AC32008 Theory of Computation
Class Test 2 - Thursday 28 March 2019 - 14.05-14.50
Answer ALL 5 Questions

Total marks: 30

1. Explain carefully what it means to say that a language L is partially decidable but **not** totally decidable. **[5 marks]**

2. Let $\langle M, w\rangle = 1110101010101101001010010011111101 1$, where M is a Turing Machine and w is a string.

   (a) Give the transition table for M.

   (b) Is $\langle M, w\rangle \in L_{\text{halt}}$? Give a very brief reason for your answer.

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

3. Consider the following languages:

$$L_{10} = \{1^n 0^n \mid n \geq 1\},$$
$$L_d = \{w_i \mid M_i \text{ does not accept } w_i\},$$
$$L_{\text{halt}} = \{\langle M, w\rangle \mid M \text{ halts on input } w\}.$$

   For each of these languages, say which of the following is true for this language:

   (a) it can be generated in standard order by some Turing Machine;

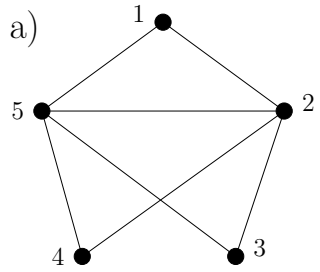
   (b) it can be generated in some order by some Turing Machine, but cannot be generated in standard order by any Turing Machine;

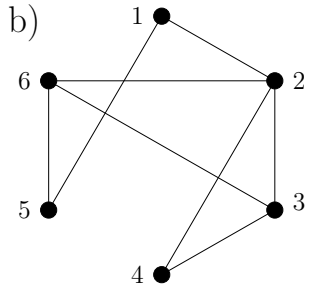
   (c) it cannot be generated in any order by any Turing Machine.

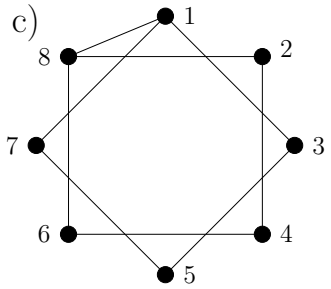
   Explain very briefly (without any proofs) the reasons for your answers. **[6 marks]**

[Questions 4 and 5 overleaf]

4. Below are three instances a), b), c) of HAMILTONIAN CIRCUIT.







Say, for each, if it is a yes-instance or a no-instance. **[6 marks]**

5. Let M be a deterministic Turing Machine (DTM) with set of states $Q = \{q_0, q_Y, q_N\}$, initial state q_0, accepting state q_Y, rejecting state q_N, input alphabet $\{0, 1\}$ and tape alphabet $\{0, 1, B\}$. The transition function δ for M is as follows:

δ	q_0	q_Y	q_N
0	$(q_0, 0, R)$	–	–
1	$(q_N, 1, R)$	–	–
B	(q_Y, B, R)	–	–

(This machine accepts only strings of zeros.)

What are:

(a) $t_M(0001010)$?

(b) $t_M(0000001)$?

(c) $T_M(7)$?

[6 marks]