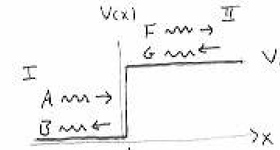
Express your answer in terms of $\boxed{E, V_0}$

HW Quiz 4



A one-dimensional potential is given by:

$$V(x)=\begin{cases}0 & \text{if } x\le 0 \\ V_0 & \text{if } x>0\end{cases}$$

$\frac{d^2\psi^{I}}{dx^2} = -\underbrace{\frac{2mE}{\hbar^2}}_{k_I^2}\psi^{I} \Rightarrow \psi^{I} = Ae^{ik_Ix} + Be^{-ik_Ix}$

$\frac{d^2\psi^{II}}{dx^2} = -\underbrace{\frac{2m(E-V_0)}{\hbar^2}}_{k_{II}^2}\psi^{II} \Rightarrow \psi^{II} = Fe^{ik_{II}x} + Ge^{-ik_{II}x}$

For scattering from right set $A=0$.

Continuity @ $x=0$: $B = F + G$

Smoothness @ $x=0$: $-k_I B = k_{II}F - k_{II}G$

Work one of the following problems:

easy

1. Calculate the reflection coefficient for a particle coming in from the **right** with E > V_0.

$R = \frac{|F|^2}{|G|^2} = ? = \frac{k_{II}^2 + k_I^2 - 2k_{II}k_I}{k_{II}^2 + k_I^2 + 2k_{II}k_I} = \boxed{\frac{E + (E-V_0) - 2\sqrt{E(E-V_0)}}{E + (E-V_0) + 2\sqrt{E(E-V_0)}}}$

$-k_I(F+G) = k_{II}F - k_{II}G \Rightarrow F(k_{II}+k_I) = (k_{II}-k_I)G \Rightarrow R = \frac{(k_{II}-k_I)^2}{(k_{II}+k_I)^2}$

Papers graded according to correct solution!

hard

2. Calculate the transmission coefficient for a particle coming in from the **right** with E > V_0.

$T = \frac{|B|^2}{|G|^2}\frac{v_I}{v_{II}} = ? = \frac{4k_{II}^2}{(k_I+k_{II})^2}\sqrt{\frac{E}{E-V_0}} = \boxed{\frac{4(E-V_0)}{E+(E-V_0)+2\sqrt{E(E-V_0)}}\sqrt{\frac{E}{E-V_0}}}$

$-k_I B = k_{II}(B-G) - k_{II}G \Rightarrow B(k_{II}+k_I) = G(2k_{II}) \Rightarrow \frac{|B|^2}{|G|^2} = \frac{4k_{II}^2}{(k_{II}+k_I)^2}$

$v_{II} = \sqrt{\frac{2}{m}(E-V_0)} \quad v_I = \sqrt{\frac{2}{m}E}$