Quiz 2

1. Classify the following languages as:

   - **rec**—the language is decidable.
   - **r.e.**—the language is recursively enumerable (r.e.) by not decidable.
   - **co-r.e.**—the complement of the language is r.e., but the language is not decidable.
   - **neither**—the language is neither r.e. nor co-r.e.

   No justification wanted or necessary.

   (a) \( L = \{ \langle M \rangle : M \) is a TM and \( L(M) \) contains a palindrome\}.

   (b) \( L = \{ \langle P \rangle : P \) is a C-program and \( P \) halts on input of itself\}.

   (c) \( L = \{ \langle M, M' \rangle : M \) and \( M' \) are Turing machines that accept the same language\}.

   (d) \( L = \{ \langle G \rangle : G = (V, \Sigma, R, S) \) is a CFG and \( L(G) = \Sigma \}\}.

   (e) \( L = \{ \langle G \rangle : G = (V, \Sigma, R, S) \) is a CFG and \( L(G) = \Sigma^* \}\}.

2. Prove that the following language is undecidable:

   \( L = \{ \langle M, q \rangle : M = (Q, \Sigma, \Gamma, \delta, q_0, q_A, q_R) \) is a TM and \( q \in Q \) and \( M \) never enters state \( q \}\}.\)