

COMPUTER SCIENCE TRIPOS Part IB – 2018 – Paper 6

3 Complexity Theory (AD)

(a) Give a precise definition of each of the complexity classes NP and co-NP. [4 marks]

(b) Give an example each of

(i) an NP-complete language; and

(ii) a co-NP-complete language,

in each case giving a precise statement of the decision problem involved. [4 marks]

(c) If A and B are the two languages identified in Part (b), give an example of a language that is polynomial-time reducible to both A and B . Justify your answer. [4 marks]

(d) Consider the following statement:

There is a polynomial p such that every valid Boolean formula of length n has a proof of length at most $p(n)$. Moreover, there is a polynomial-time algorithm that can check the correctness of the proofs.

This statement is not known to be true or false. Explain what would be the consequences of this statement being true or false for the relationship between NP and co-NP, giving full justification for your answer. [8 marks]