Numerical Homework I

Phys. 410

Consider the positive energy solution to the 1D-Schrödinger equation in the presence of a specific sech^2 potential:

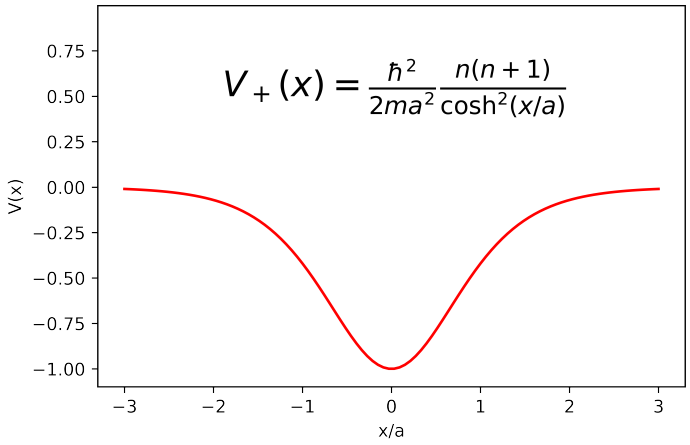
$$V_{\pm}(x) = \pm\frac{\hbar^2}{2ma^2}\frac{n(n+1)}{\cosh^2(x/a)} \tag{1}$$

The Schrödinger equation then reduces to

$$\frac{d^2\psi}{dx^2} + [k^2 \frac{n(n+1)}{a^2\cosh^2(x/a)}]\psi(x) = 0 \tag{2}$$

where $E = \frac{\hbar^2 k^2}{2m} > 0$.

I want you to use the transfer matrix approach to solve this problem for a given integer, say $n = 1$. You can also select your unit so that $\hbar = \omega = 1$ and length scale a so that $ka = 1$ for your numerics.



Consider an incident wave with energy $E < \frac{1}{a^2}$ in $?oa$ units so that $E < |V_{max}|$.

1. Find the transmission coefficient in case of $V_+(x)$ bound potential and plot $T(E)$ for $0 < E < \frac{1}{a^2}$.

2. Find the transmission coefficient in case of $V_-(x)$ well potential bound potential and plot $T(E)$ for $0 < E < \frac{1}{a^2}$.