2005 Paper 5 Question 10

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]