Quiz 2

Instructions: Show your work and explain every step.

(1) (3 points) Let A be a language. Prove that A is decidable iff $\overline{A}$ is decidable.

(2) (8 points) Decide if the following are true or false.
   (a) Every decidable language is Turing-recognizable.
   (b) For Turning machines, does not accept means reject.
   (c) Multi-tape Turing machines are equivalent to single tape Turing machines.
   (d) Non-determinist Turing machines are more powerful (i.e. recognize more languages) than deterministic Turing machines.
   (e) If L is Turing recognizable, the $\overline{L}$ is Turning-recognizable.
   (f) A decidable problem is solvable by computers (i.e. has an lgorithm).
   (g) E_{CFG} is decidable while E_{TM} is not.
   (h) EQ_{CFG} is undecidable.

(3) (4 points) Let $S = \{L \mid L \text{ is Turing-recognizable}\}$ and $\overline{S} = \{L \mid \overline{L} \text{ is Turing-recognizable}\}$.
   (a) Find a bijection from S to $\overline{S}$.

   (b) Use the fact that $S \cup \overline{S}$ is countable, to prove there is a non Turing-recognizable language.

(4) (a) (3 points) Fill out the blanks:
   A language is ..... iff both it and its complement are Turing-recognizable.
   (b) Use the first part to show that $\overline{A_{TM}}$ is not Turing-recognizable.

(5) (2 points) Give the domain and the target for the tansition fiunction δ of deterministic Turing machines.