1. Problem 3.12 on page 161, but also show that the class $P_{leftresetTM}$ of languages recognizable in polynomial time for left reset machines is the same as for standard $TM$’s.

2. Consider the language $L = \{x + y = z \mid x, y, z \text{ are binary integers, so that } x + y = z\}$. Prove that this language is decideable in time $O(n^2)$ on a one-tape Turing Machine. Prove a matching lower bound ($\Omega(n^2)$) for one-tape TMs.

3. Show that a function $f(x)$ from $\{0,1\}^*$ to $\{0,1\}^*$ is in $FP$ (functions computable in polynomial time) if and only if there is a $k$ so that $|f(x)| \in O(|x|^k)$ and the language $\{(x, i, b) \mid i \leq |f(x)| \text{ and the } i^{th} \text{ bit of } f(x) \text{ is } b\}$ is in $P$.

4. Let $L = \{<M, w> \mid M \text{ is a Turing Machine program so that there is an input } y \in \{0,1\}^* \text{ so that } M \text{ halts on } y \text{ in } 100|y| \text{ steps and } M(y) = w\}$ Is $L$ recursive? Is $L$ recursively enumerable? Is $L$ co-r.e.?

5. Give an example of a language $L$ that is neither R.E. nor co-R.E.