P1) a) False. this does not need to be a 1st preference to 1st preference matching

if we have m and m'
and w and w'
where m prefers $w > w'$
$m' \rightarrow w' > w$
w prefers $m' > m$
$w' \rightarrow m > m'$

Here none of the matches contain both first preferences but it is still a stable matching.

either both women get their first preference or both men get their first preference which works because the stable matching also requires at least one pairing where one single gets their first preference

1.) b.) True $m \to w$

$(m, w) \in J$ $\qquad (m, w) \quad (m', w)$

$m \to w > w'$

$w \to m > m'$

Case 1: $m' \to w > w'$

If m' proposes to w first, w will leave m' for m because $w \to m > m'$, so. Or if m proposes to w first then w will stay with m because w prefers $m > m'$

Case 2: m' prefers $w' > w$

If m' proposes to w' and m proposes to w, then there will be no conflict of interests because m prefers $w > w'$, and m' prefers $w' > w$, so w prefers $m > m'$ and w' preference don't matter. So it must be the case that (m, w) will be in every stable matching J