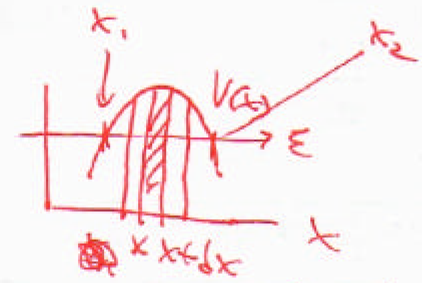
- WKB Approximation:

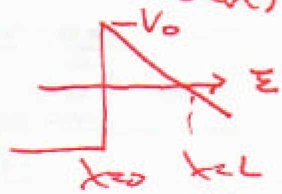
Arbitrary barrier:



$$\boxed{T \sim e^{-2\int_{x_1}^{x_2} \alpha(x)\,dx}} \qquad \alpha(x) = \frac{\sqrt{2m(V(x)-E)}}{\hbar}$$

optional

Field Emission:



$$T \sim e^{-\mathcal{E}_0/\mathcal{E}}$$

$$V(x) = 0 \quad (x<0)$$
$$= V_0 - e\mathcal{E}x \quad (x \geq 0)$$

$$\mathcal{E}_0 = \frac{4\sqrt{2m}}{3\hbar}\frac{W^{3/2}}{e} \qquad W = e\mathcal{E}L$$

- Angular Momentum:

$$\bar{L} = \bar{r} \times \bar{p} \qquad L_z^{op} = -i\hbar\frac{\partial}{\partial\phi}$$

Assume $\psi(r,\phi) = R(r)\,\Phi(\phi)$

$L_z^{op}\psi = L_z\psi \Rightarrow \Phi(\phi) = e^{+\frac{i}{\hbar}L_z\phi}$

Rotational Symmetry $\Rightarrow$ $\boxed{L_z = m\hbar}$ $\quad m = 0, \pm1, \pm2 \ldots$

e⁻ Orbital: $\begin{cases} L^2 = l(l+1)\hbar^2 & l = 0, 1, 2 \ldots \\ L_z = m_l\hbar & |m_l| \leq l \end{cases}$

(Q.M. in origin) Spin: $\begin{cases} S^2 = s(s+1)\hbar^2 & s = \frac{1}{2} \\ S_z = m_s\hbar & m_s = \pm s \end{cases}$

Dipole moments: $\begin{cases} \mu_z = -m_l\mu_B & \text{(orb)} \\ \mu_z = -2m_s\mu_B & \text{(spin)} \end{cases}$

$\mu_B = \frac{e\hbar}{2m}$ (Bohr Magneton) (MKS unit)

[Landé-g factor

- Identical Particles & Spin States:

Indistinguishability of particles $\Rightarrow$ Exchange Symmetry $\begin{cases} \text{Fermions (spin } \frac{1}{2}\text{): Anti-Sym} \\ \text{Bozon (integer spin): Sym.} \end{cases}$

under exchange

e.g. $\psi_{ANTISYM}(1,2) = \frac{1}{\sqrt{2}}[\psi_A(1)\psi_B(2) - \psi_A(2)\psi_B(1)]$

$\Rightarrow$ $\boxed{\text{Pauli Exclusion Principle}}$: No two electrons in the same atom can have all QM #'s the same