$k = \sqrt{\frac{2m}{\hbar^2}E}$, $k' = i\tilde{k} = i\sqrt{\frac{2m}{\hbar^2}(V_0-E)}$

$S_0(k',k)\begin{pmatrix}1\\B\end{pmatrix} = \begin{pmatrix}C\\D\end{pmatrix} \Rightarrow S_a(k,k')\,S_0(k',k)\begin{pmatrix}1\\B\end{pmatrix} = \begin{pmatrix}F\\0\end{pmatrix}$

$S_a(k,k')\begin{pmatrix}C\\D\end{pmatrix} = \begin{pmatrix}F\\0\end{pmatrix}$

$$R = \|B\|^2 = \frac{(k^2-k'^2)^2(1-e^{2ik'a})(1-e^{-2ik'a})}{\left[(k+k')^2-(k-k')^2e^{2ik'a}\right]\left[(k+k')^2-(k-k')^2e^{-2ik'a}\right]} =: \frac{\alpha}{\beta}$$

$$T = \|F\|^2 = \frac{16k^2k'^2\, e^{i(k'-k)a}\, e^{-i(k'-k)a}}{\beta} \qquad =: \gamma$$

$$\beta = (k+k')^4 - (k-k')^2(k+k')^2e^{2ik'a} - (k+k')^2(k-k')^2e^{-2ik'a} + (k-k')^4$$

$$= k^4 + \cancel{4k^3k'} + 6k^2k'^2 + \cancel{4kk'^3} + k'^4 - \left[(k-k')(k+k')\right]^2\left[e^{2ik'a}+e^{-2ik'a}\right]$$
$$+ k^4 - \cancel{4k^3k'} + 6k^2k'^2 - \cancel{4kk'^3} + k'^4$$

$$= 2k^4 - 4k^2k'^2 + 2k'^4 + 16k^2k'^2 - (k^2-k'^2)^2\left[e^{2ik'a}+e^{-2ik'a}\right]$$

$$= (k^2-k'^2)^2\cdot 2 + 16k^2k'^2 - (k^2-k'^2)^2\left[e^{2ik'a}+e^{-2ik'a}\right]$$

$$= 16k^2k'^2 - (k^2-k'^2)^2\left[e^{2ik'a}+e^{-2ik'a}-2\right]$$

$$\alpha = (k^2-k'^2)^2\left[1-e^{2ik'a}-e^{-2ik'a}+1\right] = -(k^2-k'^2)^2\left[e^{2ik'a}+e^{-2ik'a}-2\right]$$

$$\gamma = 16k^2k'^2$$

$$R+T = \frac{\alpha+\gamma}{\beta} = \frac{16k^2k'^2 - (k^2-k'^2)^2\left[e^{2ik'a}+e^{-2ik'a}-2\right]}{16k^2k'^2 - (k^2-k'^2)^2\left[e^{2ik'a}+e^{-2ik'a}-2\right]} = 1$$