Step 2 Sets are Unordered. Present $A \times B$ (and so $S \times S$) set theoretically:

(a, b) can be re-expressed so that its order on this surface does not affect its meaning. How? For example consider

$\{\{a, 1\}, \{b, 2\}\}$ instead of (a, b)

or even $\{a, \{a, b\}\}$ to denote a typical element of $A \times B$.