Solutions Problem 8
Spring 2014 Transmission Lines and Fields

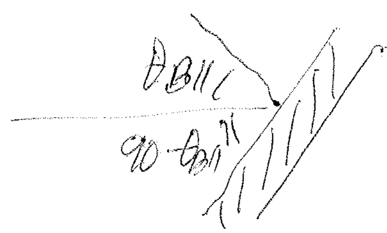
A (a) $E = 10V/m$ Power density $= \frac{|E|^2}{2\eta_0}$ W/m^2

$= \frac{100}{2 \times 377} = 0.1326$ W/m^2.

(b) A plane wave may be resolved into two contra-rotating circular polarised waves each carry half the power density.

Hence $P_{antenna}$ power received by antenna $= \frac{1}{2} 0.1326 \times 1 = 66.31$ mW

c) At the Brewster angle

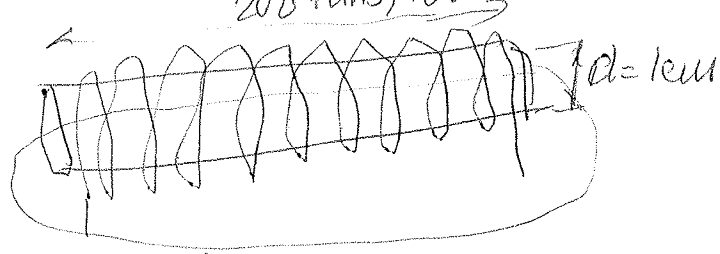


$$\sin\theta_{B//} = \frac{1}{\sqrt{1 + 1/4}}$$

$$\theta_{B//} = \sin^{-1}\frac{1}{\sqrt{1.25}} = ~~0.89443~~ \sin^{-1} 0.8944$$

$= 63.4°$.

B



$\int H.dl = NI$.

Or $H \times 0.1 = 200 I$, $H = 2000 I$

$B = \mu_0\mu_r H = 4\pi \times 10^{-7} \times 100 \times 2000 I_1$

$B = 0.25 I_1$ $\therefore \Phi = A.B = \pi \times 10^{-4} \times 0.25 I_1$

$\Phi_{200} = 1.973 \times 10^{-5} I_1$ =

$\Lambda_{200} = N\Phi_{200} = 1.973 \times 10^{-5} \times 200 I =$

$= 3.9478 \times 10^{-3} I.$

Hence $L_1 = 3.95 \times 10^{-3} H.$

<u>50 turn coil.</u> $\oint H dl = NI$

$H_{50} = \frac{50 I}{2.5 \times 10^{-2}} = 200 I.$

$B_{50} = \mu_r \mu_0 H_{50} = 0.02513 I$

$\Phi_{50} = B_{50} \times A = 0.02513 I * \pi \times 0.25 \times 10^{-4}.$

$= 1.973 \times 10^{-6} I$

$\Lambda_{50} = 1.973 \times 10^{-6} \times 50 I = 0.987 \times 10^{-6} I.$

$L_{50} = \frac{\Lambda_{50}}{I} = 0.987 \times 10^{-6} H.$

<u>Mutual Inductance.</u>

$\Phi_{200} = 1.973 \times 10^{-5} I_1 \; T.$

$\Lambda_{12} = \Phi_{200} * 50 = 9.87 \times 10^{-4} I.$

$L_{12} = \frac{\Lambda_{12}}{I_1} = 9.87 \times 10^{-4} H$