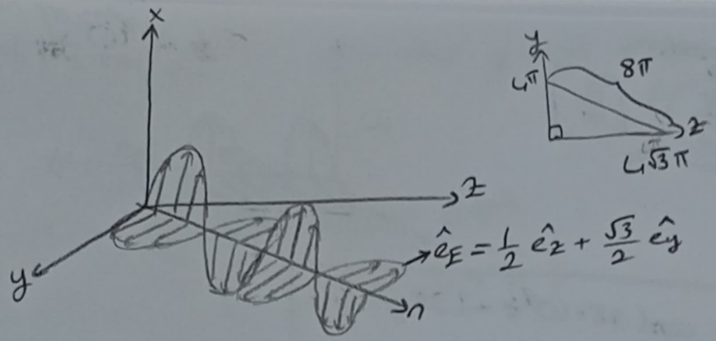
1)



$$H(r,t) = \hat{a}_x H_0 \cos(\omega t \underbrace{- 4\pi y - 4\sqrt{3}\pi z}_{-8\pi n})$$

$$\frac{\omega}{8\pi} = V_{propagation} = \frac{3\times10^8}{4}$$

$$\omega = 6\pi \times 10^8 = 2\pi f$$

$$f = 3\times10^8 \text{ Hz}$$

$$\frac{E_0}{H_0\mu} = V_{propagation} = \frac{c}{\sqrt{\mu_r \varepsilon_r}}$$

$$V_{propagation} = \frac{3\times10^8}{4}\left[\frac{m}{s}\right]$$

$$E_0 = \frac{3\times10^8}{4} \cdot H_0 \times 4\pi \times 10^{-7} = 30\pi H_0$$

$$E(r,t) = \hat{e}_E\, 30\pi H_0 (\omega t - 8\pi n)$$

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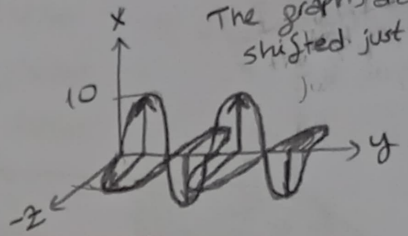
2) Phasor domain standard is cosine function.

$$H(r,t) = \hat{a}_x\, 10 \cos\left(2\pi\times10^8 t - 2\pi y + \underbrace{\frac{\pi}{6} - \frac{\pi}{2}}_{\phi}\right) \left[\frac{A}{m}\right]$$

$$\boxed{H = 10e^{-j(2\pi y + \frac{\pi}{3})}}$$



The graphs are not shifted just for simplicity

$$H = \frac{B_0}{\mu_0} = 10$$

$$B_0 = 4\pi\times10^{-6}$$

$$\boxed{E(r,t) = 400\pi \cos(2\pi\times10^8 t - (2\pi y + \tfrac{\pi}{3}))}$$

$$\boxed{E = 400\pi\, e^{-j(2\pi y + \frac{\pi}{3})} (-\hat{e}_z)}$$

$$\frac{E_0}{B_0} = \frac{c}{\sqrt{\varepsilon_r}} \quad V_{propagation}$$

$$V_p = \frac{\omega}{\kappa} = \frac{2\pi\times10^8}{2\pi} = 10^8 \text{ m/s}$$

$$E_0 = 10^8 \times 4\pi\times10^{-6} = 400\pi$$

$$\frac{1}{\sqrt{\varepsilon_r}} = \frac{1}{3} \quad \boxed{\varepsilon_r = 9}$$

$$\eta = \sqrt{\frac{\mu}{\varepsilon}} = \frac{120\pi}{\sqrt{\varepsilon_r}} = \boxed{40\pi\,\Omega}$$

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3) $E(r,t) = a_x E_0 \cos(\omega t - kz)$

