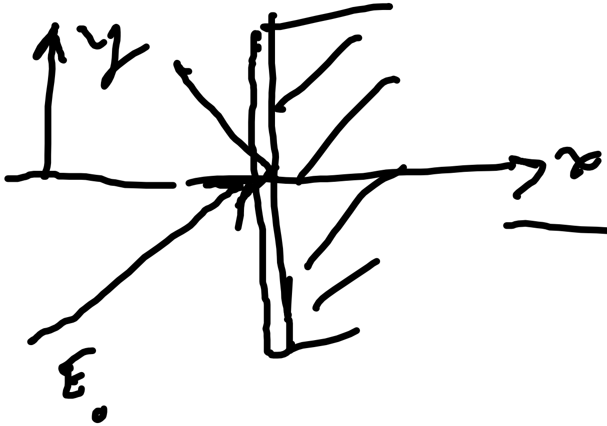
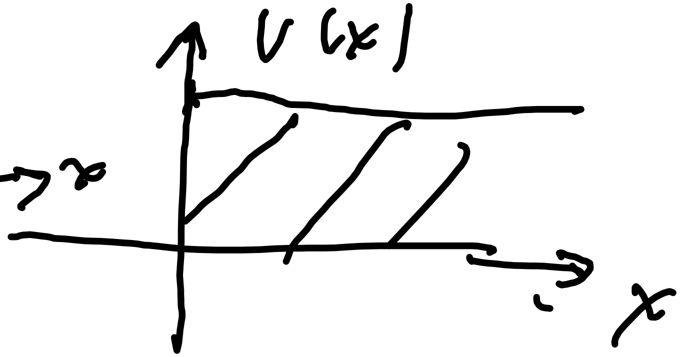




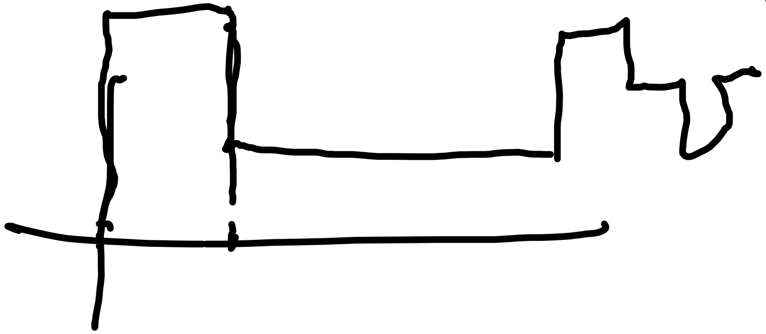
$$V = \frac{2\pi\hbar^2}{m}[Na]_x$$

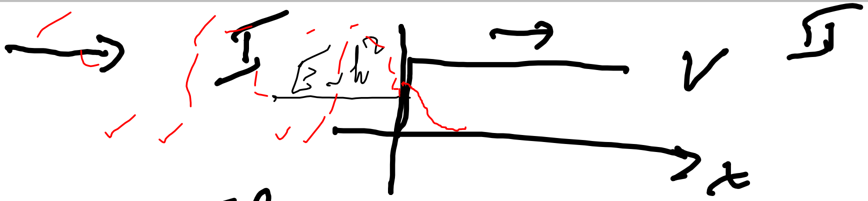
$$e^{ik_x x + k_y y} = e^{ik_x x}\left(e^{ik_y y}\right) = \underline{e^{ik_y y}}\ \underline{\psi(x)}$$

$$H = \frac{p_x^2}{2m} + V(x) + \left(\frac{p_y^2}{2m}\right)$$

$$\sigma_a \sim \left(1/v\right)$$

$$(Na)$$





$$k_1^2 + V = k_0^2$$

$$k_1^2 = k_0^2 - V$$

$x<0$ $\quad e^{ik_0 x} + R e^{-ik_0 x}$

$x>0$ $\quad T e^{ik_1 x}$

$$\psi_I = \psi_{II} \qquad \psi_I' = \psi_{II}'$$

$$\left| \begin{array}{l} 1 + R = T \\ ik_0(1-R) = \frac{ik_1}{ik} T \end{array} \right|$$

