1. Can we compose a Turing machine for recognizing prime numbers from the nondeterministic TM for composite numbers by exchanging its accepting and rejecting final states with each other? What is the reason for your answer?

2. Give unrestricted grammars for generating the following languages:
   
   (a) $\{ w \in \{a, b, c\}^* | w \text{ contains equally many } a$s, $b$s, and $c$s $\}$;
   
   (b) $\{ ww | w \in \{a, b\}^* \}$.

3. Give an unrestricted grammar for generating the language
   
   $\{ a^i b^j c^k | i \geq j \geq k \geq 0 \}$.

4. Let $A$ be the language containing only the single string $s$, where
   
   $s = \begin{cases} 0 & \text{if life never will be found on Mars.} \\ 1 & \text{if life will be found on Mars someday.} \end{cases}$

   Is $A$ decidable? Why or why not? For the purposes of this problem, assume that the question whether life will be found on Mars has an unambiguous Yes or No answer.

5. Prove Theorem B: The collection of Turing-recognizable languages is closed under union and intersection. (Hint: Follow the proof of Theorem 4.22.) Why can we not use the technique of Theorem A(1) of exchanging the accepting and rejecting final states to show that the collection would be closed under complementation?

6. Show that the collection of decidable languages is closed under the operation of
   
   (a) concatenation, and
   
   (b) star.