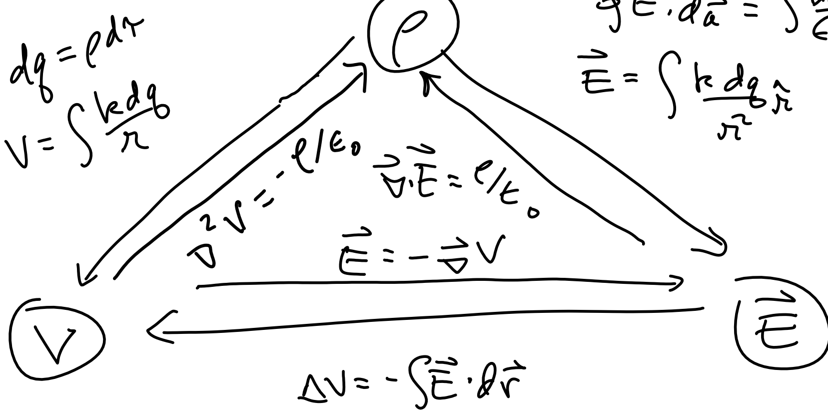
- Here is our model of electrostatics



$$\oint \vec{E}\cdot d\vec{a} = \int \frac{dq}{\epsilon_0}$$

$$\vec{E} = \int \frac{k\, dq}{r^2}\hat{r}$$

$$\vec{\nabla}\times\vec{E} = 0$$

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

To assemble a charge distribution

$$W_{me} = \int V\, dq = \Delta PE \quad \text{or} \quad = \frac{1}{2}\int V\, dq$$

$$W = \frac{\epsilon_0}{2}\left[\int E^2 d\tau + \oint V \vec{E}\cdot d\vec{a}\right]$$

$$\frac{dW}{dt} = -\frac{d}{dt}\int \frac{1}{2}\left(\epsilon_0 E^2 + \frac{B^2}{\mu_0}\right) d\tau - \frac{1}{\mu_0}\oint (\vec{E}\times\vec{B})\cdot d\vec{a}$$

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

$$\vec{D} = \epsilon_0\vec{E} + \vec{P} \qquad \vec{\nabla}\cdot\vec{D} = \rho_f$$

$$\vec{P} = \epsilon_0\chi_e\vec{E} \qquad \epsilon = \epsilon_0(1+\chi_e)$$

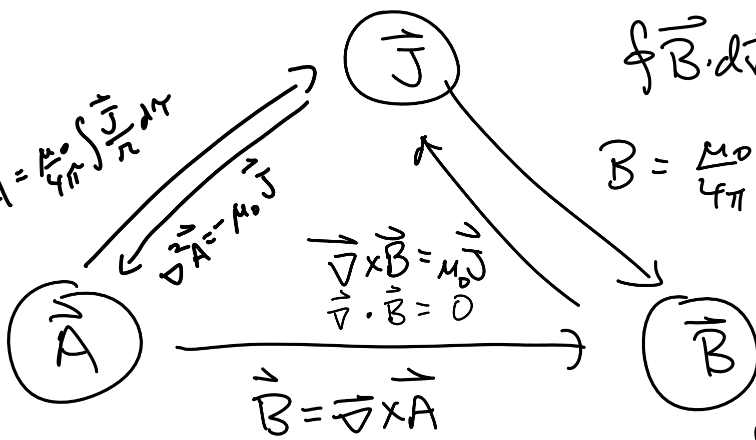
$$U = -\vec{p}\cdot\vec{E} \qquad \vec{F} = (\vec{p}\cdot\vec{\nabla})\vec{E} \qquad V_{dipole} = \frac{1}{4\pi\epsilon_0}\frac{\vec{p}\cdot\hat{r}}{r^2}$$

$$\vec{p} = \alpha\vec{E}$$

Here is our model of magnetostatics:

$$\oint \vec{B}\cdot d\vec{r} = \mu_0 \underbrace{\int \vec{J}\cdot d\vec{a}}_{I_{enclosed}}$$

$$B = \frac{\mu_0}{4\pi}\int \frac{\vec{J}\times\hat{r}}{r^2} d\tau$$



$$\vec{F} = q\vec{E} + q\vec{v}\times\vec{B}$$

$$\mu = m = I\,\text{area} \qquad \vec{\nabla}\cdot\vec{A} = 0$$

$$W = \frac{1}{2\mu_0}\left[\int_{vol} B^2 d\tau - \int_{surface} (\vec{A}\times\vec{B})\cdot d\vec{a}\right]$$

$$U = -\vec{\mu}\cdot\vec{B} \qquad \vec{J}_b = \vec{\nabla}\times\vec{M} \qquad \vec{H} = \frac{\vec{B}}{\mu_0} - \vec{M} \qquad \vec{\nabla}\times\vec{H} = \vec{J}_f \qquad \vec{M} = \chi_m\vec{H}$$

$$\vec{A}_{dipole} = \frac{\mu_0}{4\pi}\frac{\vec{\mu}\times\hat{r}}{r^2} \qquad \vec{K}_b = \vec{M}\times\hat{n} \qquad \vec{B} = \mu\vec{H} \qquad \mu = \mu_0(1+\chi_m)$$