A point charge is at rest at the origin of frame $\mathcal{F}'$, which moves with velocity $v = v \hat{i}$ relative to frame $\mathcal{F}$. In frame $\mathcal{F}'$, the point charge generates the electrostatic field,

$$E'(x') = \frac{q}{4\pi\epsilon_0|x'|^3},$$

and no magnetic field: $B'(x') \equiv 0$.

(a) Use the Lorentz transformation for the position and field vectors to determine the electric field $E(x, t)$ and magnetic field $B(x, t)$ observed in frame $\mathcal{F}$.

(b) Describe in words the direction, orientation, and shape of the electric and magnetic field lines in frame $\mathcal{F}$. Show graphical evidence for your description.

(c) Describe in words the shape of contour lines of electric and magnetic field strengths (i) in the $yz$-plane and (ii) in the $xz$-plane. Show graphical evidence for your description.

Solution: