Consider the design of a generalized linear phase bandpass FIR filter using the Parks-McClellan algorithm. Assume it has passband corner frequencies of $\omega_{p1}$ and $\omega_{p2}$.

a) Prove that at least one of these corners must be an alternation.

**Proof:**

For a bandpass filter there are 6 band edges that can potentially be alternations. An optimal design will have between $L+2$ and $L+5$ alternations, inclusive. Eliminating a passband corner as an alternation loses 2 possible alternation locations because there will not be a sign change at the adjacent stopband edge. If neither $\omega_{p1}$ and $\omega_{p2}$ are alternations, then 4 potential alternations are lost, leaving a maximum of $L+1$, which cannot be optimal.

b) In the design process for the above filter you have a candidate Parks-McClellan solution that exactly meets your specified transition band requirements, but ripple levels in all bands (2 stopbands and one passband) are three times smaller than specified. You don't want to over design, so you decide to redesign to exactly meet spec. What will your procedure be?

**Redesign Approach:**

Since all bands have ripple levels that are too small by the same factor (3), the weighting function, $W$, is correct. Band edge specification, $F$, is also correct. Just reduce filter order, $M$, until ripple levels match specification.