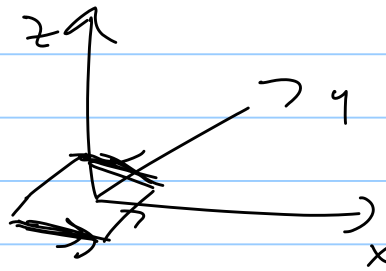
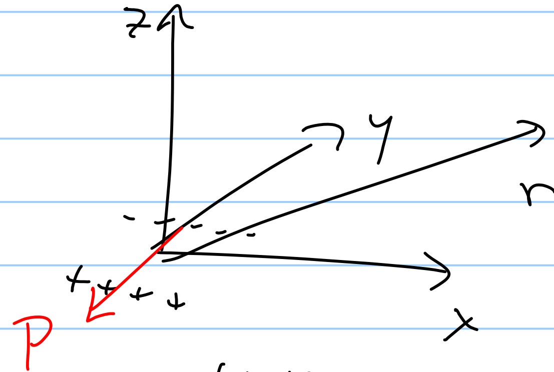
Note Title

Review Final

4/29/2009





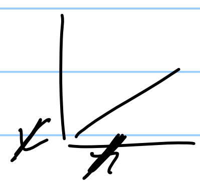
$$\vec{A} = \frac{\mu_0}{4\pi}\int \frac{I\,d\vec{\ell}}{r} \qquad V = k\int \frac{\lambda\,d\ell}{r}$$

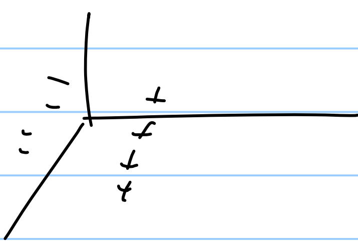
$$A_x = \frac{\mu_0}{4\pi}\int \frac{I\,dx}{r} \qquad V = k\int \frac{\lambda\,dx}{r}$$

Dipole approx

$$A_x = \qquad V_{dipole} = k\,\frac{\vec{p}\cdot\hat{r}}{r^2}$$

$$\vec{p}\cdot\hat{r} = p\cos\alpha$$





A_y

Review:

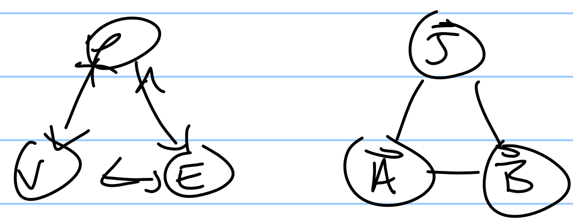
Max Eqn

$$\vec{\nabla}\cdot\vec{E} = \frac{\rho}{\epsilon_0} \qquad \vec{\nabla}\times\vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\vec{\nabla}\cdot\vec{B} = 0 \qquad \vec{\nabla}\times\vec{B} = \mu_0\vec{J} + \mu_0\epsilon_0\frac{\partial \vec{E}}{\partial t}$$

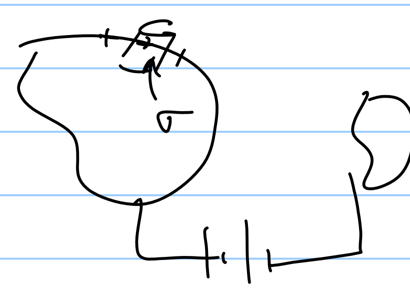
Cons. charge $\quad \vec{\nabla}\cdot\vec{J} = -\frac{\partial \rho}{\partial t}$, $\quad \vec{J} = \rho\vec{v}$

Given ρ & $\vec{J}$ find $\vec{E}$ & $\vec{B}$ via coupled PDE's



$$\vec{F} = q\vec{E} + q\vec{v}\times\vec{B} \qquad W_{nc} = \Delta(KE+PE)$$

Given V on surface find V everywhere
Boundary value problem: $\nabla^2 V = 0$



Materials :

