1. Read Kozen Lectures 28–33.

2. Give an informal description of the operation of a Turing machine that accepts 
\( \{ww^R \mid w \in \{0, 1\}^*\} \) (where \( w^R \) denotes the reverse of \( w \)). Your description should be
at the level of the descriptions given in class or in Kozen Lecture 29 of the TM that
accepts \( \{ww \mid w \in \Sigma^*\} \). In particular, do not give a list of transitions.

3. Design an enumeration machine to enumerate \( \{0^n1^n \mid n \geq 1\} \). Your description should
be informal (no transitions) but precise.

4. Say we had a way of encoding the description of any finite automaton, pushdown
automaton, or Turing machine into a string over some alphabet. Would it be possible
to build an enumeration machine that enumerated descriptions for the following
machines? (Justification is optional, but it can’t hurt to give some.)
   (a) all DFA’s
   (b) all NFA’s
   (c) all PDA’s
   (d) all TM’s
   (e) all total TM’s

5. Classify the following languages as recursive, r.e., or not r.e. Give a short justification
for each.
   (a) \( A \cap B \) for r.e. sets \( A \) and \( B \).
   (b) \( AB \) for recursive sets \( A \) and \( B \).

6. Tell whether the following problems are decidable or undecidable. Give a short justifi-
cation for each. For example, recall that the Halting Problem — whether a given TM
halts on input \( x \) — is not decidable.
   (a) whether a given TM loops on input string 10110
   (b) whether a given TM runs for at least 101 steps on input \( \epsilon \)
   (c) whether a given TM runs for at least 101 steps on all inputs
   (d) whether \( L(M) \) is a subset of \( L(N) \), where \( M \) and \( N \) are two given TMs

7. Prove that an r.e. set is recursive iff there exists an enumeration machine that enu-
merates it in increasing order.