1. To which language is $L(0^*)$ equal (5)
   A. $\emptyset$
   B. $\{\emptyset\}$
   C. $\varepsilon$
   D. $\{\varepsilon\}$

2. Let $L = \{a^n b^n \mid n \geq 0\}$. To which language is $L$ equal (5)
   A. $\{a^k b^\ell \mid k \neq \ell\}$
   B. $\{b^n a^n \mid n \geq 1\}$
   C. $\{a^k b^\ell \mid k \neq \ell\} \cup \{w \in \{a,b\}^* \mid w \text{ contains substring } ba\}$
   D. $\{a^k b^\ell \mid k \neq \ell\} \cup \{b^k a^\ell \mid k, \ell \geq 0\}$

3. The transition diagram of NFA $N$ is given by

Which one of the following strings is not in $L(N)$ (5)
   A. $abab$
   B. $baab$
   C. $baa$
   D. $aab$
4. For regular expressions \( r_1 \) and \( r_2 \) we write \( r_1 = r_2 \) iff \( \mathcal{L}(r_1) = \mathcal{L}(r_2) \). Which one of the following equalities it not correct

A. \( (r_1 + r_2)^* = (r_1^* \cdot r_2^*)^* \)
B. \( (r_1 \cdot r_2)^* = r_1^* \cdot r_2^* \)
C. \( r_1 \cdot (r_2 \cdot r_1)^* = (r_1 \cdot r_2)^* \cdot r_1 \)
D. \( (1 + r)^+ = r^* \)

5. Construct a DFA \( D \) with alphabet \( \{a, b\} \) and no more than 4 states for the language \( L = \{w \in \{a,b\}^* \mid w \text{ has substring } baa\} \). Prove that \( \mathcal{L}(D) = L \) by providing the pathsets of the states of \( D \).

6. The transition diagram of NFA \( N \) is given by

![Transition Diagram](image)

Derive a DFA \( D \) from \( N \) that accepts \( \mathcal{L}(N) \). Provide both the transition table and the transition diagram of \( D \). [hint: the resulting DFA has 5 states]

7. Given are an alphabet \( \Sigma \), a symbol \( a \in \Sigma \), and a regular language \( L \) over \( \Sigma \). Language \( L' \) is defined by

\[
L' = \{ u \in \Sigma^* \mid au \in L \}
\]

Show that \( L' \) is regular.