1. (3 points: 0.5 point each) Given the DFA $M = (Q, \Sigma, \delta, q_0, F)$ as defined in the picture 1.

a) Define the following components of the mathematical system $M$
(no mistakes for the credit).

$$Q = \{ \} \quad \Sigma = \{ \} \quad F = \{ \}$$

b) Define the value of the transition function $\delta$ for the pair $[q_1, a]$:

$$\delta(q_1, a) = \_$$

c) Given a string $w \in \Sigma^*$. The DFA $M$ is processing $w$ and finishing the work in the $q_3$ state rejecting $w$. Give the starting instantaneous machine configuration of $M$ (the configuration specifying $M$ at the moment when the work starts)

$$\_$$

d) Give the ending instantaneous machine configuration of $M$ after processing the string $w$ from the previous question.

$$\_$$

e) Given string $w \in \Sigma^*$. Let $w \in L(M)$. Give the value of the extended transition function, when $M$ (in the picture) processes $w$. $\hat{\delta}(q_0, w) = \_$$

f) Is the DFA $M$ in the picture completely deterministic? (yes/no)_______

2. (2 points: 0.5 point each) Circle the correct answer.

a) second argument of the transition function $\delta$ of a DFA is an element of the set

Q Q U {\lambda} P(Q) \Sigma \Sigma^* \Sigma U {\lambda} F

b) the result of the transition function $\delta$ of a DFA is an element of the set

Q Q U {\lambda} P(Q) \Sigma \Sigma^* \Sigma U {\lambda} F

c) second argument of the extended transition function $\hat{\delta}$ of a DFA is an element of the set

Q Q U {\lambda} P(Q) \Sigma \Sigma^* \Sigma U {\lambda} F

d) the result of the extended transition function $\hat{\delta}$ of a DFA is an element of the set

Q Q U {\lambda} P(Q) \Sigma \Sigma^* \Sigma U {\lambda} F
3. (1 point) The set \{ w \in \Sigma^* \mid [q_0, w] \vdash [q_f, \lambda] \}, where \( q_f \in F \) is called the _______________ of the DFA \( M = (Q, \Sigma, \delta, q_0, F) \).

4. (1 point) Given the following incomplete deterministic DFA over the alphabet \{a,b\}:

\[
\begin{array}{ccc}
M: & a & \rightarrow \\
& \uparrow & \\
b & \downarrow & a \\
& \downarrow & \\
& b & \leftarrow
\end{array}
\]

Make the machine completely deterministic (make additions to the diagram).

5. (1 point) Given a DFA \( M = (Q, \Sigma, \delta, q_0, F) \). The language of \( M \) is \( L(M) \). Define the machine \( M1 \) such that \( L(M1) = \overline{L(M)} \) (complement of \( L(M) \)).

\[ M1 = ( \quad ) \]

6. (1 point) Specify the language of a completely deterministic DFA \( M \) with an alphabet \( \Sigma \), whose all states are final states. \( L(M) = \) ________________

7. (1 point) Specify the language of a DFA \( M \) with alphabet \( \Sigma \), that doesn’t have any final states. \( L(M) = \) ________________