1. $\vec{E}_I = \tilde{E}_{0I}\, e^{i(k_1 z - \omega t)}\,\hat{x}$

$\vec{B}_I = \tilde{E}_{0I}\cdot\frac{1}{v_1}\cdot e^{i(k_1 z - \omega t)}\,\hat{y}$

$\vec{E}_R = \tilde{E}_{0R}\, e^{i(-k_1 z - \omega t)}\,\hat{x}$

$\vec{B}_R = \tilde{E}_{0R}\cdot\frac{1}{v_1}\cdot e^{i(-k_1 z - \omega t)}\cdot -\hat{y}$

$\vec{E}_T = \tilde{E}_{0T}\, e^{i(k_2 z - \omega t)}\,\hat{x}$

$\vec{B}_T = \tilde{E}_{0T}\cdot\frac{1}{v_2}\, e^{i(k_2 z - \omega t)}\,\hat{y}$

$\Delta \vec{E}_{\parallel} = 0$ @ $z = 0$

$$\Rightarrow \tilde{E}_{0I} + \tilde{E}_{0R} = \tilde{E}_{0T}$$

$\Delta \vec{H}_{\parallel} = \Delta(\vec{B}_{\parallel}/\mu) = 0$ @ $z = 0$

$$\Rightarrow \frac{\tilde{E}_{0I}}{\mu_1 v_1} - \frac{\tilde{E}_{0R}}{\mu_1 v_1} = \frac{\tilde{E}_{0T}}{\mu_2 v_2}$$

or $\tilde{E}_{0I} - \tilde{E}_{0R} = \frac{\mu_1 v_1}{\mu_2 v_2}\tilde{E}_{0T} = \beta\,\tilde{E}_{0T}$

2.a. $\vec{E} = -\nabla V - \partial\vec{A}/\partial t$

$= k^2 C B \sin(kx - kct)\,\hat{x} - k^2 c B \sin(kx - kct)\,\hat{x}$

$+ kc\, C \cos(kx - kct)\,\hat{y}$

$$= kc\,C\cos(kx - kct)\,\hat{y}$$

$\vec{B} = \nabla\times\vec{A} = \partial A_y/\partial x\;\hat{z}$

$$= k\,C\cos(kx - kct)\,\hat{z}$$

2.b. $\nabla\cdot\vec{A} = -k^2 B \sin(kx - kct) \neq 0$

$\mu_0\epsilon_0\, \partial V/\partial t = \frac{1}{c^2}\cdot k^2 c^2 B \sin(kx - kct)$

$\Rightarrow$ $\boxed{\text{Lorenz Gauge}}$

2.c. $V' = V - \kappa c B \cos(\kappa x - \kappa c t)$

$= V - \partial\lambda/\partial t = 0$

if $\lambda = -B \sin(\kappa x - \kappa c t)$

$\vec{A}' = \vec{A} + \nabla\lambda$

$= \vec{A} - B\kappa \cos(\kappa x - \kappa c t)\hat{x}$

$= C \sin(\kappa x - \kappa c t)\hat{y}$

3.a. $$\vec{E}_{rad} = \frac{q}{4\pi\varepsilon_0} \frac{\Delta r}{(\vec{\Delta r}\cdot\vec{u})^3}[\vec{\Delta r} \times (\vec{u} \times \vec{a})]$$

$$= \frac{q}{4\pi\varepsilon_0} \cdot \frac{x}{(cx)^3}[x\hat{x} \times (c\hat{x} \times a_0\hat{z})]$$

$$= \frac{q}{4\pi\varepsilon_0} \frac{a_0}{c^2 x}[\hat{x} \times (\hat{x} \times \hat{z})]$$

$$= \frac{-q a_0 \hat{z}}{4\pi\varepsilon_0 c^2 x} = -\frac{q\mu_0 a_0}{4\pi x}\hat{z}$$

3.b. $$\vec{S}_{rad} = \frac{1}{\mu_0 c} E_{rad}^2 \hat{x}$$

$$= \frac{\mu_0 q^2 a_0^2}{16\pi^2 c x^2}\hat{x}$$

3.c. $t_r = t - \Delta r/c = t - x/c$

$\Rightarrow t = t_r + x/c = x/c$ since $t_r = 0$ when $z_r = 0$

$\Rightarrow z = \frac{1}{2} a_0 \left(\frac{x}{c}\right)^2$

3.d. $\vec{p} = qz = \frac{q}{2} a_0 t^2$

$\ddot{p} = q a_0$

$$\vec{S} \cong \frac{\mu_0 \ddot{p}^2}{16\pi^2 c} \frac{\sin^2\theta}{r^2}\hat{r}$$

$$= \frac{\mu_0 q^2 a_0^2}{16\pi^2 c x^2}\hat{x}$$ for $\vec{r} = x\hat{x}$ $(\theta = \pi/2)$

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