

## 1996 Paper 9 Question 15

### Pi Calculus

Define the notion of a *sorting* over a set  $\mathcal{S}$  of subject sorts in the  $\pi$  calculus. Given a process  $P$  and a sorting  $ob$  over  $\mathcal{S}$ , explain the assertion that  $P$  *respects*  $ob$ .

[6 marks]

Let  $\mathcal{S} = \{A, B, C\}$  with  $a : A$ ,  $b, y : B$  and  $c, z : C$ .

Let  $P = (\nu a)(a(y, z).\bar{z}\langle y \rangle \mid c(b).\bar{a}\langle b, c \rangle)$ .

Show that  $P$  respects many different sortings over  $\mathcal{S}$ , and describe them.

On the other hand, let  $\mathcal{S}$  contain at most two subject sorts. In this case, show that there are exactly two sortings over  $\mathcal{S}$  which are respected by  $P$ .

[7 marks]

Explain how recursive definition of processes in the  $\pi$  calculus can be represented in terms of replication. Would this be possible even in the monadic  $\pi$  calculus?

[7 marks]