Quiz 6.

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1. (a) $E_x = E_0 \cos(\omega t - \beta z)$ $\quad \beta = \frac{\omega}{v_p}$ $\quad v_p = \frac{c}{\sqrt{\mu_r \epsilon_r}}$

$$\Rightarrow \beta = \frac{2\pi f \sqrt{\mu_r \epsilon_r}}{c} = \frac{2\pi \cdot 100\times10^6 \times \sqrt{4}}{3\times10^8} = \frac{4}{3}\pi \text{ rad/s}$$

$\Rightarrow E_x = E_0 \cos(2\pi \times 10^8 t - \frac{4}{3}\pi z)$ since the max value is taken as $z = \frac{1}{8}$ m

$\Rightarrow$ and value is $+10^{-4}$ (V/m) and $t = 0$

$$10^{-4} = E_0 \cos(2\pi \times 10^8 \times 0 - \frac{4}{3}\pi \cdot \frac{1}{8})$$

$$10^{-4} = E_0 \cos(-\frac{1}{6}\pi)$$

$$E_0 = \frac{10^{-4}}{\frac{\sqrt{3}}{2}} = 1.15\times10^{-4} \text{ V/m}$$

then, $E = E_x a_x = E_0 \cos(2\pi\times10^8 t - \frac{4}{3}\pi z)\, a_x$

$$= 1.15\times10^{-4}\cos(2\pi\times10^8 t - \frac{4}{3}\pi z)\, a_x \quad (V/m)$$

(b) intrinsic impedance η: $\eta = \sqrt{\frac{\mu}{\epsilon}} = \sqrt{\frac{\mu_0\mu_r}{\epsilon_0\epsilon_r}} = \eta_0\sqrt{\frac{\mu_r}{\epsilon_r}} = 377\sqrt{\frac{1}{4}} = 188.5\Omega$

$$\frac{E_x}{H_x} = \eta \Rightarrow H_x = \frac{E_x}{\eta} = \frac{1.15\times10^{-4}\cos(2\pi\times10^8 t - \frac{4}{3}\pi z)\, a_x}{188.5} = 6.13\times10^{-7}\cos(2\pi\times10^8 t - \frac{4}{3}\pi z)\, a_x$$

(c) positive maximum: $E_x = E_0 \cos(2\pi\times10^8 t - \frac{4}{3}\pi z)$ $\quad t = 10^{-8}$

$$= E_0 \cos(2\pi - \frac{4}{3}\pi z)$$

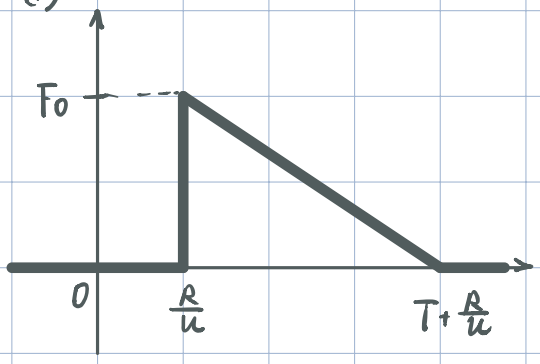
$E_{x\max} = E_0 \Rightarrow (2\pi - \frac{4}{3}\pi z) = 2k\pi$

$$6 - 4z = 6k$$

$$z = \frac{6-6k}{4}$$

$$= \frac{3-3k}{2} \text{ (m)} \quad k \in \mathbb{Z}$$

2. (1)



(2) $f(t-\frac{R}{u})$ versus $R \Leftrightarrow f[\frac{1}{u}(ut-R)]$ vs. R

transformation: inverse the graph. $(-R)$.

duration shift from $T \to uT$