Ph.D. Qualification Examination

Computation Theory (March 2011)

(1) (15%) Design an NFA to recognize the language of strings over $\{0, 1\}$ beginning with a 0, ending with a 1, and having an occurrence of 0101 somewhere in every string.

(2) (25%) Justify your answers (prove or disprove) for the following assertions.
   (a) The union of two non-regular sets is always non-regular.
   (b) A regular set can have a non-regular subset.
   (c) Every regular set has a regular set.
   (d) The union of a regular and a non-regular set can be regular.
   (e) There is a finite non-regular set.

(3) (20%) Justify your answers for the following assertions.
   (a) Every regular language is also a context-free language.
   (b) Every context-free language is also a regular language.
   (c) Every context-free language has a regular sublanguage.
   (d) Every regular language has a context-free sublanguage.

(4) (40%) Determine whether it is decidable or not for each of the following questions.
   (a) Given a context-free grammar G and two strings s_1, s_2, does G generate $s_1 s_2$?
   (b) Given a context-free grammar G, is the language accepted by G regular?
   (c) Does TM M halt on all strings?
   (d) Is the language that TM M accepts regular?