1. Prob. 111 from p. 344 of the text. One of the following sets is r.e. and the other is not. Which is which?

(a) \{ i \mid L(M_i) \text{ contains at least 481 elements} \}

(b) \{ i \mid L(M_i) \text{ contains at most 481 elements} \}

Prove your answers.

2. Suppose \( P \) is any property of \( \text{pairs of r.e. sets} \). We define

\[ L_P = \{ \langle i, j \rangle \mid P(L(M_i), L(M_j)) \} \]

We say such a property is nontrivial if it is neither identically true nor identically false; i.e.,

\[ P \text{ nontrivial} \iff (\exists \langle i, j \rangle \in L_P) \land (\exists \langle i, j \rangle \notin L_P) \]

Prove the following extension of Rice’s Theorem:

No nontrivial property of pairs of r.e. sets is decidable.

\textbf{Hint:} Consider \( P(\emptyset, \emptyset) \) and \( P(L(M), L(M')) \) for suitably chosen \( M \) and \( M' \). Also, recall that a property is decidable iff its negation is decidable.
3. Let $L$ and $L'$ denote CFLs (presented as CFGs), and let $R$ denote a regular set (presented as a regular expression or right-linear grammar). Which of the following are decidable and which undecidable?

(a) $L = R$
(b) $L \subseteq R$
(c) $L \supseteq R$
(d) $L = L'$
(e) $L \subseteq L'$
(f) $L \supseteq L'$
(g) $L = LL$

Prove your answers.