

Quiz #1, 09/26/2018

Name: _____ Signature: _____

A wave with the frequency of 1-MHz travels in the $-z$ direction in air. Assume the wave travels at the speed of light ($c = 3.0 \times 10^8 \text{ m/s}$ in air). If the wave reaches a peak value of 1.2π at $z = 50 \text{ m}$ when $t=0$. Find:

- 1) (10 points) Wavelength in air
- 2) (10 points) Expression for the instantaneous of the wave (time domain)
- 3) (10 points) Expression for the wave in the phasor domain
- 4) (extra 10 points) If the wave reflects at $z = 50 \text{ m}$ with 100% reflection and 0° phase shift, what's the time domain expression of the reflection wave?

Solution:

$$1). \lambda f = c, \lambda = \frac{c}{f} = \frac{3 \times 10^8 \text{ m/s}}{10^6 \text{ Hz}} = 300 \text{ m}$$

$$2). y(z, t) = 1.2\pi \cos\left(\omega t + \frac{2\pi}{\lambda} z + \varphi_0\right)$$

$$1.2\pi = 1.2\pi \cos\left(\frac{2\pi}{300} 50 + \varphi_0\right) \varphi_0 = -\frac{\pi}{3}$$

$$y(z, t) = 1.2\pi \cos\left(\omega t + \frac{2\pi}{\lambda} z - \frac{\pi}{3}\right)$$

$$3) \tilde{y}(z) = 1.2\pi e^{j\left(\frac{2\pi}{\lambda} z - \frac{\pi}{3}\right)}$$

$$4) \tilde{y}(z) = 1.2\pi e^{j\left(-\frac{2\pi}{\lambda} z + \frac{\pi}{3}\right)}$$