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

\[ \text{before:} \quad \text{after:} \]

2) Given a subset of rules of a regular grammar:

\[ A \rightarrow aA \mid bA \mid a \]

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

3) Given a piece of diagram ($B$ is an accepting state)

\[ A \xrightarrow{a} B \]

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

4)(2 points: 1 point each) Given two not regular languages over $\Sigma = \{a,b\}$:

$L_1 = \{ w \in \Sigma^* \mid \text{the number of } a\text{'s in } w \text{ is equal to the number of } b\text{'s} \}$

$L_2 = \{ w \in \Sigma^* \mid \text{the number of } a\text{'s in } w \text{ is not equal to the number of } b\text{'s} \}$

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

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

5) Given two regular languages: $L_1$ and $L_2$. Language $L$ is defined as $L = (L_1 \cap L_2)^*$

Can we say that $L$ is always regular? (yes/no)
6) (3 points: 1 point each) Is it safe to say that

   a) a regular set over an alphabet \( \Sigma \) can always be generated by a regular grammar with \( \Sigma \) alphabet? (yes/no)_________

   b) the language of a DFA with alphabet \( \Sigma \) is a regular set over \( \Sigma \)? (yes/no)_________

   c) a language accepted by Finite Automaton can always be generated by a regular grammar? (yes/no)_________

7) To prove that a language is a regular language, it is enough to construct an NFA-\( \lambda \) that accepts it. (true/false)________

8) (3 points: 1 point each) Given a regular language \( L \). According to Pumping Lemma (PL) for regular languages, if we take some string \( z \in L \) with length \( k \) or more (where \( k \) is the number of states in the DFA that accepts \( L \)), then we can decompose it into three parts: \( z = uvw \) etc.

   a) Is \( z' = uw \) a string in \( L \)? (yes/no)_________

   b) Let \( z = a^{k-1}b^{k+1} \) is the considered string of \( L \).
      Can substring \( v \) contain more that one \( b \)? (yes/no)_________

   c) Let \( z = a^{k-1}b^{k+1} \) is the considered string of \( L \).
      Can substring \( w \) contain letter \( a \)? (yes/no)_________

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

10) Given a DFA \( M \) with alphabet \( \Sigma \). Let \( M \) has \( k \) states. If \( M \) doesn’t accept any string of length less than \( k \) over the alphabet \( \Sigma \), then \( L(M) \) is empty. (true/false)________