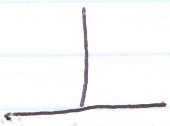
FERNANDO HERNANDEZ
CHAPTE #6

Homework #1 - CH-6

6-1

$V = 200V$
$d = 5 mm$



$$E = \frac{V}{d} = \frac{200V}{5 \times 10^{-3} m} = \boxed{40{,}000 \, V/m}$$

6-2

$V = 60V$
$d = 0.4 in = 1.016 cm$

$$E = \frac{V}{d} = \frac{60}{1.016 \times 10^{-2}} = \boxed{5905.5 \, V/m}$$

6-3

$E = 2 kV/m$

$d = 4 cm$

$$E = \frac{V}{d} \Rightarrow V = Ed$$

$$V = \left(\frac{2 \times 10^{3} V}{m}\right)\left(4 \times 10^{-2} m\right) = \boxed{80V}$$

6-4)

$E = 200 V/mm$

$d = 8 mm$

$V = Ed = \left(\frac{200V}{mm}\right)(8mm) = 1600 V$

6-5)

$I = 5A$
$d = 3m$

$H = \frac{I}{2\pi d} = \frac{5A}{2\pi(3)} = 0.2653 A/m$

6-6)

$I = 40 mA$
$d = 5ft$

$d = 5ft = 1.524 m$

$H = \frac{40 x 10^{-3} A}{2\pi(1.524)} = 4.18 x 10^{-3} \frac{A}{m}$

6-7)

$E = \frac{2KV}{m}$ => Problem 6-3

$\epsilon = 2.25$

$\epsilon = \epsilon_r * \epsilon_0 = (2.25)(8.842 \times 10^{-12}) = 19.895 \times 10^{-12}$ F/m

$D = \epsilon E = (~~2.25~~)\left(\frac{2KV}{m}\right) = 4500\ C/m^2$

$D = (19.895 \times 10^{-12}\ F/m)\left(\frac{2KV}{m}\right) = 39.79n\ C/m^2$

6-8)

$E = \frac{200V}{mm} = \frac{200V}{1 \times 10^{-3} m} = \frac{200KV}{m}$

$\epsilon = 1$ => air

$D = \epsilon E = (8.84 \times 10^{-12})\left(\frac{200KV}{m}\right) = 1.768 \times 10^{-2}\ \mu C/m^2$

6-9)

$H = 0.2653\ A/m$

$d = 3m$

$\mu(air) = 1.2566 \times 10^{-6}\ H/m$

$B = \mu H = (1.2566 \times 10^{-6}\ \frac{H}{m})(0.2653) =$

$B = 3.33 \times 10^{-7}\ Wb/m^2$

6-10)

$H = 4.18 \times 10^{-3} \frac{A}{m}$ => Prob. 6-6

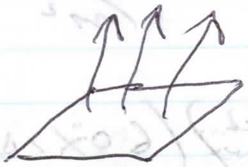
$l = 5 ft = 1.524 m$

$\mu(air) = 1.2566 \times 10^{-6} \frac{H}{m}$

$B = \mu(H) = (1.2566 \times 10^{-6})(4.18 \times 10^{-3} \frac{H}{m})$

$B = 5.25 \times 10^{-9} Wb/m^2$

6-11)



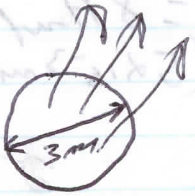
$E = 4 \mu C/m^2$

$A = 8 m \times (75 \times 10^{-2} m) = 6 m^3$

$\epsilon = 8.842 \times 10^{-12} F/m$

$\Psi = EA = (4 \times 10^{-6})(6) = 2.4 \times 10^{-5} C$

6-12) $E = 8 \frac{\mu C}{m^2}$



$A = \pi r^2 = \pi (\frac{D}{2})^2 = \pi (\frac{3}{2})^2 = 7.07 m^2$

$\Psi = EA = (8 \times 10^{-6} \frac{C}{m^2})(7.07 m^2) = 5.65 \times 10^{-5} C$

6-13)

$B = 4\,m\frac{Wb}{m^2}$

$A = \pi r^2$

$A = \pi 5^2 =$

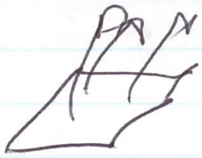
$A = 78.5\,m^2$

$\Phi = BA = \left(4\times10^{-4}\frac{Wb}{m^2}\right)(78.5\,m^2)$

$\boxed{\Phi = 3.14\times10^{-7}\,Wb}$

6-14)

$B = 12\,m\,Wb/m^2$



$A = (30\times10^{-2})(60\times10^{-2}) = 0.18\,m^3$

$\Phi = BA = (12\times10^{-9})(0.18) = \boxed{2.16\times10^{-9}\,Wb}$

6-15)

$I = 8\,Amp.$

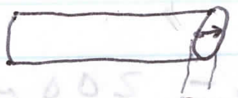
$A = (5\times10^{-3}\,m)(4\times10^{-3}\,m) = 2\times10^{-5}\,m^2$