$\sigma_b = \vec{P}\cdot\hat{n}$ $\qquad \rho_b = -\vec{\nabla}\cdot\vec{P}$

$K_b = \vec{M}\times\hat{n}$ $\qquad \vec{J}_b = \vec{\nabla}\times\vec{M}$

Linear $\quad \vec{P} = \epsilon_0 \chi_e \vec{E} \qquad \vec{M} = \chi_m \vec{H}$

$\vec{\nabla}\cdot\vec{D} = \rho_f \qquad \vec{\nabla}\times\vec{H} = \vec{J}_f$

⇒ Defns $\qquad$ Language of E & M

Math : $\quad$ divergence th (Gauss's Law) $\quad$ surface integrals (flux) $\quad$ vol integral

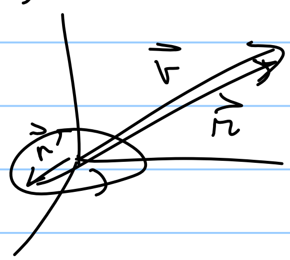
Stokes th $\qquad \oint \vec{B}\cdot d\vec{l} = \mu_0 I_{encl}$

$\vec{\nabla}\times\vec{B} = \mu_0 \vec{J}$

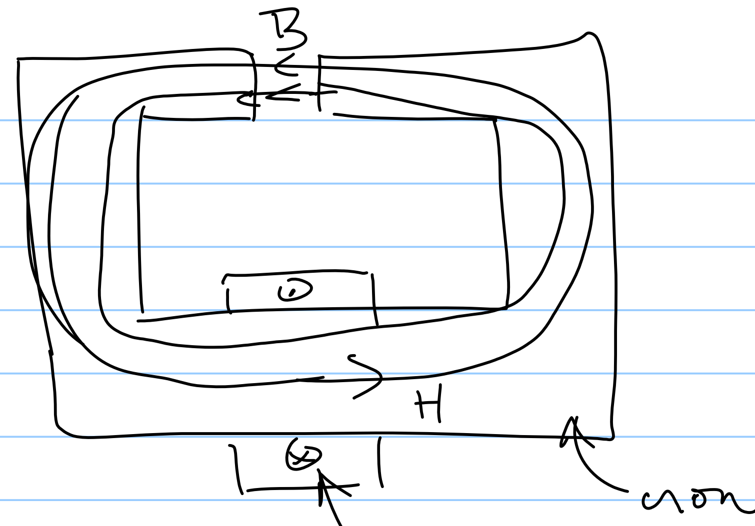
line integral

Set up

$$k\int \frac{dq}{r}, \quad \frac{\mu_0}{4\pi}\int \frac{d\vec{l}}{r}, \quad \frac{\mu_0}{4\pi}\int \frac{I\, d\vec{l}\times\hat{r}}{r^2}$$



- check results

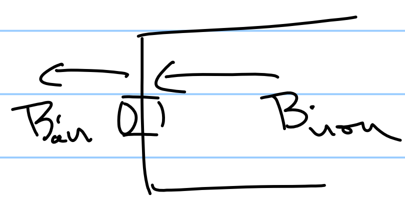


#turns

$$\oint \vec{H}\cdot d\vec{l} = NI \approx H_{iron}\, l_1 + H_{air}\, l_2 = NI$$

current/turn

air linear material $\quad B_{air} = \mu_0 H_{air}$



$$\oint \vec{B}\cdot d\vec{a} = 0$$

$$B_1 A_1 - B_2 A_2 = 0$$

$$B_{air} = B_{iron}$$

$$\boxed{H_{iron}\, l_1 + \frac{B_{iron}}{\mu_0}\, l_2 = NI}$$ lines $B_{iron}(H_{iron})$

$\cancel{H_{iron} = \mu B_{iron}}$ assume ~~linear~~ material find $H_{iron}(B_{iron}) =$

Load line analysis