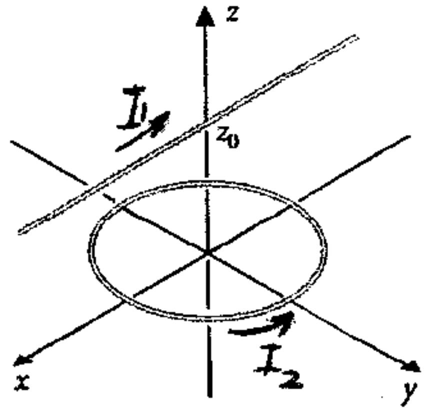
PHYS 230 SOLUTIONS - PROB. SET 9 F04

1. (29-37)



Force on Right-hand part of coil

$= I_2 \vec{l} \times \vec{B} = -I_2 l B \hat{j}$

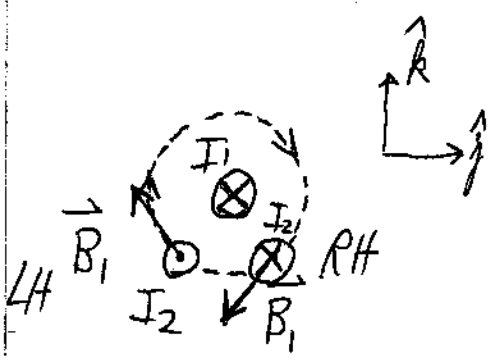
Force on Lft. part $= -I_2 l B \hat{j}$

Thus $\vec{F}_{net} = -F\hat{j}$

Get torque from $\vec{\tau} = \vec{m} \times \vec{B}$

$\vec{m} = m\hat{k} \quad \vec{B}_{at\ \vec{m}} = -B\hat{j}$

Thus $\vec{\tau} = \tau \hat{i}$



→ Answer **e**

2. (29-40)

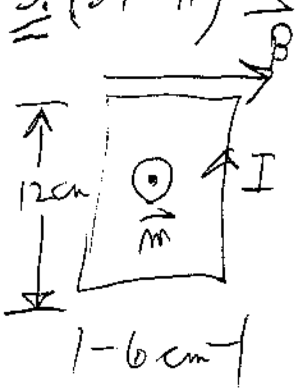
$\vec{l} = (1.2 \times 10^{-2} m)\hat{i}$

$\vec{B} = 4.5 \times 10^{-2} T (\hat{i} + \hat{j})$

$\vec{F} = I \vec{l} \times \vec{B} = (4.3 \times 10^{-3} A)(1.2 \times 10^{-2} m) \cdot (4.5 \times 10^{-2} T)\hat{k}$

$= \boxed{2.3 \times 10^{-6} N \hat{k}}$

3. (29-41)



$$A = (6\times10^{-2}\,m)(12\times10^{-2}\,m) = 7.2\times10^{-3}\,m^2$$

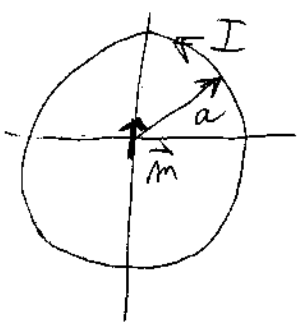
$$m = NIA = 6(1.1A)(7.2\times10^{-3}\,m^2)$$

$$\tau = |\vec{m}\times\vec{B}| = NIAB\sin 90^\circ$$

$$= 6(1.1A)(7.2\times10^{-3}\,m^2)(0.25T)$$

$$= \boxed{1.2\times10^{-2}\,N\cdot m\text{ ; direction } \hat{m}\times\hat{B}}$$

4. (29-68)



$$\vec{B}\text{ at origin from coil} = \frac{\mu_0 I a^2}{2a^3}\hat{k}$$

$$\tau = |\vec{m}\times\vec{B}| = \frac{m\mu_0 I}{2a}\sin 90^\circ$$

$$= \frac{(1.0\times10^{-4}\,A\cdot m^2)(4\pi\times10^{-7}\,\frac{N\cdot m}{A^2})(10^{-3}\,A)}{2(12\times10^{-2}\,m)}$$

$$= \boxed{5.2\times10^{-13}\,N\cdot m}$$

5. (29–10)
a) No – Diamagnetic materials have negative χ
b) No – Large and positive for ferromagnetic
c) No – Diamagnetic response not temp. dependent
d) No – Generally $\approx 10^{-6}-10^{-5}$
e) Yes

