

2006 Paper 3 Question 7

Computation Theory

(a) (i) Give a graphical representation of the following register machine program.

$L0 : Z^+ \rightarrow L1$
 $L1 : L^- \rightarrow L2, L3$
 $L2 : Z^+ \rightarrow L0$
 $L3 : Z^- \rightarrow L4, L5$
 $L4 : L^+ \rightarrow L3$
 $L5 : X^- \rightarrow L1, L6$
 $L6 : \text{HALT}$

[3 marks]

(ii) Assuming the contents of register Z is initially 0, when the program is run starting at instruction $L0$ what functions of the initial contents of registers X and L are computed in X and L when the machine halts?

[5 marks]

(b) (i) What is meant by a *Turing machine*, its *configurations*, *transition relation* and the *computations* it carries out? What does it mean to say that a computation *halts*?

[6 marks]

(ii) Given a Turing machine, is it decidable whether or not for all possible initial configurations the machine will not halt after 100 steps of transition? Justify your answer.

[6 marks]