

## 2002 Paper 6 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]