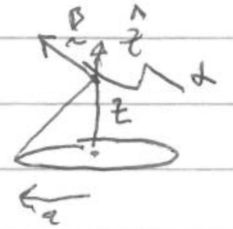
#1.

USE RESULT FROM EX. 5.6
SURFACE CURRENT DENSITY
$\underset{\sim}{K}$ ACTS AS SOLENOIDAL
CURRENT

$$\underset{\sim}{K} = \underset{\sim}{M} \times \hat{n} = M \hat{\varphi}$$



$$d\underset{\sim}{B} = \overset{\mu_0/4\pi}{\frac{I\,d\ell \cos\alpha}{(a^2+z^2)}}\ \hat{z}$$

$$dB = \frac{\mu_0}{4\pi} \frac{I\,d\ell\ a}{(a^2+z^2)^{3/2}} \qquad w/ \cos\alpha = a/(a^2+z^2)^{1/2}$$

$$B = \frac{\mu_0}{4\pi} \frac{I \cdot 2\pi a^2}{(a^2+z^2)^{3/2}}$$

$$\underset{\sim}{B} = \frac{\mu_0 I a^2}{2(a^2+z^2)^{3/2}}\ \hat{z}$$

BREAK L INTO STACK OF RINGS, EACH OF THICKNESS ds

$\Rightarrow I = K\,ds$

INTEGRATE OVER ALL RINGS.

#7 CONT.

$$\underset{\sim}{B} = \int_{s=0}^{L} \frac{\mu_0 M ds\; a^2}{2\left(a^2 + (z+s)^2\right)^{3/2}} \hat{z}$$

Let $q = z + s$, $dq = ds$, z FIXED, MEASURED FROM TOP OF CYLINDER.

$$\underset{\sim}{B} = \int_{z}^{L+z} \frac{\mu_0 M a^2 \, dq}{2(a^2+q^2)^{3/2}}$$

$$= \frac{\mu_0 M a^2}{2} \left[\frac{q}{a^2 (a^2+q^2)^{1/2}} \right] \Bigg|_{z}^{L+z}$$

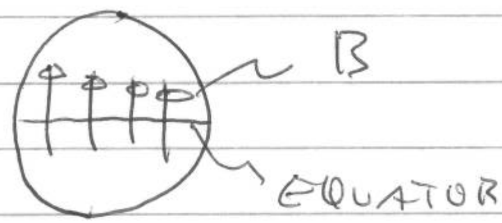
$$\boxed{\underset{\sim}{B} = \frac{\mu_0 M}{2} \left[\frac{L+z}{(a^2 + (L+z)^2)^{1/2}} - \frac{z}{(a^2+z^2)^{1/2}} \right] \hat{z}}$$

NOTE THAT FOR z FIXED, $L \to 0$, $B \to 0$

ALSO, FOR $z = 0$, $\lim_{L \to \infty} B = \frac{\mu_0 M}{2}$

APPROPRIATE FOR LONG SOLENOID.

#2.



FLUX THROUGH EQUATOR FIXED

$$B_1 r_1^2 = B_2 r_2^2$$

$$B_2 = B_1 \left(r_1 / r_2 \right)^2$$

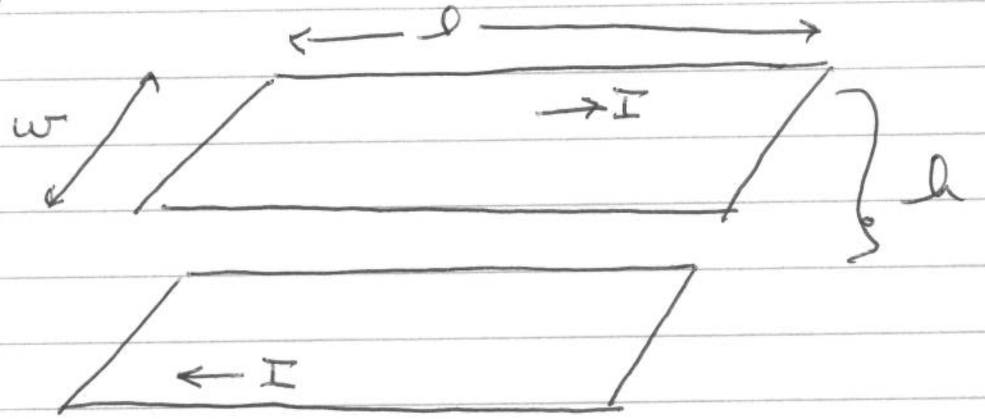
$$= 10^{-2}\,T \left(10^6 / 5 \right)^2$$

$$\boxed{B_2 = 4 \times 10^8\ T}$$

#3.

THE TEMP OF EARTH'S CORE ($T \simeq 5500$ C) GREATLY EXCEEDS Fe's CURIE TEMPERATURE ($T \sim 770$ C). HENCE DOMAINS ARE COMPLETELY RANDOMLY ORIENTED.

#4



(a) ON EDGE, STRIPS LOOK LIKE A PAIR OF PLATES SIMILAR TO A PARALLEL PLATE CAPACITOR.

$$C = \varepsilon_0 A/h = \varepsilon_0 w l/h$$

$$\Rightarrow \boxed{\mathcal{C} = C/l = \varepsilon_0 w/h}$$

(b) $\mathcal{L} = L/l$ & $\phi = LI = BA = Bhl$

NOTE THAT B IS ONLY BETWEEN STRIPS. USE AMPERE'S LAW

$$\oint \vec{B}\cdot d\vec{l} = \mu_0 I_{enc}$$

$$Bw + Bw = \mu_0 Kw$$

$$B = \mu_0 K/2 \quad \text{(1-STRIP)}$$

$$B = \mu_0 K \quad \text{(SUM 2 STRIPS)}$$

#4 CONT.

(b) but $K = I/w$

$B = \mu_0 I/w$

so,

$$\phi = \mu_0 \frac{I}{w} h \ell = LI$$

$$\Rightarrow L = \mu_0 h \ell / w$$

$$\Rightarrow \boxed{\mathcal{L} = L/\ell = \mu_0 h/w}$$

(c) $\mathcal{L}\,\mathcal{C} = (\mu_0 h/w)(\varepsilon_0 w/h)$

$$\boxed{\mathcal{L}\,\mathcal{C} = \mu_0 \varepsilon_0}$$

$$\boxed{\text{NUMERICALLY, } \mathcal{L}\,\mathcal{C} = 1.1 \times 10^{-17}\ s^2/m^2}$$

NOTE THAT $v = 1/\sqrt{\mathcal{L}\,\mathcal{C}} = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$

$$v = 3.0 \times 10^{8}\ m/s$$

LOOK FAMILIAR?

#4 CONT.

(d) $\varepsilon \to \varepsilon_0$

$\mu_0 \to \mu$

So,

$$\boxed{\begin{aligned} LC &= \varepsilon\mu \\ v &= \frac{1}{\sqrt{\varepsilon\mu}} \end{aligned}}$$