SET 12

10.12)

Use the Jefimenko equations. For B;

$$\vec{B}(\vec{r},t) = \frac{\mu}{4\pi} \int d\tau' \, [\frac{\vec{J}(\vec{r}', t_{rt}) \times \vec{R}}{R^3} + \frac{\dot{\vec{J}}(\vec{r}', t_{rt}) \times \vec{R}}{R^2 c}]$$

Where $\vec{R} = \vec{r} - \vec{r}'$ and $t_{rt} =, t - R/c$. Use an expansion;

$$\vec{J}(\vec{r}, t_{tr}) = \vec{J}(\vec{r}, t_{tr}) + (t_{rt} - t)\dot{\vec{J}}(\vec{r}, t)$$

Insert this into the expression for $\vec{B}$ and assume that to 1^{st} order one can write $\dot{\vec{J}}(\vec{r}, t_{rt}) \approx \dot{\vec{J}}(\vec{r}, t)$. Cancel terms to obtain the result.

$$\vec{B}(\vec{r},t) = \frac{\mu}{4\pi} \int d\tau' \, [\frac{\vec{J}(\vec{r}', t) \times \vec{R}}{R^3}$$

10.15)

For a particle in hyperbolic motion along the $\hat{x}$ axis look at the 2-D plot of position vs time which forms the hyperbolia;

$$x = \sqrt{b^2 + (ct)^2}$$

A light ray moves in this 2-D space as a line with slope, c. The graphical solution is shown in the figure.

The light becomes visable when a right ray from a retarded point on the trajectory passes through the point x_0

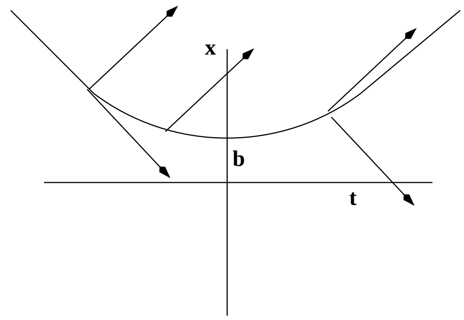

Figure 1: The geometry for problem 10.15

9.19)

The field of a point charge is;

$$\vec{E} = \frac{1}{4\pi\epsilon} \frac{1 - \beta(2}{[1 - \beta^2 \, sin^2(\theta)]^{3/2}} \frac{\hat{r}}{r^2}$$

For a continuium of point charges, let $q \rightarrow \lambda \, dx$.

$$sin(\theta) = d/r$$

$$dz/r^2 = d\theta/d$$

Substitute into the integral and project the field perpendicular to the wire as the horizontal component cancels. ther will be an additional $sin(\theta)$ in the numerator.

$$\vec{E} = \frac{1}{4\pi\epsilon}\lambda[1 - \beta^2] \int_0^\pi d\theta \, \frac{sin(\theta)}{[1 - \beta^2 \, sin^2(\theta)]^{3/2}}$$

Change variable to $u^2 = 1 - sin^2(\theta)$ and integrate to obtain;

$$E_\perp = \frac{1}{4\pi\epsilon} \frac{2\lambda}{d}$$

The magnetic field is a constant due to the constant current on the wire.

$$\vec{B} = \frac{I\mu}{2\pi d} \hat{\phi}$$

10.23)

The Lorentz gauge is $\vec{\nabla} \cdot \vec{A} = 1/c^2 \frac{\partial V}{\partial t}$

The potentials due of a point charge are;

$$V = \frac{1}{4\pi\epsilon} \frac{q}{r - \beta \cdot \vec{r}}$$

$$\vec{A} = \vec{\beta}/c\, V$$

In the problem $\vec{\nabla} \cdot \beta = 0$ substitute into the differential operators. there is much algebra, but the result is forhtcoming.