ECSE 2100 – Fields and Waves I  
Fall 2006  
Homework #1

1. For the following wave expressions, indicate if the wave is standing or traveling. If the wave is traveling, find the direction of propagation and the velocity.

   a) \( \sin(1000t + 0.2x) \) Traveling \( \text{in } -x \), \( v = \frac{0.2}{\beta} = 5 \times 10^2 \text{ m/s} \)
   
   b) \( \cos(10^6 t - 0.01z) \) Traveling \( \text{in } z \), \( v = \frac{0.01}{\beta} = 10^8 \text{ m/s} \)
   
   c) \( \cos(377t) \sin(5x) \) Standing

2. Find the phasor representation of the following expressions

   a) \( v(t) = 50 \cos\left(\frac{\omega t - 2\pi}{3}\right) \)
      \( \tilde{V} = 50 \mathbf{e}^{-\frac{2\pi}{3}} = 50 \mathbf{e}^{-\frac{2\pi}{3}} \)

   b) \( v(t) = 100 \sin\left(\omega t + \frac{\pi}{3}\right) \)
      \( \tilde{V} = 100 \mathbf{e}^{-\frac{\pi}{6}} \)

   c) \( v(t) = 3 \sin\left(\omega t + \frac{\pi}{3}\right) + 8 \cos\left(\omega t - \frac{2\pi}{3}\right) \)
      \( \tilde{V} = 3 \cos\left(\frac{\pi}{2} - (\omega t + \frac{\pi}{3})\right) + 8 \cos\left(\omega t - \frac{2\pi}{3}\right) \)
      \( \tilde{V} = 8.54 \mathbf{e}^{-1.7} \)

3. Find the time domain expression for the following phasors.

   a) \( \tilde{V} = 9 + j3V \) = 9.4037 \( \mathbf{e}^{j0.4378} \)
      \( v(t) = 9.4037 \cos(\omega t + 0.4378) \)

   b) \( \tilde{V} = 2.7e^{\frac{j\pi}{4}}V \)
      \( v(t) = \Re\left(2.7 \mathbf{e}^{\frac{j\pi}{4}} \mathbf{e}^{j\omega t}\right) = 2.7 \cos(\omega t + \frac{3\pi}{4}) \)

4. A wave is described by \( v(t, z) = 30.0e^{-az} \sin(2\pi \times 10^6 t - \pi z)V \). Find the frequency, wavelength and velocity. At \( z = 2\text{m} \) the magnitude is measured as 1V. Find the attenuation constant.

   \( f = 10^6 \), \( \beta = \pi \), \( \lambda = \frac{2\pi}{\beta} = 2 \), \( \frac{\omega}{\beta} = \frac{2\pi \times 10^6}{\pi} = 2 \times 10^6 \text{ m/s} \)

   \( \exists \Omega e^{-2\lambda} = 1 \), \( \Rightarrow \alpha = -\frac{1}{2} \ln \frac{1}{30} = 1.7 \)