Name:______________________Key______________________ Grade:_____<-- instructor use

1. Why can't a PDA recognize the language $A^nB^nC^n$?

   A stack can be used to match the counts of two things, but not three.

2. Describe (in English) the actions of a TM that recognizes $A^nB^nC^n$.

   mark left and right ends.
   If a, erase, then erase a b, then a c
   move back to mark.
   keep repeating until there is no a, or
   b or c before a, or c before b.

   Students may have their own variations

3. What does it mean for a language to be *semidecidable*?

   ∃ a TM that accepts all strings in the language

4. What is a decision problem?

   A decision problem is one that has a yes/no answer for each instance.

5. Is the problem: "Are there any prime Fermat numbers greater than 1,000,000?" decidable? Explain.

   Yes. One of the following algorithms is correct for this problem.

   - def t(): return TRUE
   - def f(): return FALSE

   So there is a decision procedure, we hust don't know which one it is.

6. If L is $\{b^na : n \geq 0\}$ What is maxstring (L)? It is the same as L.

7. What does $(q, w) \mid\!\!-_M (q', w')$ mean? The machine M, in state q with w as the remaining input, transitions to sate q' with w' as the remaining input. THIs happens iff w = aw' for some $a \in \Sigma$, and $\delta(q, a) = q'$.

8. Prove: Every DFSM *M*, in configuration (q, w), halts after |*w*| steps .

   Base case: If w is ε, it halts in 0 steps.

   Induction step: Assume true for strings of length n and show for strings of length n+1.

   Let $w \in \Sigma^*$, $|w| = n+1$ for some $n \in \mathbb{N}$.

   Then w is ax for some $a \in \Sigma$, $x \in \Sigma^*$, $|x| = n$.

   Let q' be δ(q, a). Then $(q,w) \vdash_M (q', x)$

   By induction, from configuration (q', x), M halts in n steps.

   So, starting from the original configuration, M halts in n+1 steps.

9. Draw the transition diagram (or transition table) for a DFSM that accepts OddParity = {w∈{0, 1}* : w contains an odd number of 1s}