1995 Paper 9 Question 4

Concurrency Theory

Define the notions of *strong equivalence* ($\sim$) and *observation equivalence* ($\approx$) for CCS agents. [4 marks]

A CCS agent P is called τ*-free* if τ does not occur in P, or in the definitions of any constants occurring in P. For any τ-free agent P, show that $\tau.P$ is strongly equivalent to a τ-free agent. (You may assume that there is at least one name, a, which does not occur in the syntactic sort of P.) [6 marks]

A CCS agent expression is called *normal* if it is of the form $\sum_{i \in I} \ell_i.P_i$, where all the ℓ_i are labels (that is, not τ actions). Show that the property

$$(*)\ P_1 \approx P_2 \text{ and } Q_1 \approx Q_2 \text{ implies } P_1 + Q_1 \approx P_2 + Q_2$$

holds for all normal agents P_1, P_2, Q_1, and Q_2. [5 marks]

Does $(*)$ hold for all τ-free agents P_1, P_2, Q_1, and Q_2? [5 marks]