

## 1996 Paper 3 Question 9

### Computation Theory

Show how to code the program and initial data for an  $n$ -register machine into natural numbers  $p$  and  $d$ . In what sense do the codes  $p$  and  $d$  determine a unique computation? [9 marks]

Using your codes establish a precise statement of the Halting Problem for Register Machines. [3 marks]

Assume that the Halting Problem is in general undecidable. Prove that it cannot be decided whether a general program  $p$  terminates when the initial data is zero in every register. [8 marks]