Problem 1 Let $L_1$ be the language
\[
\left\{ \langle M, w, q \rangle \mid M \text{ is a Turing machine, } w \text{ is a string, and } q \text{ is a state;} \right. \\
\left. \text{and } M, \text{ when run on input } w, \text{ never enters the state } q. \right\}.
\]
Prove that $L_1$ is undecidable.

Problem 6 Let $L_2$ be the language
\[
\left\{ \langle G, H \rangle \mid G \text{ and } H \text{ are CFGs, and } L(G) \subseteq L(H) \right\}.
\]
Prove that $L_2$ is undecidable.

Problem 3 Let $L_3$ be the language
\[
\left\{ \langle M \rangle \mid M \text{ is a Turing machine and } |L(M)| = 1 \right\}.
\]

a. Show that $L_3$ is not R.E.

b. Show that $L_3$ is not co-R.E.