YES/NO questions Circle the correct answer Write SHORT justification.

1. Any regular language is finite.
   **Justify:** $L = a^*$ is infinite  

2. For any language $L$ there is a deterministic automata $M$, such that $L = L(M)$.
   **Justify:** language must be regular  

3. Given $L_1, L_2$ regular languages over $\Sigma$, then $(L_1 \cap (\Sigma^* - L_1))L_2$ is not regular.
   **Justify:** Regular languages are closed under intersection and complement  

4. There is an algorithm that for any finite automata $M$ computes a regular expression $r$, such that $L(M) = r$.
   **Justify:** defined in the proof of Main Theorem  

5. For any $M$, $L(M) = \bigcup \{ R(1, j, n) : q_j \in F \}$, where $R(1, j, n)$ is the set of all strings in $\Sigma^*$ that may drive $M$ from state initial state to state $q_j$ without passing through any intermediate state numbered $n + 1$ or greater, where $n$ is the number of states of $M$.
   **Justify:** only when $M$ is a finite automaton  

6. Pumping Lemma says that we can always prove that a language is regular.
   **Justify:** it gives certain characterization of infinite regular languages and can be used for proving that a language is not regular.  

7. $L = \{ a^{2n} : n \geq 0 \}$ is regular.
   **Justify:** $L = (aa)^*$  

8. $L = \{ a^n : n \geq 0 \}$ is not regular.
   **Justify:** $L = a^*$  

9. $L = \{ b^n a^n : n \geq 0 \}$ is not regular.
   **Justify:** proved using Pumping Lemma  

item Let $L$ be a regular language. The language $L^R = \{ w^R : w \in L \}$ is regular.
   **Justify:** $L^R$ is accepted by a finite automata $M^R = (K \cup s', \Sigma, \Delta', s', F = \{ s \})$, where $K$ is the set of states of $M$ accepting $L$, $s' \not\in K$, $s$ the initial state of $M$, $F$ is the set of final states of $M$ and
   \[ \Delta' = \{ (r, \sigma, p) : (p, \sigma, r) \in \Delta \} \cup \{ (s', e, q) : q \in F \}, \]
   where $\Delta$ is the set of transitions of $M$.  

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10. Any subset of a regular language is a regular language.

\textbf{Justify}: \( L_1 = \{b^n a^n : n \geq 0\} \subseteq L = b^* a^* \) and \( L \) is regular, and \( L_1 \) is not regular.

\textbf{QUESTION 1} Use the constructions defined in the proof of theorem

\textit{A language is regular iff it is accepted by a finite automata}

construct a finite automata \( M \) such that \( L(M) = a(\text{ab} \cup \text{aab})^* b \) and

\[ M = M_a(\text{Mab} \cup \text{Maab})^* \text{Mb} \]

\textbf{Solution} - follow DIRECTLY book definitions!