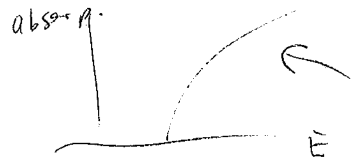
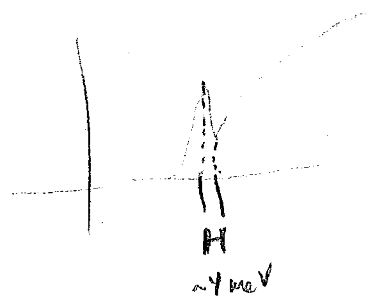
Chapter 15 (some of, anyway)

Optical Absorption



"joint density of states"
combined CB + VB

GaAs actual



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exciton! (e⁻) (h⁺)

bound state

like hydrogen atom again

Ch 14 + 15

Maxwell's Eqns

1) Gauss's law $\oint \vec{E} \cdot d\vec{a} = \frac{q_{enc}}{\epsilon_0}$ $\xrightarrow{\text{div. thm.}}$ $\boxed{\nabla \cdot \vec{E} = \rho/\epsilon_0}$

2) No magn. monopoles aka Gauss's law for B $\oint \vec{B} \cdot d\vec{a} = 0$ $\xrightarrow{\text{div thm}}$ $\boxed{\nabla \cdot \vec{B} = 0}$

3) Faraday's Law $\mathcal{E} = -\frac{\partial \Phi_B}{\partial t}$

$\rightarrow \oint \vec{E} \cdot d\vec{l} = -\frac{\partial \Phi_B}{\partial t}$ $\xrightarrow{\text{Stokes Thm}}$ $\boxed{\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}}$

4) Ampere's Law $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$ $\longrightarrow$ $\nabla \times \vec{B} = \mu_0 \vec{J}$

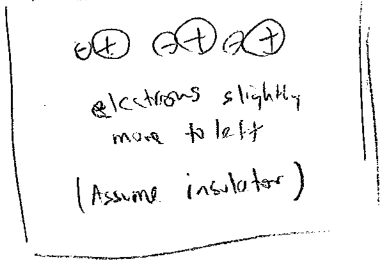
w/ Maxwell correction

$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc} + \underbrace{\mu_0 \epsilon_0 \frac{\partial \Phi_E}{\partial t}}_{\text{displacement current}} \rightarrow \boxed{\nabla \times \vec{B} = \mu_0 \vec{J} + \mu_0 \epsilon_0 \frac{\partial \vec{E}}{\partial t}}$

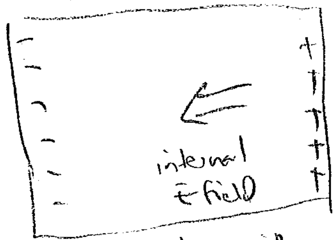
These are equations in vacuum.

Also true in materials, but not the most useful form.

Inside materials $E \rightarrow$



overall end result



which partially cancels external field

For Maxwell's Eqns, need total $\vec{E} = \vec{E}_{ext} + \vec{E}_{int}$

instead, use Polarizability $\vec{P} = \epsilon_0 \chi_e \vec{E}$ ↳ electric susceptibility. Describes dipole moments that get formed ($\equiv$ ave $\frac{\text{dipole moment}}{\text{volume}}$)

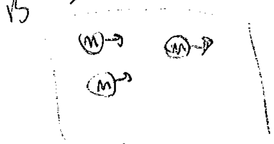
"D-field" or "displacement field" $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$

then ① $\boxed{\nabla \cdot \vec{D} = \rho_{extra}}$ ← "ρ_{free}"

② $\boxed{\vec{\nabla} \cdot \vec{B} = 0}$ still

③ $\boxed{\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}}$ still (why?)

Same sort of Deal for B field



$\vec{M} = \chi_m \vec{H}$

$\vec{H} = \frac{\vec{B}}{\mu_0} - \vec{M}$ } historically done this way instead of $\vec{M} = \chi_m \vec{B}$ and $\vec{H} = \mu_0 \vec{B} + \vec{M}$

Magnetic moment / volume

Then $\boxed{\nabla \times \vec{H} = \vec{J}_{extra} + \frac{\partial \vec{D}}{\partial t}}$