Transmission, Tunnelling, reflection

A word on coefficients

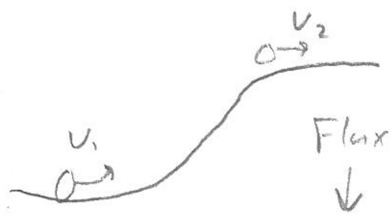
$A \to \frac{1}{L}$ or # per unit length

$j \to \frac{\#}{s}$ flux of probability

$\underline{\underline{T}} = \left|\frac{T}{I}\right|^2$, $\underline{\underline{R}} = \left|\frac{R}{I}\right|^2 = \#$

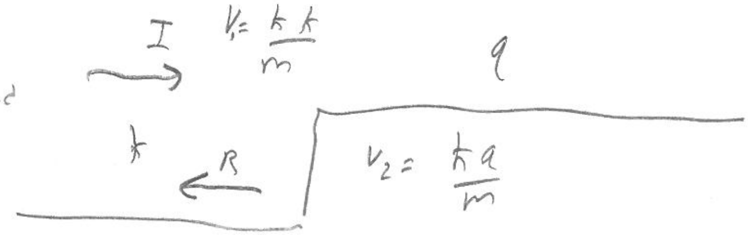
if $v_1 = v_2$ These are probability fluxes

Really $\left|\frac{T}{I}\right|^2 \frac{\hbar k}{m} \cdot \frac{m}{\hbar k}$



if $v_1 \neq v_2$ $\frac{\hbar k}{m} \neq \frac{\hbar q}{m}$

$\underline{\underline{T}} = \frac{T^2}{I^2} \frac{q}{m} = \frac{\#}{\text{second}}$



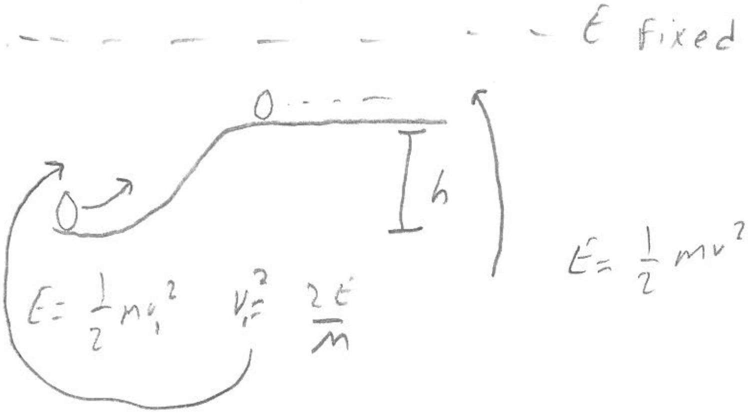
$-\frac{\hbar^2}{2m}\psi'' = E\psi$

$k^2 = -\frac{2mE}{\hbar^2}$

$-\frac{\hbar^2}{2m}\psi'' + V\psi = E\psi$

$q^2 = -\frac{2m}{\hbar^2}(E-V)$

Bound

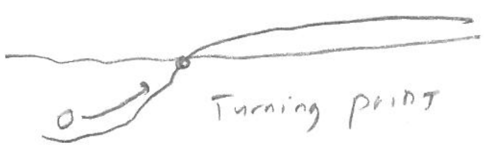


$E > V$

$E = \frac{1}{2}mv^2 + mgh \quad v_2^2 = \frac{2(E - mgh)}{m}$

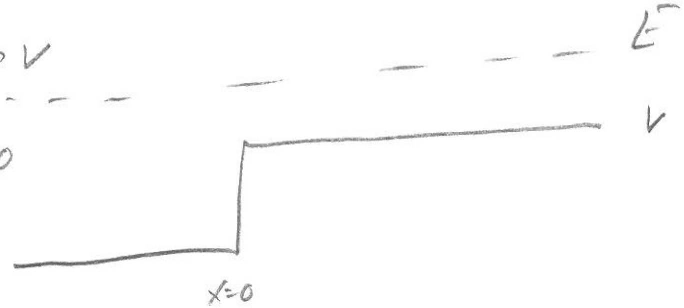
$E = \frac{1}{2}mv_1^2 \quad v_1^2 = \frac{2E}{m}$

