LECTURE ~~#~~ 13 7-15-09

$^1/_3$ DOWN $^2/_3$ TO GO

COMPLEX NUMBERS

LAPLACE'S EQN

ELECTROSTATICS

MAGNETOSTATICS

THERMOSTATICS

PIEZOSTATICS

⋮

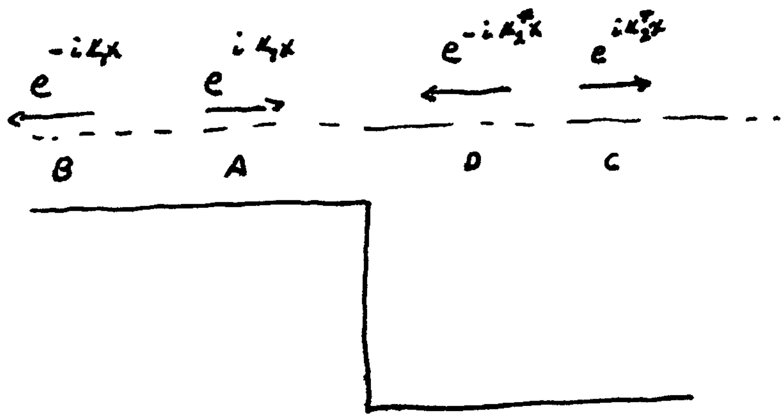
$\frac{1}{3}$

$^1/_3$ QUANTUM (QM) SCHRODINGER EQN

$^1/_3$ VECTOR EM MAXWELL'S EQNS

1d SCATTERING

1d TRANSMISSION AND REFLECTION



TWO KNOWNS: k_1 AND k_2^*

FOUR UNKNOWNS: A, B, C, D

TWO EQUATIONS: ψ CONTINUOUS

ψ' CONTINUOUS

D = 0 UNLESS WE SEND IN A WAVE

THREE UNKNOWNS: A, B, C

MEASURE RELATIVE TO A: $\frac{B}{A}$, $\frac{C}{A}$

2 EQN'S

2 UNKNOWNS

TISE $\quad H|\psi\rangle = E|\psi\rangle$

$$\left[\frac{-\hbar^2}{2m}\frac{d^2}{dx^2} + V(x)\right]\psi = E\psi$$

$$\frac{d^2\psi}{dx^2} = \left[\frac{2m}{\hbar^2}(V-E)\right]\psi$$

$$\frac{d^2\psi}{dx^2} = \Omega\psi$$

SOLN'S $\quad \psi(x) = \exp(\pm\sqrt{\Omega}\,x)$

THREE CASES:

(1) $\quad E > V \Rightarrow \Omega < 0 \Rightarrow \pm\sqrt{\Omega} = \pm i k$

$\psi(x) = A e^{ikx} + B e^{-ikx}$

(2) $\quad E < V \Rightarrow \Omega > 0 \Rightarrow \pm\sqrt{\Omega} = \pm \kappa$

$\psi(x) = C e^{+\kappa x} + D e^{-\kappa x}$

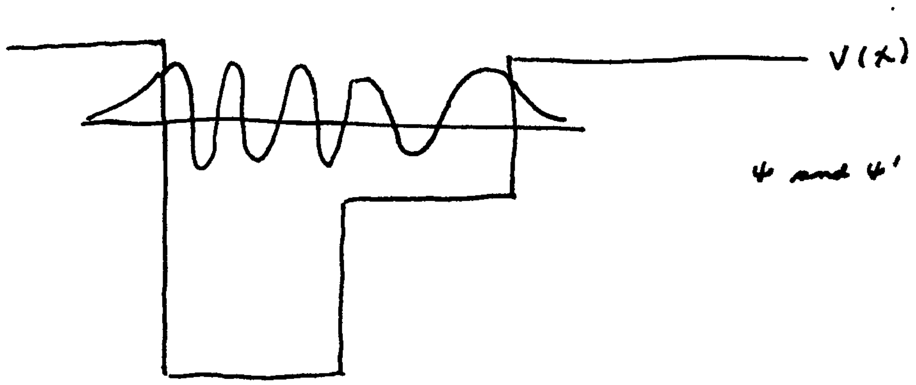
(3) $\quad E = V \Rightarrow \Omega = 0$

