

## 2005 Paper 12 Question 12

### Complexity Theory

- (a) Explain what it means to say that a problem is
- (i) NP [2 marks]
  - (ii) NP-Complete [2 marks]
- (b) Define the standard problem 3-SAT and describe how you would take an instance of it and derive an integer  $n$  that you would use in any formulae relating to the cost of solving that instance. [3 marks]
- (c) What is a non-deterministic Turing Machine? Supposing that some computation of such a machine takes  $N$  steps, what information needs to be reported to describe exactly how the computation proceeded? In what way is this relevant to the problem of solving an *arbitrary* NP problem? [7 marks]
- (d) Sketch a proof of Cook's result, that the problem 3-SAT is NP complete. Justify that any transformations you introduce are polynomial. [6 marks]