AC32008 Theory of Computation

Tutorial Sheet 6 - Partially and Totally Decidable Languages.

1. Consider the Turing Machine M_i defined using the standard encoding. Which is the smallest value of i for which:
   (a) M_i has a transition?
   (b) M_i accepts some string, i.e., $L(M_i)$ is non-empty?
2. Show that any regular language is totally decidable.
3. Construct a TM M which has input alphabet $\{0, 1\}$ and accepts the language $\{0^n \mid n \geq 0\}$. [The TM should be of the special type for coding with states $q_1, \ldots, q_n$ for some n, where q_1 is the initial state and $F = \{q_2\}$, and the tape alphabet is $\{0, 1, B\}$]. Let $w = 010$. Calculate $\langle M, w\rangle$. Is $\langle M, w\rangle \in L_u$?
4. Is $1110100100100100111111010010010010011 \in L_u$?

   Is $1110100100100100111 \in L_d$?
5. Show that some language over the alphabet $\Sigma = \{0\}$ is not partially decidable.
6. Show that there are infinitely many languages over $\Sigma = \{0, 1\}$ which are not partially decidable. [Hint: Consider the strings $w_2, w_4, w_6, \ldots$, and use a diagonal argument similar to that used to construct L_d.]