Regular Expression Practice Questions with Solution

Question 1: The regular expression 0*(10*)* denotes the same set as
(A) (1*0)*1*
(B) 0 + (0 + 10)*
(C) (0 + 1)* 10(0 + 1)*
(D) none of these

Solution : Two regular expressions are equivalent if languages generated by them are same.
Option (A) can generate 101 but 0*(10*)* cannot. So they are not equivalent.
Option (B) can generate 0100 but 0*(10*)* cannot. So they are not equivalent.
Option (C) will have 10 as substring but 0*(10*)* may or may not. So they are not equivalent.

Question 2: Which one of the following languages over the alphabet {0,1} is described by the regular expression?
(0+1)*0(0+1)*0(0+1)*
(A) The set of all strings containing the substring 00.
(B) The set of all strings containing at most two 0's.
(C) The set of all strings containing at least two 0's.
(D) The set of all strings that begin and end with either 0 or 1.

Solution : Option A says that it must have substring 00. But 10101 is also a part of language but it does not contain 00 as substring. So it is not correct option.
Option B says that it can have maximum two 0's but 00000 is also a part of language. So it is not correct option.
Option C says that it must contain at least two 0. In regular expression, two 0 are present. So this is correct option.
Option D says that it contains all strings that begin and end with either 0 or 1. But it can generate strings which start with 0 and end with 1 or vice versa as well. So it is not correct.

Question 3: Write regular expressions for the following languages over the alphabet Σ = {a, b}:

1. Write regular expressions for the following languages over the alphabet $\Sigma = \{a, b\}$:
   (a) All strings that do not end with aa.
   $$\epsilon + a + b + (a + b)^*(ab + ba + bb)$$
   (b) All strings that contain an even number of b's.
   $$a^*(ba^*ba^*)^*$$
   (c) All strings which do not contain the substring ba.
   $$a^*b^*$$

Question 4: Exercise 3.1.1

2. Exercise 3.1.1 on page 91 of Hopcroft et al.

   Write regular expressions for the following languages.

   (a) The set of strings over alphabet $\{a, b, c\}$ containing at least one a and at least one b.

   $\mathbf{(A + B + C)^*(A(A + B + C)^*B + B(A + B + C)^*A)(A + B + C)^*}$

   (b) The set of strings of 0's and 1's whose tenth symbol from the right end is 1.

   $\mathbf{(0 + 1)^*1(0 + 1)^9}$

   (c) The set of strings of 0's and 1's with at most one pair of consecutive 1's.

   $\mathbf{(0 + 10)^*(11 + \epsilon)(0 + 10)^*}$

Question 5: Exercise 3.1.4

3. Exercise 3.1.4 on page 92 of Hopcroft et al.

   Give English descriptions of the languages of the following regular expressions.

   (a) $\mathbf{(1 + \epsilon)(00^*1)^*0^*}$

   This is the language of strings with no two consecutive 1's.

   (b) $\mathbf{(0^*1^*)^*000(0 + 1)^*}$

   This is the language of strings with three consecutive 0's.

   (c) $\mathbf{(0 + 10)^*1^*}$

   This is the language of strings in which there are no two consecutive 1's, except for possibly a string of 1's at the end.

Question 6: Find a regular expression for the language consisting of alternating zeroes and ones.

Alternative 1:

1. $(01)^*$ is the language of zero or more 01.
2. $(1 \cup \varepsilon)(01)^*$ is the language of alternating zeroes and ones which ends in 1.
3. $(1 \cup \varepsilon)(01)^*(0 + \varepsilon)$ is the language of alternating zeroes and ones.

Alternative 2: $(0 \cup \varepsilon)(10)^*(1 + \varepsilon)$ according to the above.

Question 7: Find a regular expression for the language *L* over Σ = *{a, b}* consisting of strings which contain exactly two or exactly three *b*'s.

1. a^*ba^* is the set of strings with exactly one b.
2. $a^*ba^*ba^*$ is the set of strings with exactly two b's.
3. $a^*ba^*ba^*ba^*$ is the set of strings with exactly three b's.
4. The language L is then $a^*ba^*ba^* \cup a^*ba^*ba^*ba^*$.

Question 8: Find a regular expression over the language *L* over the alphabet Σ = *{a, b}* consisting of strings where the number of *b*'s can be evenly divided by 3.

1. $a^*ba^*ba^*ba^*$ are all strings with exactly three b's.
2. $(a^*ba^*ba^*ba^*)^*a^*$ is then the language L.

Question 9: Describe which languages the following regular expressions represents, using common English.

(i) $(0 \cup 1)^*01$

(ii) 1^*01^*

(iii) $(11)^*$

(iv) $(0^*10^*10^*)^*$

(v) $(0 \cup 1)^*01(0 \cup 1)^*$

(vi) 1^*0^*

(vii) $(10 \cup 0)^*(1 \cup 10)^*$

(viii) $0^*(1 \cup 000^*)^*0^*$

(i) An arbitrary number of binary characters (0 or 1) precedes the substring 01.

(ii) Strings that must contain a zero but which otherwise consists only of ones.

(iii) Strings consisting only of ones and which lengths are even.

(iv) An arbitrary number of repetitions of a string consisting two 1's and an arbitrary number of zeroes in arbitrary positions.

(v) Strings containing the substring 01.

(vi) Strings on the form $111\ldots000\ldots$, that is, strings that begins with zero or more ones followed by zero or more zeroes.

(vii)
- $(10 \cup 0)^*$ is all strings which doesn't contain the substring 11.
- $(1 \cup 10)^*$ is all strings which doesn't contain the substring 00.

so the concatenation of these is all strings where each occurrence of 00 precedes all occurrences of 11.

(viii) Al strings which doesn't contain the substring 101.

Question 10: Find a regular expression which represents the set of strings over *{a, b}* which contains the two substrings *aa* and *bb*.

$$(a \cup b)^* \Big(\big(aa(a \cup b)^* bb\big) \cup \big(bb(a \cup b)^* aa\big) \Big) (a \cup b)^*$$