EM Ch 5 HW - Magnetostatics - weeks 6-7 Fall 2002

due 11 Nov: worksheet on Ex 5.2

#1, 2(a, b), 3-5, 12, 13
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due 18 Nov: find $\bar{B}(\bar{r})$ for #13, do #10 (a) p. 220

#15, 31 (a), 39 (12)

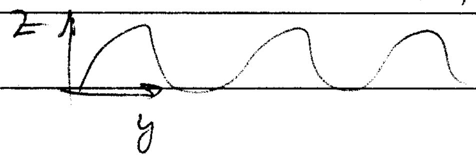
#1: $mv = p = qBR$ and $R = \frac{a^2+d^2}{2d}$

2a: $\bar{V}(0) = \frac{E}{B}\hat{j}$, $\bar{E} = E\hat{k}$, $\bar{B} = B\hat{i}$ $\rightarrow x(t) = z(t) = 0$

$y(t) = \frac{E}{B}t$

2b: $\bar{V}(0) = \frac{E}{2B}\hat{j} \rightarrow y(t) = \frac{Et}{B} - \frac{E}{2B\omega}\sin\omega t$

$z(t) = \frac{E}{2B\omega} - \frac{E}{2B\omega}\cos\omega t$



#3 (a) $V = \frac{E}{B}$, (b) $\frac{q}{m} = \frac{E}{B^2R}$

#4 Force on square loop $\vec{F} = Ika^2\hat{z}$

#5 (a) $K = \frac{I}{2\pi a}$

(b) $J = \frac{I}{2\pi a s}$

(c) $I = \frac{2\pi k}{3}r^3$

EM Ch 5 HW continued...

#12 → → $\frac{F_E}{l} = \lambda_1 E_2$ where $E_2 = \frac{\lambda_2}{2\pi\epsilon_0 d}$, $\frac{F_M}{l} = |\bar{I}_1 \times \bar{B}_2|$ where $I_1 = v\lambda$

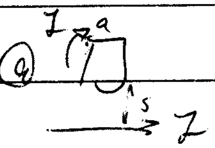
220 and $B_2 = \frac{\mu_0 I_2}{2\pi d}$

$\frac{F_E}{l} = \frac{F_M}{l} \to v^2 = \frac{1}{\mu_0 \epsilon_0} = c^2$

#13 (a) $\bar{B}(r>a) = \frac{\mu_0 I}{2\pi r}\hat{\varphi}$, $B(r<a) = 0$

231 (b) $\int J \cdot da = I = \int kr \cdot r\,dr\,d\theta = 2\pi k \frac{r^3}{3} \to \bar{B}(r<a) = \frac{\mu_0 k r^2}{3}\hat{\varphi}$

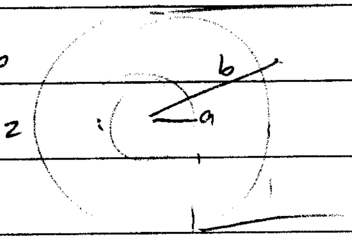
$I_{tot} = 2\pi k \frac{a^3}{3}$ $\quad$ $\bar{B}(r>a) = \frac{\mu_0 I_{tot}}{2\pi r}\hat{\varphi}$

#10 (a) 

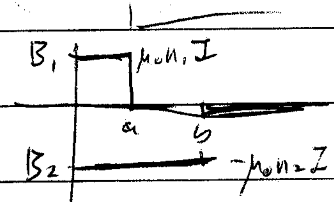
220 $B(s) = \frac{\mu_0 I}{2\pi s}$ $\quad$ $F_{bottom} = IaB(s) = Ia\frac{\mu_0 I}{2\pi s}$ ↑

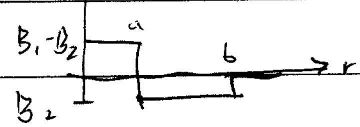
$F_{top} = IaB(a+s) = Ia\frac{\mu_0 I}{2\pi(a+s)}$ ↓

$\bar{F}_{tot} = \bar{F}_{bot} + \bar{F}_{top}$

#15 Solenoids 

231 $B_{out} = 0$, $B_{in} = \mu_0 N I$



If $n_1 > n_2$, then: 

#31 Ex 1: Solenoid: $\vec{B}_{in} - \vec{B}_{out} = \mu_0 N I \hat{z} = \mu_0 \vec{K} \times \hat{n}$ ✓

242 Current/length $\vec{k} = NI\hat{\theta}$, $\hat{n} = \hat{r}$

#39 (a) $\vec{v} \rightarrow \odot B$ (b) $\vec{F} = q\vec{E} + q\vec{v} \times \vec{B} = 0$ when $\vec{v} \times \vec{B} = -\vec{E} = -\nabla V$

247 $\Delta V = vBt$ (velocity) (potential)