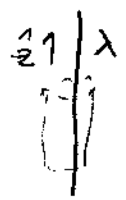
Fall 2001 #8 (Like 11,13)

Change coordinates so line charge is on z-axis

a) 

$\oint_S E \cdot da = 4\pi q$ $\quad \lambda = \frac{q}{L}$

$\underbrace{2\pi r L}_{A} E = 4\pi \lambda L$ $\quad E = \frac{2\lambda}{r}$

$$\boxed{\vec{E} = \frac{2\lambda}{\rho}\hat{\rho}} \leftarrow \text{polar coordinates}$$

b) Now line charge is moving with $\vec{v} = v\hat{z}$
Relativisticly

$\beta = \frac{\vec{v}}{c}$

Eq 559 Jackson

$E = \gamma(\vec{E}' - \beta \times B') - \frac{\gamma^2}{\gamma+1}\beta(\beta \cdot E')$ ($\hat{z} \cdot \hat{r}$)

$B = \gamma(B' + \beta \times E') - \frac{\gamma^2}{\gamma+1}\beta(\beta \cdot B')$

To change equation to find E', $E \to E'$, ect. $\beta \to -\beta$

$'$ means in objects rest frame

$B' = 0$

$\vec{E} = \gamma\vec{E}' = \frac{2\gamma\lambda}{\rho}\hat{\rho}$

$\vec{B} = \gamma\beta \times E' = \frac{2\gamma\beta\lambda}{\rho}\hat{\phi}$