1) Given the following piece of a diagram of a finite automaton. Give the piece of expression graph after deleting the node $q_4$ according to the algorithm 7.2.2.

$$
\text{before : } \quad \quad \text{after : }
$$

$$
q_3 \xrightarrow{a} q_4 \quad q_6 \xrightarrow{b} q_5
$$

2) The language of a DFA is always represented by a regular expression. (true/false)_______

3) Given a subset of rules of a regular grammar

$$
B \rightarrow aA \\
A \rightarrow a
$$

Build the piece of diagram for these rules according to the “Algorithm of construction of NFA from a regular grammar”.

4) Given a piece of diagram ($B$ is an accepting node)

$$
\text{a}
$$

what is the subset of rules (for this piece) of the corresponding grammar, built according to the “Algorithm of construction of a regular grammar from NFA”.

5) Given languages $L_1$, $L_2$ and $L$ over alphabet $\Sigma$. $L = L_1 \cap L_2$

$L_1$ is a regular language. $L$ is not a regular language. Can $L_2$ be regular? (yes/no)_____

6) Given two not regular languages over $\Sigma=\{a,b\}$

$$
L_1 = \{ a^i b^j \mid i,j \geq 0, i \neq j \} \quad \text{and} \quad L_2 = \{ a^i b^i \mid i \geq 0 \}
$$

Is the language $L = L_1 \cap L_2$ regular(yes/no)?_______

7) Given two regular languages: $L_1$ and $L_2$ over the alphabet $\{a,b\}$. $L$ is defined to be

$$
L = (L_1\cup L_2)^* (L_1 \cap L_2) \cup \{\lambda, aa, bb\}
$$

Is $L$ a regular language? (yes/no)________

8) $R_1$ and $R_2$ are regular expressions. Is $R_1 \cap R_2$ regular expression (yes/no)?________
9) A regular set can always be generated by a regular grammar (true/false)_________

10) For every DFA M there is a regular grammar that generates L(M).(true/false)________

11) Given a regular language L. Suppose the DFA accepting this language has k states. According to Pumping Lemma, every string \( z \in L \) satisfying certain condition can be decomposed into three parts: \( z = uvw \) etc.
   
   a) What is the condition that string \( z \) has to satisfy ?___________________________
   
   b) Suppose \( z = a^{k/2} b^{k/2} c^k \) is a string of L (where \( k \) is the number specified in the PL). According to Pumping Lemma, \( z \) can be decomposed into three parts: \( z = uvw \) etc.
      Is it possible that the substring \( v \) contains both - a’s and b’s?(yes/no)_________
      Is it possible that the substring \( v \) contains one or more c’s?(yes/no)_________
      (one wrong answer will cost you the point)
   
   c) Is \( z' = uw \) a string in L?(yes/no)________

12) To prove that a language is regular, the Pumping lemma for regular languages must be used(true/false).________

13) Given a DFA M with \( k \) states. L(M) is not empty. Is it possible that the shortest string in L(M) is longer than \( k \)?(yes/no)________