8/12/13
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Solution to Problem 7.34

$$\vec{E}(\vec{r},t) = -\frac{q}{4\pi\epsilon_0}\frac{\theta(vt-r)\hat{r}}{r^2} \quad \& \quad \vec{B}(\vec{r},t) = 0$$

* the only eqns we can "check" are the ones without sources

* Eqn (ii) $\vec{\nabla}\cdot\vec{B} = 0$

* Eqn (iii) $\vec{\nabla}\times\vec{E} = 0$ because $\vec{E} = -\vec{\nabla} V$ where $V = -\frac{q}{4\pi\epsilon_0}\Big[\frac{\theta(vt-r)}{r} + \frac{\theta(r-vt)}{v \cdots}$

$$= -\frac{\partial \vec{B}}{\partial t}$$

* Eqn (i) really fixes $\boxed{\rho = \epsilon_0 \vec{\nabla}\cdot\vec{E} = -q\delta^3(\vec{r}) + \frac{q}{4\pi r^2}\delta(vt-r)}$

* Eqn (iv) fixes $\boxed{\vec{J} = \frac{1}{\mu_0}\vec{\nabla}\times\vec{B} - \epsilon_0\frac{\partial\vec{E}}{\partial t} = \frac{q\,v\,\delta(vt-r)}{4\pi r^2}\hat{r}}$

* this represents the creation of a negative point charge at the origin at $t=0$ with positive spherical shell expanding at speed v