Ph.D. Qualification Examination

Computation Theory (Oct. 2008)

(1) (15%) Let S be the set of all possible Turing machines. Show that S is countable.

(2) (15%) Let $P = \{L \subseteq \Sigma^* \mid \Sigma = \{a, b\}\}$. Show that P is uncountable.

(3) (25%) Determine whether the following languages or problems are decidable or not. Justify your answer.
  (a) $L_1 = \{1 \text{ if God exists and } 0 \text{ otherwise}\}$
  (b) $L_2 = \{n \in N \mid x^n + y^n = z^n \text{ has an integral solution for } (x, y, z)\}$
  (c) $L_3 = \{\langle C, G\rangle \mid C \text{ is a Hamiltonian cycle of } G\}$
  (d) Given two DFSMs M_1 and M_2, is $|L(M_1)| < |L(M_2)|$?
  (e) Given a regular grammar G, is $L(G)$ regular?

(4) (15%) What is a *left-linear grammar*? Show that languages defined by left-linear grammars are exactly regular languages.

(5) (15%) Show that the power of DPDAs is unequal to the power of NPDAs.

(6) (15%) Draw a transition diagram for a Turing machine accepting the language $\{x \in \{a, b, c\}^* \mid n_a(x) = n_b(x) = n_c(x)\}$.