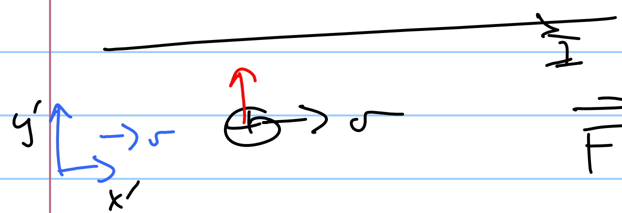
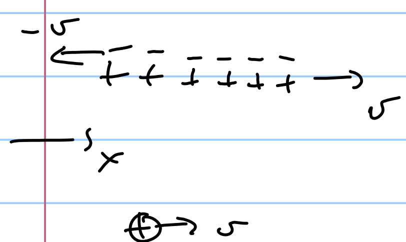
Lecture 27

Note Title 3/29/2006



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

in moving frame $\vec{v} = 0$

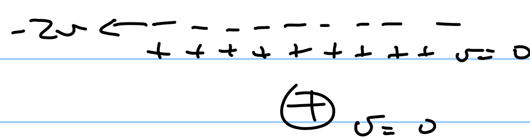


$I = \lambda v$

+ charge pos current

− charge pos current

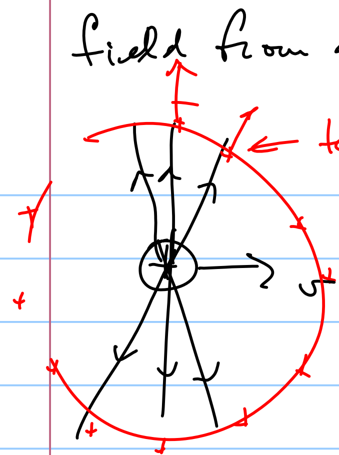
in primed frame



$\lambda^- > \lambda^+$

wire has net neg charge density ⇒ E

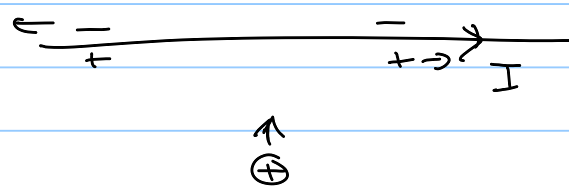
field from a moving charge



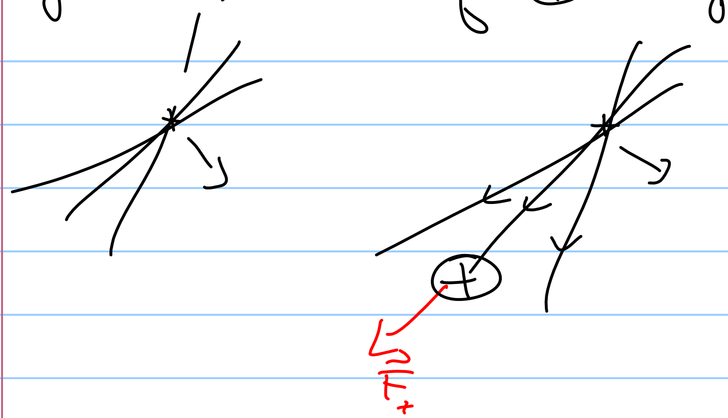
Gauss's law $\int \vec{E} \cdot d\vec{a} = \frac{Q_{encl}}{\epsilon_0}$

Q_{encl} is same as when charge is at rest

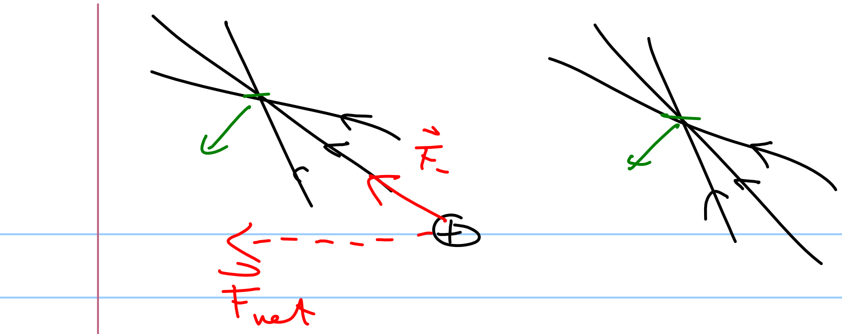
Ex:



go to rest frame of ⊕ charge



$v = 0 \Rightarrow q\, v \times B = 0$



Electrostatics $\qquad \vec E = -\vec\nabla V$

↑ scalar potential

Cons of energy $\quad \Delta(KE + PE) = W_{nc}$

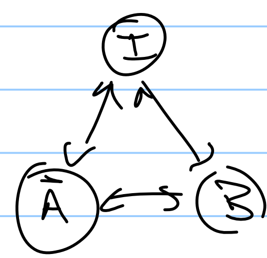
$\Delta PE = q\Delta V$

Now have

$\vec B$ but $\vec B$ does no work

$\vec B \equiv \vec\nabla \times \vec A$

↑ defines vector potential $\vec A$



$\boxed{\vec\nabla \cdot \vec B = 0}$ no charge magnetostatic $\quad \vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$

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

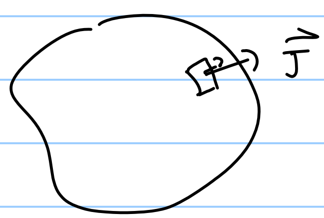
div of curl of any vector function $\equiv 0$

$$\left(\hat{i}\frac{\partial}{\partial x} + \hat{j}\frac{\partial}{\partial y} + \hat{z}\frac{\partial}{\partial z}\right) \cdot \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ B_x & B_y & B_z \end{vmatrix} \equiv 0$$

Cons. of charge

$$\vec{\nabla} \cdot \vec{J} = -\frac{\partial \rho}{\partial t} \quad \text{Div. Theorem} \quad \int \vec{\nabla} \cdot \vec{J}\, d\tau = \oint \vec{J} \cdot d\vec{a}$$

$$\int -\frac{\partial \rho}{\partial t}\, d\tau = -\frac{\partial Q_{encl}}{\partial t}$$



flux of J out of surface

$$\vec{J} \cdot d\vec{a}$$

$$\frac{\text{Coul}}{s \cdot m^2}\, m^2 = \frac{\text{Coul}}{s}$$

magnetostatic $\frac{dQ_{enc}}{dt} = 0 \Rightarrow \frac{\partial \rho}{\partial t} = 0 = \vec{\nabla} \cdot \vec{J}$