Regular Languages and Finite Automata

Prove or disprove each of the following statements, stating clearly any well known results that you use.

(a) The set of strings over the alphabet \{0, 1\} that contain exactly twice as many occurrences of 0 as of 1 is a regular language;

(b) Let \(L\) be a regular language over an alphabet \(\Sigma\). Then the language consisting of those \(u \in \Sigma^*\) such that there is some \(v \in \Sigma^*\) with \(uv \in L\), is also a regular language;

(b) Any finite subset of \(\{a, b\}^*\) is a regular language;

(d) For any regular expressions \(r\) and \(s\), the regular expressions \((r^*s^*)^*\) and \((r|s)^*\) always denote the same language.

[20 marks]