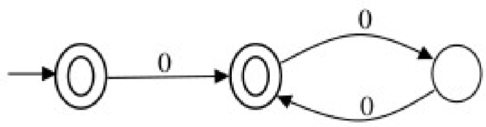
(B) $(0+1)^*(00(0+1)^*11 + 11(0+1)^*00)(0+1)^*$

(C) $(0+1)^*00(0+1)^* + (0+1)^*11(0+1)^*$

(D) $00(0+1)^*11 + 11(0+1)^*00$

Q.10 Consider string homomorphism $h : \{0, 1\} \rightarrow \{a\}$ s.t. $h(0) = a, h(1) = aa$. Cardinality of $h^{-1}(h(010))$ is _____.

Q.11 The order of a language L is defined as the smallest k such that $L^k = L^{k+1}$. Consider the language L_1 (over alphabet 0) accepted by the following automaton.



The order of L_1 is _____.

Q.12 Consider the following language.

$$L = \{x \in \{a, b\}^* \mid \text{number of } a\text{'s in } x \text{ is divisible by 2 but not divisible by 3}\}$$

The minimum number of states in a DFA that accepts L is ______.

Q.13 $L = \{w_1 a w_2 \mid w_1, w_2 \in \{a, b\}^*, |w_1| = 2, |w_2| \geq 3\}$ and R is the equivalence relation on $\{a, b\}^*$ s.t. xRy iff $\forall z \in \{a, b\}^*$, $xz \in L \Leftrightarrow yz \in L$. Index of R is ______.

Q.14 Let $(a + b)^* b(a + b)^*$ represent the language L over $\Sigma = \{a, b\}$. If we consider DFAs with partial transition function, the minimum possible number of states of a DFA that accepts the regular language $\overline{L}$ is _____.

Q.15 Language L is accepted by a NFA with 3 states. Number of states in the minimal DFA accepting L is at most _____.