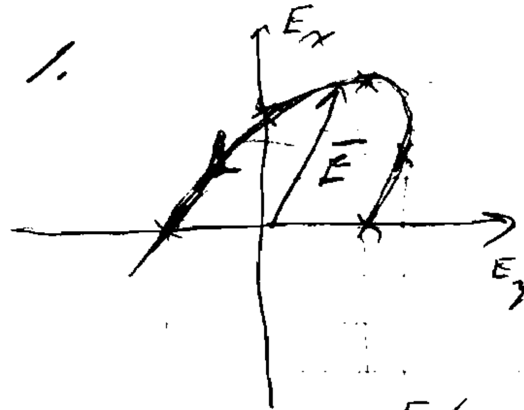
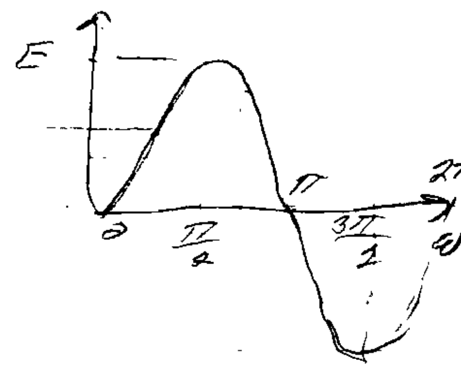
EE 333 Test 2 (Solutions)

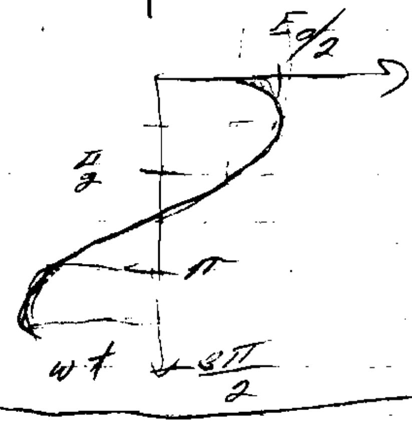
20 min

1.





plots for $z=0$



a) ccw elliptical

b) No, Need seperate dipoles to receive E_x and E_y.

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2. ① ϵ_0 ↑ z

② $3\epsilon_0$

a) $\bar{E}_1 = -2\bar{a}_x + 3\bar{a}_y + 6a_z \quad \therefore \boxed{\bar{D}_1 = \epsilon_0 \bar{E}_1}$

b) $E_2 = -2\bar{a}_x + 3\bar{a}_y + 2\bar{a}_z$ and $\bar{D}_2 = 3\epsilon_0 \bar{E}_2$

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3. $\oint \bar{H} \cdot d\bar{l} = I \quad \therefore \quad \boxed{H_\phi = \frac{I}{2\pi\rho}} \quad a<\rho<c$ ←

$\oint \bar{D} \cdot d\bar{s} = \int \rho_v \, dv \quad \therefore \quad 2\pi\rho \Delta D_\rho = Q\Delta \quad D_\rho = \frac{Q}{2\pi\rho} \quad a<\rho<c$ ←

$\boxed{E_\rho = \frac{D_\rho}{\epsilon}}$ use proper ϵ in the two layers

b) D_ρ and H_ϕ would be unchanged! E_ρ would be $\frac{D_\rho}{\epsilon_0}$ ←

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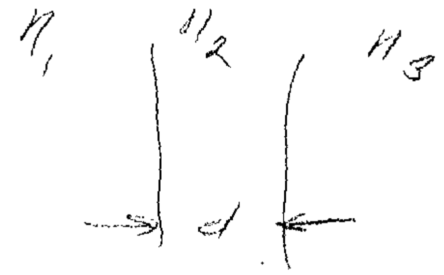
4. a) Alligned internal magnetic dipoles.

b) $\mathcal{P}_{ave} = \frac{1}{2}\mathrm{Re}\{\hat{E} \times \hat{H}^*\} = \frac{1}{2}\mathrm{Re}\{2 e^{-x} e^{-jx} \bar{a}_z \times \frac{1}{5} e^{-x} e^{+jx} (-\bar{a}_y) e^{j45°}\}$

$\boxed{\mathcal{P}_{ave} = \frac{1}{5} e^{-2x} \cos 45° \, \bar{a}_x}$ ←

5.



a) $d = \lambda/4$, $n_2 = \sqrt{n_1 n_3}$

b) $d = \lambda/2$, $n_1 = n_3$