If $E < V$



$E > V$

$E > 0$



$$-\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2} = E\psi$$

$$\psi'' = -\frac{2mE\psi}{\hbar^2}$$

$$\psi'' + \frac{2mE\psi}{\hbar^2} = 0$$

$$-\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2} + V\psi = E\psi$$

$$\psi'' - \frac{2mV}{\hbar^2}\psi = -\frac{2mE\psi}{\hbar^2}$$

$$\psi'' = \frac{2m}{\hbar^2}(V - |E|)\psi$$

This is less then zero

#1. $\psi_I'' + k^2\psi_I = 0 \qquad k = \frac{\sqrt{2mE}}{\hbar} > 0 \qquad \psi_I = \underset{\rightarrow}{Ae^{ikx}} + \underset{\leftarrow}{Be^{-ikx}}$

#2. $\psi_{II}'' + q^2\psi_{II} = 0 \qquad q = \frac{\sqrt{2m(E-V)}}{\hbar} \qquad \psi_{II} = Ce^{iqx}$. No reflected wave

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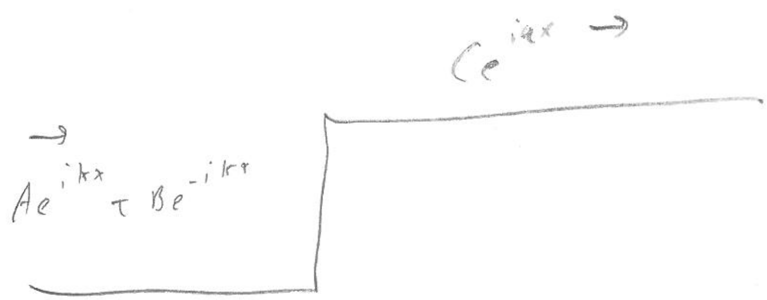


$\psi(0) \rightarrow \quad A + B = C \qquad \psi'(0) \quad ik(A-B) = iqC$

$R = ? \quad ik(A-B) = iq(A+B)$

$$\frac{k}{q}A - \frac{k}{q}B = A + B$$

$$\left(\frac{k}{q} - 1\right)A = \left(1 + \frac{k}{q}\right)B$$

$$\left(\frac{k-q}{q}\right)A = \left(\frac{k+q}{q}\right)B \qquad \frac{B^2}{A^2} \quad \frac{(k-q)^2}{(k+q)^2} = \frac{(k-q)^2}{(k+q)^2} \cdot \frac{(k-q)^2}{(k-q)^2}$$

$$= \frac{(k-q)^4}{(k^2-q^2)^2} = \frac{\left(\sqrt{E} - \sqrt{E-V}\right)^4}{V^2}$$

$T = R - 1$

$T + R = 1$

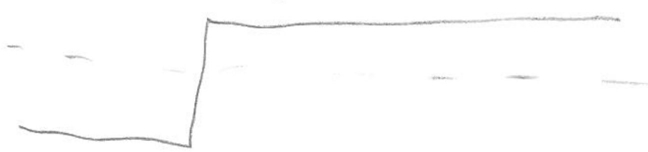
$E < V$

$k > 0$ $\qquad\qquad\qquad\qquad$ $q > 0$

$$\psi_I'' + \frac{\sqrt{2mE}}{\hbar}\psi_I = 0 \qquad \psi_{II}'' + \frac{\sqrt{2m(V-E)}}{\hbar}\psi_{II} = 0$$

$+qx$ diverges

$$\psi_I = A\overrightarrow{e^{ikx}} + Be^{-ikx} \qquad \psi_{II} = Ce^{-ax}$$



$\psi(0)$ $\qquad$ $\psi'(0)$ $\qquad\qquad$ C

$$A + B = C \qquad ik(A-B) = -qC \qquad ik(A-B) = -q(A+B)$$

$$\frac{ik}{q}(B-A) = A+B$$

$$\left(\frac{ik}{q} - 1\right)B = \left(1 + \frac{ik}{q}\right)A$$

$$\frac{B}{A} = \frac{1+il}{1-il} \qquad \frac{B^2}{A^2} = \frac{(1+il)(1-il)}{(1-il)(1+il)} = 1$$ All reflected

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how about