$$2 = T\left[1 + k_1/k\right]$$

$x \Rightarrow$

$$|R|^2 + |T|^2 = 1$$

$$k_1 = \sqrt{(E - V)\frac{2m}{\hbar^2}}$$

$$R = \frac{k_0 - k_1}{k + k_1} \qquad T = \frac{2k}{k_1 + k}$$

$E > V \Rightarrow R < 1$

total reflection $\quad E < V \Rightarrow |R|^2 = 1$

$k' = i\kappa \longrightarrow$ real $\qquad \psi_{II} = T e^{-\kappa x}$

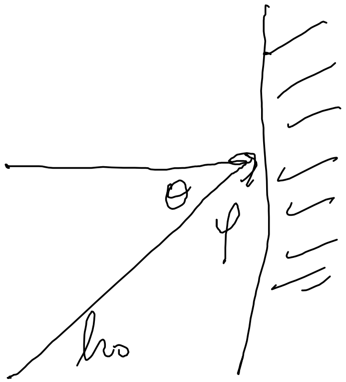
$d = 1/k$

$$\sqrt{(V - E_0)\frac{2m}{\hbar^2}}$$

$V = U - iW$

$= U\{1 - if\}$

$$R = \frac{k - k'}{k + k'} = \left(\frac{\sqrt{E} - \sqrt{E_\perp - V}}{\sqrt{E} + \sqrt{E + V}}\right)$$



$k_\perp = k_0 \cos\theta$

$E_\perp = E_0 \cos^2\theta < V \quad (R)^2 \leq 1$

if $E_0 < V$ $\quad R]^2 < 1$ for all θ

$V \sim 250\,neV$

$E \sim 25\,meV$

$1.8\,A^\circ$

$\cos^2\theta \leq V/E \sim \varphi^2$

$\varphi \sim \sqrt{V/E} = \sqrt{10^{-5}}$

$.3 \times 10^{-2}$

$\sim .2$ degrees

$.1$ degree$/A^\circ$

$(e^{-\kappa x} T)$ $\qquad H = \frac{p^2}{2m} + V(x) + (\vec{p}\cdot\vec{A})$

$U - iW$

$$\left(i\hbar \frac{\partial \psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\psi + V\psi\right)\psi^*$$

$$\left(-i\hbar \frac{\partial \psi^*}{\partial t} = - \quad \nabla^2\psi^* + V^*\psi^*\right)\psi$$

$$i\hbar\frac{\partial}{\partial t}(\psi\psi^*) = -\frac{\hbar^2}{2m}\left(\psi^*\nabla^2\psi - \psi\nabla^2\psi^*\right) + (V - V^*)\psi\psi^*$$

$$\vec{J} = \left(\psi^*\vec{\nabla}\psi - \psi\nabla\psi^*\right)\frac{\hbar}{2m}(-i)$$

$$i\frac{\partial\rho}{\partial t} = i\vec{\nabla}\cdot\vec{J} + (V - V^*)|\psi|^2$$

$$-2iW|\psi|^2$$

$U = V - iW$

$V - V^* = -2iW$

$$\left.\frac{d\rho}{dt}\right|_{loss} = -2W|\psi|^2 = -2W\rho \qquad \rho = \rho_0 e^{-\frac{2Wt}{\hbar}}$$

$$1/\tau_{abs} = [n\, v_{abs}\, \sigma] \rightarrow \frac{2W}{\hbar}$$

$$W = \frac{\hbar}{2}\left[\sum_i n_i \sigma_i\right] v$$

$\xrightarrow[n]{}$ A $\bigcirc$

$\xrightarrow{h}$ $n(\omega)_h$

$A+L$ $\bigcirc$ $\rightsquigarrow \gamma L$ E_γ $\equiv$

$\xrightarrow{h'}$ $n(\omega_k) - \delta_{\omega_n \omega_k}$

$\equiv$

$V \to U - iW$

reverse transition is negligible

$$U = V - iW = 2\pi \frac{\hbar^2}{m} (\widetilde{Na}) - i \frac{\hbar}{2} [N \tilde{\sigma}_a] v$$

$$= 2\pi \frac{\hbar^2}{\cancel{2} m} N (a_r - i a_i)$$

$$4\pi a_r^2 = \sigma_{coh}$$

$$a_i = \frac{\sigma_a v m}{\hbar \, 4\pi}$$

$$\boxed{\frac{a_i}{a_r} = \frac{k \sigma_a}{4\pi} \sqrt{\frac{4\pi}{\sigma_{coh}}}}$$

