4C-999: Electromagnetism for Sci/Eng NAME: _____

Week 10

Group: _____

1. (12 points) Two waves (same wavelength and frequency) are given by:

$$\begin{aligned} \psi_1(x,t) &= \psi_{1m}\cos(kx-\omega t+\phi_1) \\ \psi_2(x,t) &= \psi_{2m}\cos(kx-\omega t+\phi_2) \end{aligned}$$

where

$$\psi_{1m}=4.0 \qquad \psi_{2m}=7.0 \qquad \phi_1=\pi/4\,\text{rad} \qquad \phi_2=-\pi/6\,\text{rad}$$

Assume that the units on ψ_{1m} and ψ_{2m} are appropriate for the type of wave involved.

a. (3 points) Draw a phasor diagram showing the two waves at $x=0$ and $t=0$, and how they would combine and interfere (assuming that the waves meet at $x=0$). As time elapses, which direction would the phasor diagram rotate?

b. (3 points) Determine the complex amplitudes, ψ_{1mc} and ψ_{2mc}, both in polar form ($re^{i\theta}$) and cartesian form ($a+bi$).

c. (3 points) Determine the complex amplitude of the combined wave, ψ_{mc}, both in cartesian and polar form. Identify the amplitude and phase of the combined wave.

d. (3 points) Calculate $I/(I_1+I_2)$, where I_1 and I_2 represent the intensities of the individual waves and I represents the intensity of the combined wave.

2. (8 points) Determine the total energy of a standing wave in a string in terms of T (tension), μ (mass/length), L (length), n (harmonic number), and y_m (amplitude).