Assignment 6

1. See notes.

2. Transformation Eqns. are:

$$E'_z = E_z \qquad\qquad B'_z = B_z$$

$$E'_y = \gamma(v)\left(E_y + \frac{v}{c}B_x\right) \qquad\qquad B'_y = \gamma(v)\left(B_y - \frac{v}{c}E_x\right)$$

$$E'_x = \gamma(v)\left(E_x - \frac{v}{c}B_y\right) \qquad\qquad B'_x = \gamma(v)\left(B_x + \frac{v}{c}E_y\right)$$

If $\vec{B}' = 0 \Longrightarrow \quad B_y = \frac{v}{c}E_x$ and $B_x = -\frac{v}{c}E_y$

Since $\vec{v} = (0, 0, v) \Rightarrow \vec{B} = \frac{\vec{v}}{c} \times \vec{E}$.

For a motionless charge $\vec{E}' = \frac{q}{r'^2}\hat{r}'$ & $\vec{B}' = 0$.

Using $B_y = \frac{v}{c}E_x$ & $B_x = -\frac{v}{c}E_y$ we find that electric field is given by:

$$E'_z = E_z.$$

$$E'_y = \gamma(v)\left(E_y - \frac{v^2}{c^2}E_y\right) = \gamma(v)^{-1}E_y.$$

$$E'_x = \gamma(v)\left(E_x - \frac{v^2}{c^2}E_x\right) = \gamma(v)^{-1}E_x.$$

$$\therefore \; E_x = \gamma(v)E'_x$$
$$E_y = \gamma(v)E'_y$$
$$E_z = E'_z$$

$$\therefore \quad \vec{B} = \frac{\vec{v}}{c} \times \vec{E}$$

$$= \frac{\vec{v}}{c} \times \left(\gamma(v) E_x', \gamma(v) E_y', E_z \right)$$

where $\vec{E}' = \frac{q}{r'^2} \hat{r}'$