Problem 1 Give a mapping function $f$ showing that $E_{TM} \leq_m L$, where $E_{TM}$ is the emptiness problem for Turing machines and $L$ is the language

$$\{ \langle M, w \rangle \mid M \text{ is a Turing machines and } L(M) = \{w\} \} .$$

Explain why your choice of $f$ gives a correct mapping reduction.

Problem 2 Show that if $L \leq_m \emptyset$ then $L = \emptyset$. (As usual, $\emptyset$ is the empty language.)

Problem 3 Let $L$ be the language

$$\{ \langle G_1, G_2 \rangle \mid G_1 \text{ and } G_2 \text{ are CFGs and } L(G_1) \leq_m L(G_2) \} .$$

Show that $L$ is undecidable.

**Hint:** You’ll want to work with $ALL_{CFG}$, not $EQ_{CFG}$.