$J = \frac{I}{A} = \frac{8A}{2\times10^{-5}\,m^2} = \boxed{4\times10^{5}\,A/m^2}$

6-16)

$I = 4\ A$

$A = \pi r^2 = \pi\left(\frac{D}{2}\right)^2$



$= \pi\left(\frac{3\times10^{-2}}{2}\right)^2 = 7.06\times10^{-4}\ m^2$

$J = \frac{I}{A} = \frac{4\ A}{7.06\times10^{-4}\ m^2} = 5658.8\ \frac{A}{m^2}$

6-17)

$\sigma = 5MS/m =$

$J = 4\times10^5\ \frac{A}{m^2}$

$J = \sigma E$

$E = \frac{J}{\sigma} = \frac{4\times10^5\ \frac{A}{m^2}}{5MS/m} = 0.08\ \frac{V}{m}$

$5MS/m = 5\times10^6\ S/m$

6-18)

$\sigma = 6\times10^7\ S/m$

$J = 5658.8\ \frac{A}{m^2}$

$J = \sigma E$

$E = \frac{J}{\sigma} = \frac{5658.8\ \frac{A}{m^2}}{6\times10^7\ S/m} = 9.4\times10^{-5}\ \frac{V}{m}$

6-19)

(rms) $H_y = 200\ \mu A/m$

$E \Rightarrow$ in the $+x$

Area = circular with $d = 50$ m in x-y plane.

a) E_x ; b) P_z ; c) total power transmitted to the air ;

a)

$$E_x = H_y \eta_0 = (200\ \mu A/m)(377) =$$

$$E_x = 0.075\ \frac{V}{m}$$

b)

$$P_z = H_y^2 \eta = (200\ \mu A/m)^2 (377)$$

$$P_z = 1.508 \times 10^{-5}\ W/m^2$$

c)

$$P = P_z A = (1.508 \times 10^{-5}\ W/m^2)\left(\pi\left(\tfrac{50}{2}\right)^2\right)$$

$$P = 0.0296\ W$$

6-20)

→ (rms) $E_x = 3\ V/m$

→ H → in +y

→ ($\epsilon_r = 80$)

→ square 15 m × 15 m in x-y plane.

a) H_y ; b) P_z c) total power.

a)

$$H_y = \frac{E_x}{\eta}$$

$$\eta = \frac{\eta_0}{\sqrt{\epsilon_r}} = \frac{377}{\sqrt{81}} = 42.14\ \Omega.$$

$$H_y = \frac{2\ V/m}{42.14\ \Omega} = 0.0474\ \frac{Amp}{m}$$

b) $P_z = E_x H_z = \left(2\ \frac{V}{m}\right)\left(0.474\ \frac{Amp}{m}\right)$

$P_z = 0.095\ W/m^2$

c)

$$P = \mathcal{P}_z(A) = (0.095)(15\times15) = \boxed{21.35W}$$

6-21)

$E_x = 50\ mV/m$

0/8

$H_y = 100\mu\ A/m$

a)

$$\eta = \frac{E_x}{H_y} = \frac{50\times10^{-3}\ V/m}{10\times10^{-6}\ Amp/m} = 500\Omega$$

b)

$$\mathcal{P}_z = E_x H_y = (50\times10^{-7}\ V/m)(100\times10^{-6})$$

$$\boxed{\mathcal{P} = 5\times10^{-6}\ W/m^2}$$

c)

$$\epsilon_r = \frac{(377)^2}{\eta^2} = \frac{(377)^2}{(500)^2} = 0.5685$$

The electrostatic field intensity $E = -\nabla V$. Determine $\vec{E}$ at $(1, 1, 0)$

If: $V = V_0 e^{-x} \sin \frac{\pi y}{2}$

$$\nabla V = \frac{\partial V}{\partial x}\vec{a}_x + \frac{\partial V}{\partial y}\vec{a}_y + \frac{\partial V}{\partial z}\vec{a}_z \quad (\to 0)$$

$$\nabla V = \frac{\partial (V_0 e^{-x} \sin \frac{\pi}{2} y)}{\partial x}\vec{a}_x + \frac{\partial (V_0 e^{-x} \sin \frac{\pi}{2} y)}{\partial y}\vec{a}_y$$

$$\nabla Y = \left(-V_0 e^{-x} \sin \frac{\pi}{2} y\right)\vec{a}_x + \left(\frac{\pi}{2} V_0 e^{-x} \cos \frac{\pi}{2} y\right)\vec{a}_y$$

$$\nabla Y = \left(-V_0 e^{-1} \sin \frac{\pi}{2}\right)\vec{a}_x + \left(\frac{\pi}{2} V_0 e^{-1} \cos \frac{\pi}{2}\right)\vec{a}_y \quad (\sin \to 1,\ \cos \to 0)$$

$$\nabla Y = -V_0 e^{-1} \vec{a}_x$$

$$E = -\nabla E = V_0 e^{-1} \vec{a}_x$$