1995 Paper 8 Question 6

Pi Calculus

Show that every term of the π-calculus can be converted, using structural congruence, into the form

$$S = (\nu z_1) \cdots (\nu z_k)(M_1 \mid \cdots \mid M_m \mid !Q_1 \mid \cdots \mid !Q_n)$$

where each M_i is a non-empty choice term. Which rules of structural congruence are *not* needed for the conversion? [10 marks]

Such a form is said to be a *simple system* if no M_i or Q_j contains a composition or a replication. A process P is said to *handle* a name x if it contains a free occurrence of x in some output preaction $\overline{y}\langle\vec{u}\rangle$. A system S as above is said to *uniquely handle* x if at most one of the M_i, and none of the Q_j, handles x.

In the monadic π-calculus, assume S is simple and uniquely handles x, and that $S \longrightarrow S'$ where S' is also simple. Give extra conditions on S which ensure that S' in turn uniquely handles x, and also satisfies the extra conditions. Show by example why your extra conditions are needed, and argue informally that they are sufficient. [10 marks]