2002 Paper 13 Question 12

Complexity Theory

(a) State and prove the time hierarchy theorem.   [10 marks]

(b) For each of the following statements, state whether or not it can be derived as a consequence of the time hierarchy theorem. Give justification for your answer.

(i) There is a language in $\text{TIME}(n^2)$ that is not in $\text{TIME}(n \log n)$.   [3 marks]

(ii) There is a language in $\text{TIME}(2^n)$ that is not decidable in polynomial time. [4 marks]

(iii) There is a language in $\text{TIME}(2^n)$ that is not in **NP**.   [3 marks]