Exercise sheet 5

1. Find deterministic finite automata to recognize the following languages

   a) The empty language, i.e. $\emptyset$
   b) The language consisting of only the empty string, ϵ (note the difference with the previous one)
   c) A singleton

2. Use the previous question and the theorems proved during the lecture to prove that every regular expression describes a language that is a regular language.

3. Find regular expressions to describe the following languages over the alphabet $\Sigma = \{0, 1\}$

   a) Strings with the nth last character 0, for a given natural number n.
   b) Strings that begin with 01.
   c) Every third position of the string is 1

4. Prove that every any regular language can be recognized by a (non-deterministic) finite state automaton that has only one accept state. Can one ensure that it is deterministic and yet has only one state? Why or why not?

5. Problem 1.31 from Sipser's book.