2007 Paper 2 Question 8

Regular Languages and Finite Automata

(*a*) State the *Pumping Lemma* for regular languages. Is every language that satisfies the pumping lemma property a regular language? [5 marks]

(*b*) State, with justification, whether or not each of the following languages is regular. Any standard results you use should be clearly stated, but need not be proved.

(*i*) $L_1 = \{ww \mid w \in \{a\}^*\}$ [3 marks]

(*ii*) $L_2 = \{ww \mid w \in \{a, b\}^*\}$ [3 marks]

(*iii*) $L_3 = \{w_1 w_2 \mid w_1 \in \{a\}^* \text{ and } w_2 \in \{b\}^*\}$ [3 marks]

(*iv*) $L_4 = \{w \mid w \in \{a, b\}^*$ and w contains the same number of as and bs$\}$ [3 marks]

(*v*) $L_5 = \{w \mid w \in \{a, b\}^*$, w contains the same number of as and bs, and that number is no more than 128$\}$ [3 marks]