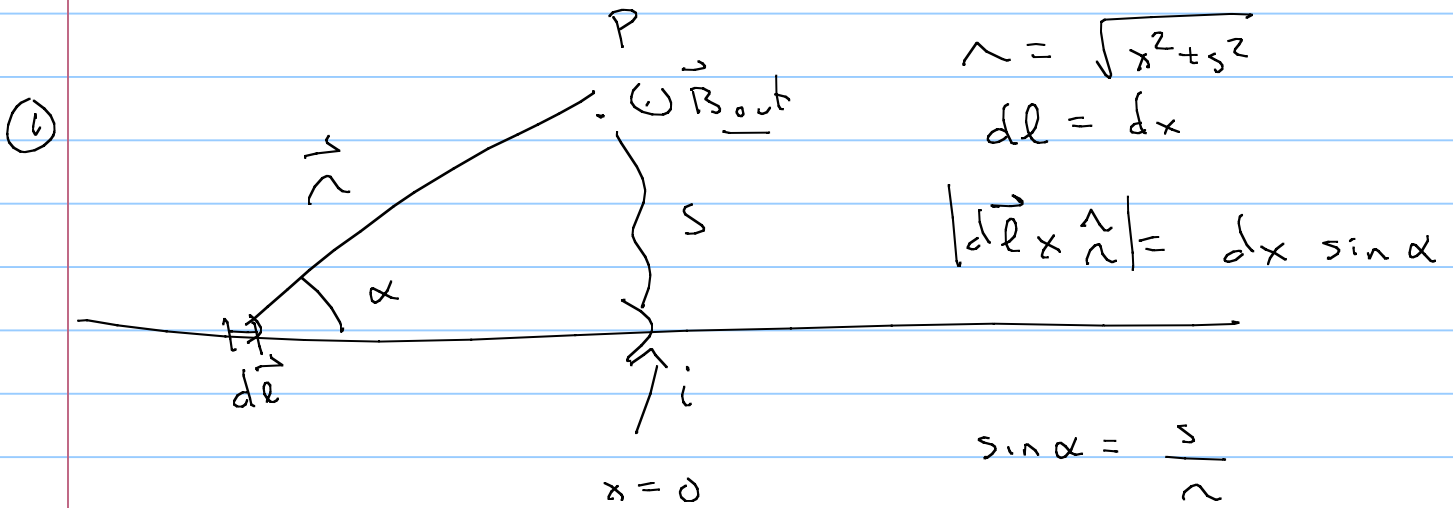


Quiz 3 Solutions

Note Title

4/6/2011



$d\vec{l} \times \hat{r}$ is out for all segments $d\vec{l}$ along line

$$|B| = \frac{\mu_0 i}{4\pi} \int \frac{|d\vec{l} \times \hat{r}|}{r^2} = \frac{\mu_0 i}{4\pi} \int_{-\infty}^{\infty} \frac{s dx}{(x^2 + s^2)^{3/2}}$$

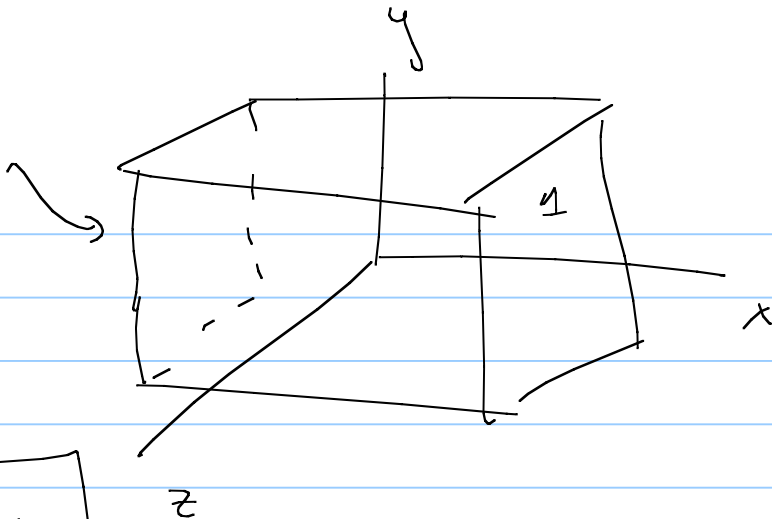
$$|B| = \frac{\mu_0 i s}{4\pi} \left[\frac{x}{s^2 \sqrt{x^2 + s^2}} \right]_{x=-\infty}^{x=+\infty}$$

$$|B| = \frac{\mu_0 i}{4\pi s} [+1 - (-1)]$$

$$\boxed{|B| = \frac{\mu_0 i}{2\pi s}}$$

(2)

$$\vec{P} = kx \hat{x}$$



$$\rho_b = -\nabla \cdot \vec{P} = -k$$

$\sigma_b = 0$ on all sides except 1 + 2

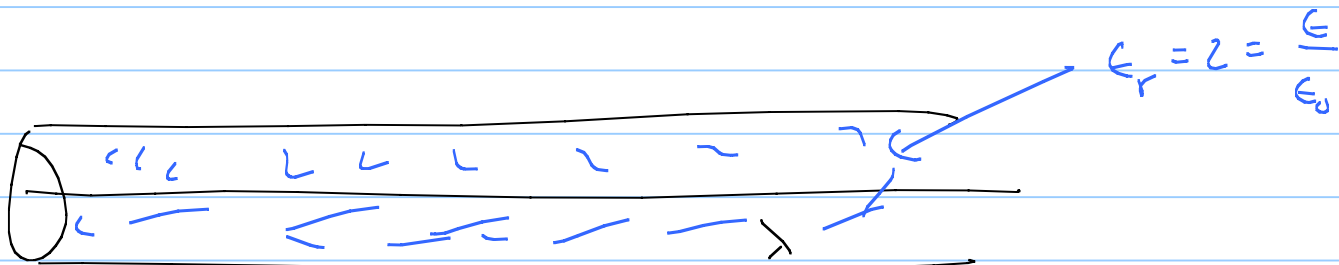
side 1: $\hat{n} = +\hat{x}$, $x > 0 \Rightarrow x = +\frac{s}{2}$ (say)

$$\sigma_b^1 = \vec{P} \cdot \hat{n} \Big|_{x = +\frac{s}{2}} = +k \frac{s}{2}$$

side 2: $\hat{n} = -\hat{x}$, $x < 0 \Rightarrow x = -\frac{s}{2}$

$$\sigma_b^2 = \vec{P} \cdot \hat{n} = +k \frac{s}{2}$$

(3)



$$\oint \vec{D} \cdot d\vec{a} = Q_{\text{free}} \Rightarrow D(2\pi s L) = Q_{\text{free}} \Rightarrow D = \frac{\lambda}{2\pi s}$$

$$\vec{E} = \frac{\vec{D}}{\epsilon} = \begin{cases} \frac{\lambda}{2\pi \epsilon_0 s} & s > a \\ \frac{\lambda}{2\pi \epsilon s} = \frac{\lambda}{4\pi \epsilon_0 s} & s < a \end{cases}$$