$\psi(x) = Ex + F$

SKETCHING BOUND STATE WAVEFCN'S

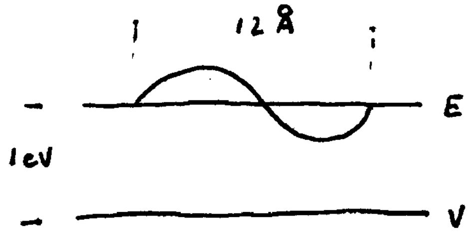
$E > V$ OSCILLATING

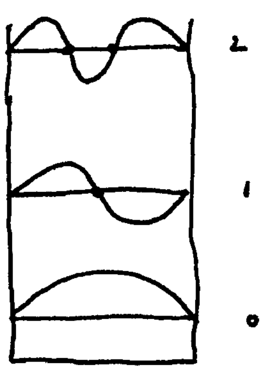
$E < V$ DECAYING

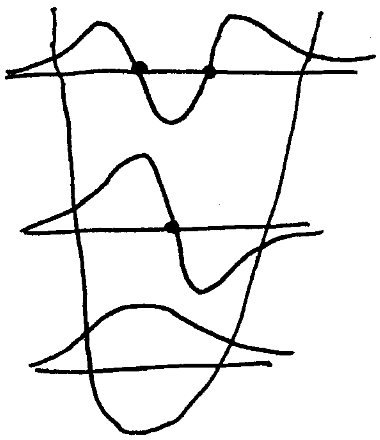


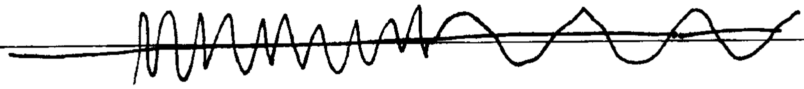
ψ and ψ' CONTINUOUS

FOR ELECTRONS: $\lambda = \dfrac{12}{\sqrt{E-V}}$ Å, eV

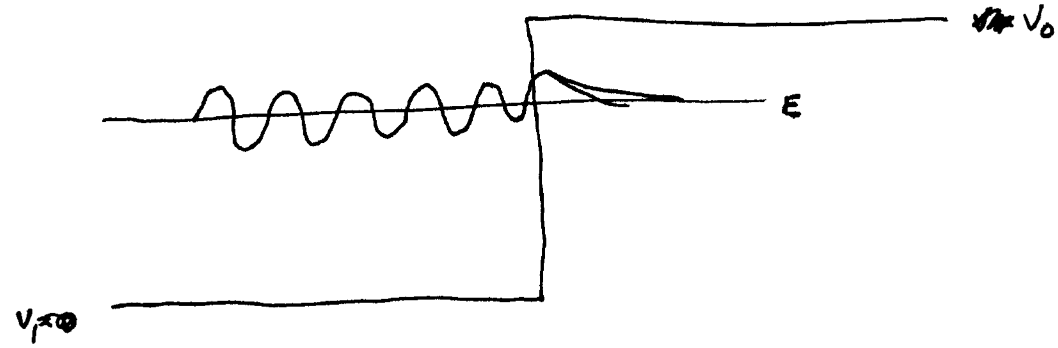








SCATTERING



CLASSICALLY: $E < V_0$ ALL REFLECTED

BALL: all T

$E > V_0$ wave $\begin{cases} \text{SOME REFLECTED} \\ \text{SOME TRANSMITTED} \end{cases}$

LEFT REGION $E > V$

$$\psi_1(x) = \underbrace{A e^{i k_1 x}}_{\text{incident}} + \underbrace{B e^{-i k_1 x}}_{\text{reflected}}$$

$$k_1 = \sqrt{2m(E - V_1)/\hbar^2} = p_1/\hbar$$

RIGHT REGION

BC at $+\infty$ no incoming wave

$$\psi_2(x) = \underbrace{C e^{i k_2 x}}_{\text{TRANSMITTED}} + \cancel{D e^{-i k_2 x}}$$