2002 Paper 3 Question 6

Computation Theory

(*a*) Explain how each number $e \in \mathbb{N}$ can be decoded uniquely as a register machine program $Prog_e$. [6 marks]

(*b*) What would it mean for a register machine to *decide the halting problem*? [4 marks]

(*c*) Prove that such a register machine cannot exist. (You may assume the existence of suitable register machines for copying registers and manipulating lists of numbers so long as you specify their behaviour clearly.) [10 marks]