2003 Paper 2 Question 9

Regular Languages and Finite Automata

(a) Let L be the set of all strings over the alphabet $\{a, b\}$ that end in a and do not contain the substring bb. Describe a deterministic finite automaton whose language of accepted strings is L. Justify your answer. [5 marks]

(b) Explain what is meant by a *regular expression* $\mathbf{r}$ over an alphabet Σ and by the language $L(\mathbf{r})$ determined by $\mathbf{r}$. [6 marks]

If a regular expression $\mathbf{r}$ does not contain any occurrence of the symbol $\emptyset$, is it possible for $L(\mathbf{r})$ to be empty? [2 marks]

Explain why it is always possible, given a regular expression $\mathbf{r}$ over Σ, to find a regular expression $\sim\mathbf{r}$ with the property that $L(\sim\mathbf{r})$ is the set of all strings over Σ that are not in $L(\mathbf{r})$. Any standard results you use should be carefully stated, but need not be proved. [7 marks]