1. Give state diagrams for DFA as required for recognizing the following languages. In all parts the alphabet is \{0, 1\}.

(a) \( \{w \mid w \text{ does not contain the substring } 110 \} \).
(b) \( \{\varepsilon, 0\} \).
(c) The empty set.
(d) All strings except the empty string (also give a formal description of this last DFA).
(e) \( \{w \mid w \text{ contains at least two zeros} \} \).

2. For language \( A \), let \( A^R = \{w^R \mid w \in A\} \) (recall \( w^R \) is the reverse of \( w \)). Show that if \( A \) is regular then \( A^R \) is regular.

3. Let \( D = \{w \mid w \text{ contains an even number of } a \text{'s and an odd number of } b \text{'s and does not contain the substring } ab \} \). Give a DFA with five states that recognizes \( D \).

4. Let \( F \) be the language of all strings over \{0, 1\} that do not contain a pair of 1s that are separated by an odd number of symbols. Give the state diagram of a DFA with 5 states that recognizes \( F \).

5. Let \( C = \{x \mid x \text{ is a binary number that is a multiple of } 3\} \). Show that \( C \) is a regular language.

6. For languages \( A \) and \( B \), let the perfect-shuffle of \( A \) and \( B \) be the language:

\( \{w \mid w = a_1b_1 \cdots a_kb_k, \text{ where } a_1 \cdots a_k \in A \text{ and } b_1 \cdots b_k \in B, \text{ each } a_i, b_i \in \Sigma \} \).

Show that the class of regular languages is closed under perfect-shuffle.