

Name: _____

Exam 2
CSc 75010: Theoretical Computer Science
Graduate Center of CUNY
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(Pink Version)

Question 1	
Question 2	
Question 3	
Question 4	
Question 5	
Question 6	
Total	

Do five of the following six problems. Write each answer on a separate piece of paper.

1. (a) Define *decidable set* and give an example of a set that is not decidable.
(b) Assume that the alphabet and tape alphabet are: $\Sigma = \Gamma = \{0, 1\}$. Give an implementation level description of a Turing machine that decides the language:

$$\{w \mid w \text{ contains an equal number of 0's and 1's}\}$$

2. (a) Show that for any finite set Σ , the set of all finite strings of Σ , Σ^* is countable.
(b) Let $\Sigma = \{0, 1\}$. Show that the set of all infinite strings over Σ is uncountable.
3. (a) Show that the Halting Problem is undecidable, using the diagonalization method.
(b) Show that the set of all constant computable functions is not decidable.
4. (a) Show that the set of decidable languages is closed under union.
(b) Show that if A and \bar{A} are Turing-recognizable, then A is decidable.
5. (a) State Rice's Theorem.
(b) Prove Rice's Theorem.
6. (a) Show that for all A and B , $A \leq_m B$ implies $\bar{A} \leq_m \bar{B}$.
(b) Show for all A, B , there exists a set J such that $A \leq_T J$ and $B \leq_T J$.