$|E(z=0, t=0)| = 10\,V/m \rightarrow E_0 = 10\,\frac{V}{m}$

$|E(z=5m, t=0)| = 2\,V/m$

$|E(z=0, t=5\mu s)| = 1\,V/m$

$k = \frac{2\pi}{\lambda}$

$\omega = 2\pi f$

$10\,V/m \quad 0,2$

$E_0 \cos(-5k) = 2\,V/m$

$E_0 \underbrace{\cos(5\mu\omega)}_{0,1} = 1\,V/m$

$\cos(-5k) = \cos(5k)$

$5k = \frac{5 \cdot 2\pi}{\lambda} = \frac{10\pi}{\lambda}$

$\arccos(0,2) = 1,369\,rad = 78,4437^\circ = 0,436\pi$

$\frac{10\pi}{\lambda} = 0,436\pi$

$\lambda = \frac{10}{0,436} = 22,94\,m$

$\cos(5 \times 10^{-6} \cdot 2\pi f) = 0,1$

$\arccos(0,1) = 1,47\,rad = 84,2248^\circ = 0,468\pi$

$10^{-5}\pi f = 0,468\pi$

$f = 46800\,Hz$

$f \cdot \lambda = v_{propagation} = 1073592\,m/s$

$v = \frac{1}{\sqrt{\mu\varepsilon}} = \frac{c}{\sqrt{\varepsilon_r}}$ ($\mu_r = 1$) $\Rightarrow \sqrt{\varepsilon_r} = \frac{c}{v_p} \simeq 280$

$\varepsilon_r \simeq 77976$

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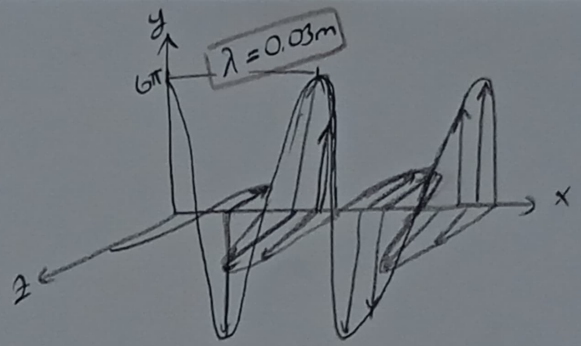
4) Linearly polarized along the y-axis means

$\underline{E} = E_0 \hat{a}_y e^{j(kx-\omega t)}$



$\vec{E} = 6\pi \cos\left(\frac{2\pi x}{\lambda}\right)\hat{y}$ = the given graph

$k = \frac{2\pi}{0,03} = 66,6\pi$ $\quad \omega = 2\pi f = 10^{10}\pi$

$\vec{H} = \frac{B_0}{\mu} \cos(kx-\omega t)\Big|_{x=0,\,t=0}$

$\frac{B_0}{\mu_0} = 0,1 \left[\frac{Amp}{m}\right]$

$B_0 = 0,1 \times 4\pi \times 10^{-7} = 4\pi \times 10^{-8}[T]$

$\frac{E_0}{B_0} = V_p = \frac{3\cancel{6}\pi}{2\cancel{4}\pi \times 10^{-8}} = 1,5 \times 10^8 \frac{m}{s} = \frac{c}{2}$

$V_p = \frac{\omega}{k} = \lambda f = 1,5 \times 10^8 = 0,03 \cdot f$

$f = 5 \times 10^9$ Hz

$\vec{E} = 6\pi \cos(66,6\pi x - 10^{10}\pi t)\,\hat{a}_y$

$\vec{H} = 0,1 \cos(66,6\pi x - 10^{10}\pi t)\,\hat{a}_z$

$V_p = \frac{c}{\sqrt{\varepsilon_r}} = \frac{c}{2} \rightarrow \varepsilon_r = 4$ $\quad \eta = \sqrt{\frac{\mu}{\varepsilon}} = \frac{120\pi}{\sqrt{\varepsilon_r}}\,\Omega = 60\pi\,\Omega$

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