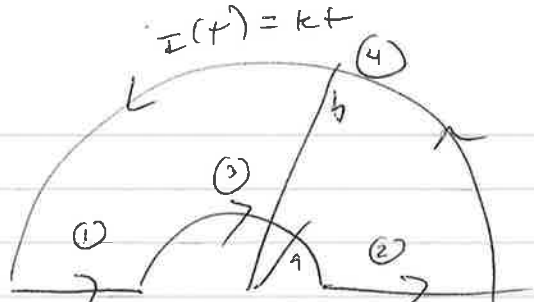
m12e3




$$t_r = t - \frac{r}{c}$$

$$V(r,t) = \frac{1}{4\pi\epsilon_0}\int \frac{\rho(\vec r\,', t_r)}{r}\, d^3 r' \qquad \vec A = \frac{\mu_0}{4\pi}\int \frac{\vec J(\vec r\,', t_r)}{r}\, d^3 r'$$

$= 0.$

$$\vec E = -(\nabla V + \dot{\vec A}), \quad \vec B = \vec\nabla \times \vec A.$$

$= -\dot{\vec A}$ (at origin)

$|x| = -x$

$$① \quad \vec A = \frac{\mu_0}{4\pi}\hat x\int_{-b}^{-a} \frac{k(t + x/c)}{-x}\, dx = \frac{\mu_0 k}{4\pi}\left[\cancel{t \log\left(\frac{a}{b}\right)} + \cancel{\frac{1}{c}(-a+b)}\right]\hat x$$

$$② \quad \vec A = \frac{\mu_0}{4\pi}\hat x\int_{a}^{b} \frac{k(t - \frac{x}{c})}{x}\, dx = \frac{\mu_0 k}{4\pi}\left[\cancel{t \log\left(\frac{b}{a}\right)} - \cancel{\frac{1}{c}(b-a)}\right]\hat x$$

pick out $\hat x$ component only, $\hat y$ cancels by symm

$$③ \quad \vec A = \frac{\mu_0}{4\pi}k\hat x\int_0^{\pi} \frac{(t - \frac{a}{c})}{a}\, a\, d\theta \sin\theta = \frac{\mu_0 k}{4\pi}\left(2\left(t - \frac{a}{c}\right)\right)\hat x$$

$$④ \quad \vec A = -\frac{\mu_0 k}{4\pi}\left(2\left(t - \frac{b}{c}\right)\right)\hat x$$

same as ③ with sign change, and $a \to b$.

$$\vec A_{tot} = \cancel{\frac{\mu_0 k}{2\pi c}(b-a)}\,\hat x \to \dot{\vec A} = 0 \to \vec E = 0$$

① + ② add instead of subtract $\rightarrow \dfrac{2\mu_0 k}{4\pi}\left(t \log\left(\dfrac{b}{a}\right) - \dfrac{(b-a)}{c}\right)\hat x$

thus $-\dot{\vec A} = -\dfrac{2\mu_0 k}{4\pi}\log\left(\dfrac{b}{a}\right)\hat x = \vec E.$