1. (Problem 15.1 on Page 493) Let $M$ be the Turing machine

(b) [10 pts] Describe the computation of $M$ with input $a^n$ that requires the maximum number of transitions.

(c) [3 pts] Give the function $t_{CM}$.

2. The (following) machine $R$ computes a function from $\{a, b\}^* \rightarrow \{c, d\}^*$ (Problem 15.12 on Page 495):

(b) [10 pts] What string of length $n$ will cause $R$ to use the greatest number of transitions? Explain Why.

(c) [3 pts] Give the function $t_{CR}$.

(d) [8 pts] Does the machine $R$ reduce the language $L = abb(a \cup b)^*$ to the language $Q = (c \cup d)^*cdd^*$? If yes, prove that the function computed by $R$ is a reduction. If no, give a string that demonstrates that the mapping is not a reduction.

3. [16 pts] Assume that $P = NP$. Let $L$ be the language in $NP$ with $L \neq \emptyset$ and $\overline{L} \neq \emptyset$. Prove that $L$ is $NP$-complete (Problem 15.17(a) on Page 495).