1997 Paper 8 Question 15

Communicating Automata and Pi Calculus

The main reaction rule of the π-calculus is

$$COMM : (M + x(y).P) \mid (N + \overline{x}\langle z\rangle.Q) \longrightarrow \{z/y\}P \mid Q$$

What other reaction rules are needed to infer all reactions?   [4 marks]

Using these rules, show how to infer a reaction on the x-channel for the following process:

$$(!x(y).\overline{z}\langle y\rangle) \mid (\boldsymbol{\nu}\, z)\big(Q \mid (\overline{x}\langle z\rangle.R + \overline{y}\langle z\rangle.S)\big)$$

Indicate exactly which rules of structural congruence are required in making the inference.   [7 marks]

Let $P \longrightarrow P'$ be an arbitrary reaction inferred for a process P not containing "+". Prove, by induction on the depth of the inference, that if P contains an instance of replication "!" then so does P'.   [6 marks]

Show that this is not necessarily true if P contains "+".   [3 marks]