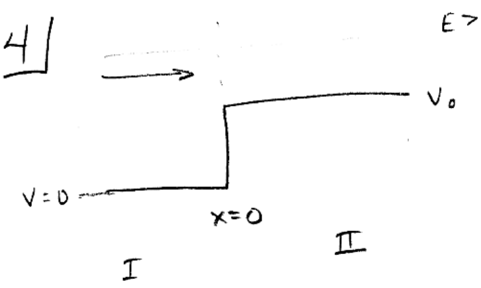
4]



$$\psi_I = Ae^{ikx} + Be^{-ikx} \qquad k^2 = \frac{2mE}{\hbar^2}, \quad q^2 = \frac{2m(E-V_0)}{\hbar^2}$$

$$\psi_{II} = Ce^{iqx} + \underbrace{De^{-iqx}}_{0}$$

0 since that would represent wave coming from right

boundary conditions:

$$\psi_I(0) = \psi_{II}(0) \implies A + B = C$$

$$\psi_I'(0) = \psi_{II}'(0) \implies Aik + B(-ik) = C(iq)$$

$$Ak - Bk = q(A+B)$$

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

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

$$\frac{C}{A} = \frac{B}{A} + 1 = 1 + \frac{k-q}{k+q} = \frac{k+q+k-q}{k+q}$$

$$\boxed{T = \frac{C}{A} = \frac{2k}{k+q}}$$

Should satisfy:

$$v_I = v_I|R|^2 + v_{II}|T|^2$$

where v_I & v_{II} are the particles' velocities in regions I & II

$$v_I = \frac{p_I}{m} = \frac{\hbar k}{m} \quad \& \quad v_{II} = \frac{p_{II}}{m} = \frac{\hbar q}{m}$$

$$v_I(1-|R|^2) = \frac{\hbar k}{m}\left(1 - \left(\frac{k-q}{k+q}\right)^2\right) = \frac{\hbar k}{m}\left(1 - \frac{k^2-2kq+q^2}{k^2+2kq+q^2}\right)$$

$$= \frac{\hbar k}{m}\left(\frac{\cancel{k^2}+2kq+\cancel{q^2}-\cancel{k^2}+2kq-\cancel{q^2}}{k^2+2kq+q^2}\right) = \frac{\hbar k(4kq)}{m(k+q)^2}$$

$$= \left(\frac{\hbar q}{m}\right)\frac{4k^2}{(k+q)^2} = v_{II}|T|^2 \checkmark$$

As $E \to V_0$, q gets small, $R \to 1$ and $T \to 2$.
But the <u>flux</u> transmitted is $v_{II}|T|^2$ and this $\to 0$ as $E \to V_0$.