1. For any NFA-$\Lambda$ $M = (Q, \Sigma, q_0, A, \delta)$, let $M_{\Lambda}$ be the NFA-$\Lambda$ $(Q, \Sigma, q_0, A, \delta_{\Lambda})$ such that, for all $q \in Q$,

- $\delta_{\Lambda}(q, a) = \delta(q, a)$ for all $a \in \Sigma$, and
- $\delta_{\Lambda}(q, \Lambda) = \delta(q, \Lambda) \cup \{q\}$.

Show that $L(M_{\Lambda}) = L(M)$.

2. Let $M = (Q, \Sigma, q_0, A, \delta)$ be an NFA-$\Lambda$. Let $M_A$ be the NFA-$\Lambda$ obtained by adding $\Lambda$-transitions from each state in $A$ to $q_0$. Describe in terms of $L(M)$ the language recognized by $M_A$.

3. For which languages $L$ over $\Sigma$ is there exactly one equivalence class of $I_L$?

4. Let $M$ be an FA with two states s.t. $L(M) \neq \emptyset$ and $L(M) \neq \Sigma^*$. What is the number of equivalence classes of $I_{L(M)}$?

5. How many languages $L$ over $\{a\}$ have exactly two equivalence classes of $I_L$? (Hint: Identify a small class of FAs that are adequate to accept all such languages.)

6. Are there more than 24 languages $L$ over $\{a, b\}$ that have exactly two equivalence classes of $I_L$?

7. Use the construction discussed in class to reduce the following NFA-$\Lambda$ to a regular expression. Show the NFA-$\Lambda$ obtained at each step, eliminating states in the order: 3,4,5,2.
8. Given the FA shown below, show the minimum state FA recognizing the same language that is obtained by the construction presented in class.

9. Use the Pumping Lemma to show that
\[ L = \{0^i1^j0^k \mid j < i + k\} \]
is not regular.

10. Use the Pumping Lemma to show that
\[ L = \{0^i1^j \mid i = j \text{ or } i = 3j\} \]
is not regular.

11. Show that \( L = \{0^i1^j \mid i \neq j\} \) is not regular.