# Examples

7.1: 10 MHz $\mu = \mu_0$ $\varepsilon_r = 9$

a.) phase velocity

$$v = \frac{1}{\sqrt{\mu\varepsilon}} = \frac{1}{\sqrt{\mu_r\mu_0\varepsilon_r\varepsilon_0}} = \frac{c}{\sqrt{\mu_r\varepsilon_r}} = \frac{3e8}{\sqrt{9\cdot 1}} = 1\cdot 10^8 \frac{m}{s}$$

b.) wavenumber

$$\omega = 10\cdot 10^6 \cdot 2\pi$$

$$v = \frac{\omega}{k} \Rightarrow k = \frac{\omega}{v} = \frac{20\pi\cdot 10^6}{1\cdot 10^8} = 20\pi\cdot 10^{-2} = 20\pi\cdot 10^{-2}\ m$$

c.) wavelength

$$\lambda = \frac{v}{f} = \frac{1\cdot 10^8}{1\cdot 107} \Rightarrow \lambda = 10\ m$$

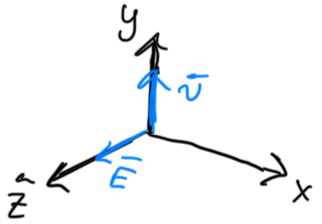
d.) intrinsic impedance of the medium

$$\eta = \sqrt{\frac{\mu}{\varepsilon}} = \sqrt{\frac{\mu_r}{\varepsilon_r}} \cdot \underbrace{\sqrt{\frac{\mu_0}{\varepsilon_0}}}_{377\,\Omega} = \sqrt{\frac{1}{9}}\cdot 377 \simeq 125\,\Omega$$

7.2.) 188.5 Ω $\bar{E} = \hat{z}\, 10 e^{-j4\pi y}$ (mV/m)

a.) magnetic field

$$|\bar{B}| = \frac{10\ mV/m}{188.5\ \Omega} = 0.053\ mA/m \qquad \bar{B} \text{ in the } \hat{x}$$




$$\bar{B} = \hat{x}\ 53 e^{-j4\pi y}\ \mu A/m$$

b.) $E(y,t)$ if medium is nonmagnetic $\mu = \mu_0$

$$\eta = \sqrt{\frac{\mu}{\varepsilon}} \Rightarrow 188.5\,\Omega = \frac{377\,\Omega}{\sqrt{\varepsilon_r}} \qquad v = \frac{c}{\sqrt{\mu_r\varepsilon_r}} = 1.5\cdot 10^8 \frac{m}{s}$$

$k = 4\pi \qquad \omega = kv = 6\pi \cdot 10^8 \ \frac{rad}{s}$

$\bar{E}(y,t) = 10\hat{z}\, e^{-4\pi j y + j\omega t} \Rightarrow \underset{part}{real} \Rightarrow \underline{10\hat{z}\cos(\omega t - 4\pi y) \ mV/m}$

7.3

$\eta = 100\,\Omega \qquad \bar{H} = (\hat{y}\,10 + \hat{z}\,20)\, e^{-j4x} \ (mA/m)$