In answering the questions show all your work. No credit will be given for unsubstantiated answers.

1. Prove that the following language is decidable.

\[ \text{INF}_{\text{DFA}} = \{ \langle D \rangle \mid D \text{ is a DFA and } L(D) \text{ is infinite} \} \]

Hint: Various approaches can be pursued here. E.g., one can pursue an approach similar to that used in showing the decidability of \( E_{\text{DFA}} \); another is to consider other formalisms for describing the language \( \text{INF}_{\text{DFA}} \).

2. Given a Turing machine \( M \) and a string \( w \) we use the notation \( M(w) \downarrow^k \) to denote the fact that \( M \) halts on \( w \) in no more than \( k \) steps (and either accepts or rejects). Prove that the following language is decidable.

\[ \text{HK}_{\text{TM}} = \{ \langle M, w, k \rangle \mid M \text{ is a TM, } w \text{ is a string, and } M(w) \downarrow^k \} \]

3. Problem 4.30 from the textbook (additional hint: read Chapter 4).

4. Problem 5.1 from the textbook (hint: use Theorem 5.13).

5. Problem 5.12 from the textbook.