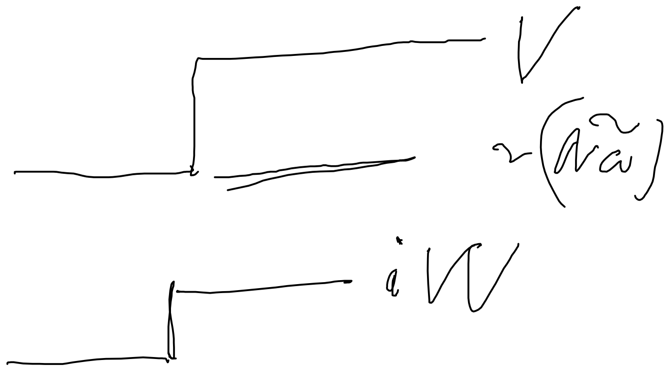
$$= \frac{k}{\sqrt{4\pi}} \sqrt{\sigma}$$

$$\left[a_i = \left(\frac{k \sigma_a}{4\pi} \right) \right]$$

$$\sim 2\pi \times 10^8 \; 10^{-12} \sim 10^{-4}$$

$$Gd^{157}$$

$$f = \frac{W}{V} = \frac{a_i}{a_r}$$



$$R = \frac{k - k'}{k + k'} \qquad \frac{k'}{k} = \frac{i\kappa}{k} = i\sqrt{\frac{V - E}{E}}$$

$$= \left[\frac{1 - k'/k}{1 + k'/k}\right]\left[\quad\right]^{*}$$

$$\sqrt{\frac{V - iW}{E}} \to \sqrt{\frac{V}{E}(1 - if)}$$

$$\left[R^2 = 1 - 2f\sqrt{\frac{E_\perp}{V - E_\perp}}\right]$$

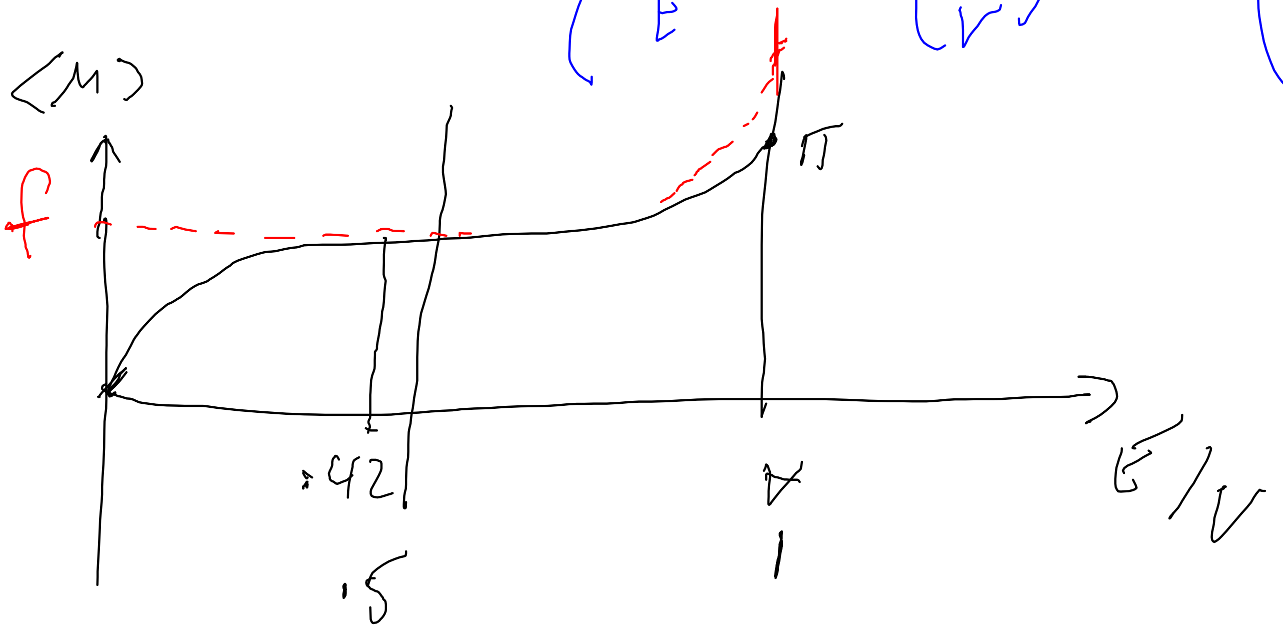
$$E_\perp = E_0 \cos^2\theta$$

$$\frac{E_0 < V}{\text{UCN}}$$

$$\mu = 2f\sqrt{\frac{E\cos^2\theta}{V - E\cos^2\theta}} \qquad f = \frac{W}{V}$$

$$\langle\mu\rangle = 2\int_0^{\pi/2} \mu(E,\theta)\,(\cos\theta)\,(\sin\theta\, d\theta)$$

$$\langle M \rangle_\theta = 2f\left\{ \frac{V}{E}\sin^{-1}\left(\frac{E}{V}\right)^{1/2} - \left(\frac{V}{E}-1\right)^{1/2} \right\}$$



$$\frac{V}{E} = .52 \qquad 2\left[\frac{\pi}{2} - 1\right]$$