Optics and Waves (week 4)

Two strings of density μ_1 and μ_2 are joined together and are under the same tension. An incident wave $y_1 = A\cos(k_1 x - \omega t)$ is partially transmitted and partially reflected at the point where the strings are joined. The transmitted and reflected waves are $y_t = B\cos(k_2 x - \omega t)$ and $y_r = C\cos(k_1 x + \omega t)$, respectively. We know that $B = \dfrac{2k_1}{k_1 + k_2} A, \quad C = \dfrac{k_1 - k_2}{k_1 + k_2} A$.

The incident wave has energy $\dfrac{1}{2}\omega^2 A^2 \mu_1 \lambda_1$ over one wavelength.

Show that the sum of the energy carried by the transmitted wave y_t and that by the reflected wave y_r equals the energy from the initial wave y_1.