6.4

$H = I / 2\pi r$

$H = (1A) / 2\pi (1m)$

$\approx .16\ A/m$

$F = IL \times B$

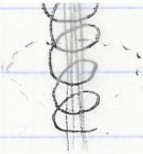
$= (1A)(1m)\left(\frac{1A}{2\pi m}\right) / \mu$

$\boxed{= 2 \times 10^{-7}\ N}$

.3A

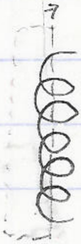
↙ vertical

field is Flat internally



Can we assume 0 External Field???

~~$\oint I = \int H = N/l \; I$~~



Inner like [illegible]

$$\oint H\,dl = \int_S \left(\vec{J} + \frac{\partial D}{\partial t}\right)\cdot dA$$

(with $\frac{\partial D}{\partial t}$ struck out, → 0)

$$\downarrow$$

$$Hl = NI$$

$$H = \frac{N}{l} I$$

Zero net current

Internal	Radial	$\emptyset$
	Axial	NI/l
	Circumferential	$\emptyset$ -
External	Radial	$\emptyset$ - vanishes with ∞ length
	Axial	$\emptyset$ -
	Circumferential	$I/2\pi R$

5.2A

E field strength = V/d

$\oint E \cdot dA = Q/\varepsilon$

$VA/d = Q/\varepsilon$

$\boxed{Q/V = A\varepsilon_0/d}$

5.2B

$\oint H \cdot dl = \int_S \left(\vec{J} + \frac{\partial D}{\partial t}\right) \vec{dA}$

$\oint H \cdot dl = \emptyset$

$\emptyset = \int_S \left(\vec{J} + \frac{\partial D}{\partial t}\right) dA$

$\boxed{\int_S J \cdot dA = -\int_S J \frac{\partial D}{\partial t} dA}$

5.2C

Energy $= \int \varepsilon |E|^2/2$

$= (Ad)\,\varepsilon \left|V/d\right|^2/2$

$= A/d\,\varepsilon\, V^2/2$

$\boxed{\text{Energy} = C V^2/2}$

5.2D

$10V \cdot 10A \cdot 3600s = 360kJ$

$\frac{1}{2} \frac{A}{d} \varepsilon V^2 = 360kJ$

$\rightarrow 720cF$

$A = 360kJ \cdot 2/(10V)^2\, d/\varepsilon$

$\boxed{A = 8.13 \times 10^8\ m^2}$

$N = A/(.1)^2$

$N = 8 \times 10^{11}$

$\text{Height} = 8 \times 10^{11} \cdot 1 \times 10^{-6}\ m$

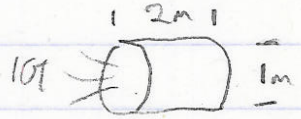
$\boxed{= 8 \times 10^5\ m}$

5.3b

$$\text{Energy} = \frac{1}{2} H^2 V_m$$

$$= \frac{1}{2} \left(\frac{N}{\ell} I\right)^2 \pi r^2 \ell_m$$

$$= \frac{1}{2} I_m^2 (\pi r^2 N^2 / \ell)$$



5.3c

$$10T = N/\ell_m I$$

$$IN = 16 \times 10^5 \text{ Amp turns}$$

$$F = I L \times B$$

$$2m \cdot 1.6MA \quad 10T$$

8 MPa

$$P \cdot A = 8MPa \cdot 2m \cdot 2\pi \cdot 1m$$

100 MN

65 A

$E = \sqrt{\text{Intensity} \cdot Z_0}$

$\sqrt{1\ kW/m^2} \cdot \sqrt{\mu_0/\varepsilon_0} = 377\ \Omega$

614 V/m

$\sqrt{1\ W/(mm)^2} \cdot 377\ \Omega$

19,416 V/m

$\sqrt{1\ W/\mu m^2} \cdot 377\ \Omega$

19 MV/m

. Square root of 2 everywhere