CSC445, Quiz #2 on Languages
Instructor: Dr. Hasmik Gharibyan

Name___________________________________________Score________

Total points 17.

Fill in the answers.

1. (1 point) Given the alphabet $\Sigma = \{1, 22, 3\}$.
   Check every item in the following list that is a string over this alphabet
   (one wrong answer will cost you the point)
   _____111, _____111222, _____312, _____2222, _____1000, _____aaabb, _____λ.

2. (1.5 points) Given the alphabet $\Sigma = \{a, b, c\}$.
   Check every item in the following list that is a language over this alphabet
   (one wrong answer will cost you the point)
   _____λ, _____{λ}, _____∅, _____{∅}, _____a, _____{a}, _____Σ, _____Σ∗

3. (1.5 points: 0.5 point for each) Given strings $u$ and $v$ over the alphabet $\Sigma$.
   Is the following true: $(uv)^R = u^Rv^R$? (yes/no)._____
   Is the following true: $uv = vu$? (yes/no)._____
   Is the following true: for any $i>0$ natural number $(uv)^i = u^iv^i$? (yes/no)._____

4. (1 point) Given the alphabet $\Sigma$.
   The set of all strings over $\Sigma$ is (choose the correct answer)
   _____finite, _____denumerable, _____uncountable

5. (1 point) Given the alphabet $\Sigma$.
   The set of all languages over $\Sigma$ is (choose the correct answer)
   _____finite, _____denumerable, _____uncountable

6. (1 point) Given the recursive definition of a language $L$ over the alphabet \{a,b\}

   **Basis:** $a \in L$
   **Recursive step:** if $u \in L$ then $au \in L$ and $ub \in L$.
   **Closure:** a string is in $L$ if it can be obtained from the basic element by finite number of applications of the recursive step.

   Check every item in the following list that is a string of $L$
   (one wrong answer will cost you the point)
   _____aaa, _____bbb, _____ababab, _____abbb, _____abbbaba, _____aaabbb, _____λ.
7. (1 point) Given the following regular expressions over the alphabet \{a, b\}

1) \((a^* \cup b^*)^*\)  
2) \((ab)^*\)  
3) \((a \cup b)^*\)

Which regular expressions are equivalent? Check the correct answer.

_____ 1) and 2) are equivalent, but they are not equivalent to 3).
_____ 1) and 3) are equivalent, but they are not equivalent to 2).
_____ 2) and 3) are equivalent, but they are not equivalent to 1).
_____ there are no equivalent regular expressions among those listed.
_____ all listed regular expressions are equivalent to each other.

8. (1 point) Given a language over the alphabet \{a, b\} defined with the help of a regular expression

\[a^* b^* \cup (ab)^*\]

Check all the strings that are strings of L (one wrong answer will cost you the point)

_____ bbb, _____ aaa, _____ aabbb, _____ ababab, _____ aabab, _____ abbbbb, _____ λ

9. (1 point) Given set \(X = \{a, b\}\).
How many elements does the set \(X^5\) have? (give a number)

10. (1 point) Let \(X = \{aa, bb, cc\}\) and \(Y = \{a, b\}\).
How many elements does the set \(XY\) have? (give a number)

11. (1 point) Let \(X = \emptyset\).
How many elements does the set \(X^*\) have? (give a number)

12. (1 point) Given a set \(X\). How can you obtain the set \(X^*\) (using set operations), if the set \(X^+\) is given?

\(X^* = X^+\)

13. (1 point) Given languages \(X = \{a, aa, b\}\), \(Y = \{a^i \mid i > 0\}\) over the alphabet \(Σ = \{a, b\}\). Is the language \(L = X \cap Y\) a regular set over \(Σ\)? (yes/no)

14. (1 point) Given alphabet \(Σ = \{a, b\}\). Is \(a(a \cup b)^* a \cap (a \cup b)^* b(a \cup b)^*\) a regular expression over the alphabet \(Σ\)? (yes/no)

15. (1 point) List the basic regular sets over a given alphabet \(Σ\) (the sets mentioned in the basis of the recursive definition of the regular sets).

16. (1 point) List the set operations that are used in the recursive step of the recursive definition of the regular sets over a given alphabet \(Σ\) (the set operations that are used to obtain new regular sets from the “old” ones).