5. The dynamic vibration absorber shown is “tuned” for minimum displacement of the main mass, $m_1$. Find the expression for the new natural frequencies of the total system as a function $\omega^*$ and the mass ratio $m_1/m_2$. Show that one of these frequencies will always be less than $\omega^*$ while the other will always be greater than $\omega^*$.

\[ \omega^* = \sqrt{\frac{k_1}{m_1}} \]