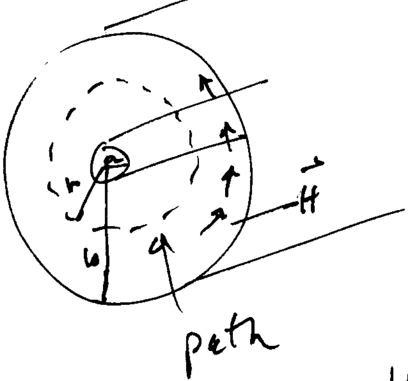
Name ....

Quiz [redacted] 15
PH361

$\overrightarrow{p} = \int \overrightarrow{r'} \rho(r') d\tau'$
solenoid $\quad B = \mu_0 n I$
$\overrightarrow{F} = (\overrightarrow{p} \cdot \overrightarrow{\nabla})\overrightarrow{E}$
$E = \frac{1}{4\pi\epsilon_0}\frac{1}{r^3}(3\overrightarrow{p}\cdot\hat{r}\,\hat{r} - \overrightarrow{p})$
$\overrightarrow{\nabla} t = \frac{\partial t}{\partial r}\hat{r} + \frac{1}{r}\frac{\partial t}{\partial \theta}\hat{\theta} + \frac{1}{r\sin\theta}\frac{\partial t}{\partial \phi}\hat{\phi}$
$\hat{r} = \sin\theta\cos\phi\ \hat{x} + \sin\theta\sin\phi\ \hat{y} + \cos\theta\ \hat{z}$
$\hat{\theta} = \cos\theta\cos\phi\ \hat{x} + \cos\theta\sin\phi\ \hat{y} - \sin\theta\ \hat{z}$
$\hat{\phi} = -\sin\phi\ \hat{x} + \cos\phi\ \hat{y}$
$\overrightarrow{D} = \epsilon_0\overrightarrow{E} + \overrightarrow{P}$
$\overrightarrow{D} = \epsilon\overrightarrow{E}$
$\overrightarrow{F} = q\overrightarrow{v} \times \overrightarrow{B}$
$\overrightarrow{dF} = I\overrightarrow{dl} \times \overrightarrow{B} = \overrightarrow{K} \times \overrightarrow{B} da = \overrightarrow{J} \times \overrightarrow{B} d\tau$
$\overrightarrow{dA} = \frac{\mu_0}{4\pi}\int \frac{I}{|\overrightarrow{r} - \overrightarrow{r'}|} d\overrightarrow{l'} = \frac{\mu_0}{4\pi}\int \frac{J(\overrightarrow{r'})}{|\overrightarrow{r} - \overrightarrow{r'}|} d\tau'$
$W = \frac{1}{2\mu_0}\int_{all\ space} B^2 d\tau$
$\overrightarrow{\nabla} \times \overrightarrow{H} = \overrightarrow{J_f}$ ⇒ Stokes ⇒ $\oint \vec{H}\cdot d\vec{l} = \int \vec{J}_f \cdot d\vec{a} = I_{encl,free}$
$\overrightarrow{M} = \chi_m \overrightarrow{H}$

1. A coaxial cable consists of two very long cylindrical tubes, separated by linear insulating material of magnetic susceptibility χ_m. A current flows uniformly down the inner conductor and returns along the outer one. Derive an expression for $\overrightarrow{B}$ in the region between the tubes.



$\oint \vec{H}\cdot d\vec{l} = I_{encl,f} \equiv I$

$\vec{H}$ is in $\hat{\phi}$ direction; $d\vec{l}$ " " " " $\Rightarrow \oint \vec{H}\cdot d\vec{l} = H 2\pi r$

$H 2\pi r = \frac{I}{\cancel{2\pi}}$ for $b > r > a$

$H = \frac{I}{2\pi r}$; $\vec{B} = \mu\vec{H} = \mu_0(1+\chi_m)\vec{H}$

$$\vec{B} = \frac{\mu_0}{2\pi}\frac{(1+\chi_m) I}{r}\hat{\phi}$$