Problem numbers are from the second edition of Sipser’s book. If unsure about which problem to solve, ask. Collaboration is permitted; looking for solutions from external sources (books, the web, material from previous years, etc.) is prohibited.

1. 7.36

2. 7.24

3. * 7.27 (Optional hint: do not follow the hint in the book and show $\not= SAT \leq_p 3COLOR$, where $\not= SAT$ is from problem 2.)

4. Show that $2COLOR \in P$, where

$$2COLOR = \{\langle G \rangle : \text{the nodes of } G \text{ can be colored with two colors such that no two nodes joined by an edge have the same color}\}.$$

5. (extra credit) * Show that $NP$-complete languages are large, unless $P = NP$. More precisely, show that if there exists an $NP$-complete language $L \subseteq \{1\}^*$, then $P = NP$. (Hint: show first that determining the satisfiability of a boolean formula reduces efficiently to determining the satisfiability of two strictly smaller formulas).