AC32008 Theory of Computation
Class Test 2 - Monday 10 March 2014 - 10.05-10.55
Answer ALL 6 Questions

Total marks: 30

1. Say what it means for a language L to be totally decidable. **[3 marks]**

2. Let $\langle M, w\rangle = 11101001010001001101000101010011111111111$, where M is a Turing Machine and w is a string.

   (a) Give the transition table for M.

   (b) What is w?

   (c) Is $\langle M, w\rangle \in L_{\text{halt}}$?

   [Recall that $X_1 = 0$, $X_2 = 1$, $X_3 = B$, $D_1 = L$, $D_2 = R$.] **[7 marks]**

3. Let L be the language given by

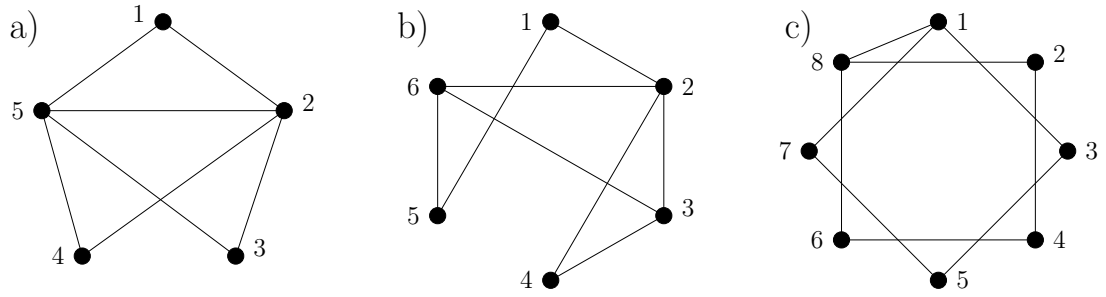
$$L = \{w_i \,|\, M_i \text{ does not accept } w_i\}.$$

   Then it can be shown (by diagonalisation) that L is not partially decidable and (by simulation) that $\bar{L}$ *is* partially decidable.

   Given these facts, show that there is a language which is partially decidable (recursively enumerable) but not totally decidable (recursive).

   [7 marks]

4. Which of the graphs a), b), c) below have a Hamiltonian circuit?



[6 marks]

[Questions 5 and 6 overleaf]

5. Suppose that M is a nondeterministic Turing machine (NDTM), and that for an input x:

   - with guess g_1, the computation on x takes 101 steps and halts in state q_Y;
   - with guess g_2, the computation on x takes 89 steps and halts in state q_N;
   - with guess g_3, the computation on x takes 131 steps and halts in state q_Y;
   - with all other guesses, the computation on x does not halt.

   What is $t_M(x)$? Why? **[4 marks]**

6. Say informally what it means for there to be a polynomial transformation (or reduction) from one problem to another.

   [3 marks]