6. (29–11)

$H = 1.00000 \times 10^{2}\ A/m$

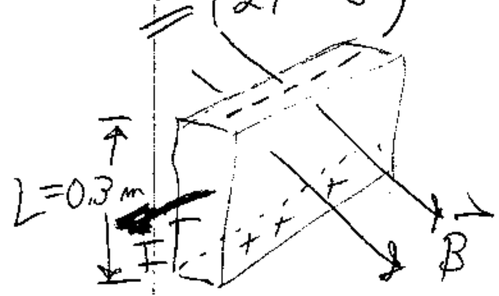
$M = \chi_m H = 2.8\times10^{-4}(1.0\times10^{2}\ \frac{A}{m}) = \boxed{2.8\times10^{-2}\ A/m}$

$\vec{B} = \mu_0(1+\chi_m)H$

$= (4\pi\times10^{-7}\ \frac{T\cdot m}{A})(1+2.8\times10^{-4})(1.00\times10^{2}\ \frac{A}{m})$

$= \boxed{1.25699\times10^{-4}\ T}$

7. (29–50)



$B = 1T$

$V_d = 10^{-5}\ m/s$

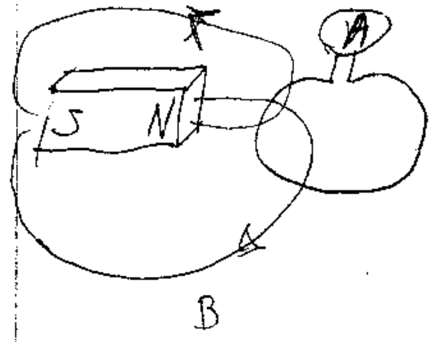
$|\Delta V_H| = V_d B_\perp L$

$= (10^{-5}\ \frac{m}{s})(1T)(0.3\ m)$

$= 3\times10^{-6}\ \frac{Wb}{s} = \boxed{3\times10^{-6}\ V}$

Top negative relative to bottom

8. (30-2)



The net flux through the loop is ≈ 0 both before and after the magnet is reversed, so $\frac{d\Phi_B}{dt} \cong 0$ and $\mathcal{E}_{ind} \cong 0$

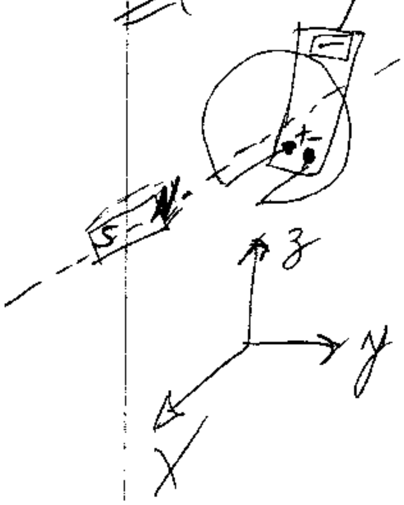
Answer (e) (b) on-line

9. (30-3) $\Phi_B = (1\ mWb)(At^4 + \cos \omega t)$

$$\mathcal{E} = -\frac{d\Phi_B}{dt} = -(1\ mWb)\left[4At^3 - \omega \sin(\omega t)\right]$$

$$= (0.4V)\sin\left[\left(400\ \tfrac{rad}{s}\right)t\right] - (4\times10^{-7}V)\frac{t^3}{s^3}$$

10. (30-17)



Initially the Φ_B through the loop is in the $+x$ direction. At the end Φ_B is in the $-x$ direction. Thus $\mathcal{E}_{ind} = -\frac{d\Phi_B}{dt}$ gives a counterclockwise current in the loop; ammeter reads (+) during rotation

Answer (c) (e) on-line