EE3140 Quiz 3, Spring 2003

Show your work for full credit. Useful formulae:

\[ \varepsilon_0 = 8.854 \times 10^{-12} \text{ } F/m \]
\[ \mu_0 = 4\pi \times 10^{-7} \text{ } H/m \]

1. The amplitude of \( \vec{E} \) just inside a liquid is 1.0V/m and \( \text{Re}\{\varepsilon\} = 20 \times \varepsilon_0 \), with \( \sigma = 0.5 \text{mho/m} \). Determine the amplitude of \( \vec{E} \) at a distance of 0.1m inside the medium for \( f=5 \text{GHz} \) (\( 5 \times 10^9 \text{ Hz} \)). (5 points)

\[ k = \omega \sqrt{\mu \varepsilon} \left( 1 - \frac{\sigma}{\omega \varepsilon} \right)^{1/2} = 469.1 - 321.04 \]

(Note that \( \frac{\sigma}{\omega \varepsilon} \approx 0.09 \ll 1 \), \( k_x \approx \frac{1}{2} \sqrt{\frac{\mu}{\varepsilon}} = 21.06 \))

Then, \( 0.1 \text{ e}^{-k x (0.1)} = 0.122 \text{ V/m} \)

2. Given \( \vec{E} = ((2 - j)x + (3 - j)\hat{z}) \text{ exp}^{jy} \),

(a) What direction is the wave traveling? (2 points)

\( \text{ - y, } \text{ direction} \)

(b) What polarization does this wave have, linear, circular, or elliptical? (3 points)

Elliptical (magintudes of \( x \), \( y \) not equal, and phase not equal, either)