PROBLEM 1 (10 Points)

What are intrinsic impedance, wave impedance, characteristic impedance, and input impedance?

PROBLEM 2 (20 Points)

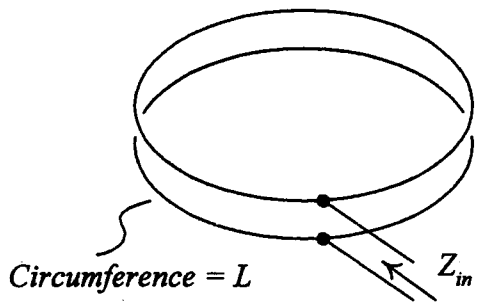
Consider the following complex phasor expression for a time-harmonic electric field in free space:

$$\vec{E} = \left[3\hat{x} + 4\hat{y} + j5\hat{z}\right] e^{-j(8x-6y)\pi}\ mV/m$$

(a) What is the frequency? (b) What is the direction of propagation and the state of polarization? (c) Find the associated magnetic field.

PROBLEM 3 (10 Points)

A length L of two-wire transmission line (of characteristic impedance Z_c and wave number β) is bent into a loop by connecting its ends together as shown below. Find an expression for the input impedance Z_{in} seen looking into the connection terminals.



PROBLEM 4 (20 Points)

Calculate the dimensions of an air-filled rectangular waveguide for which the cutoff frequencies for TM_{11} and TE_{03} modes are both equal to 12 GHz. What is the dominant mode of this waveguide? At 8 GHz, determine whether the dominant mode will propagate or evanescent in the waveguide.

PROBLEM 5 (20 Points)

What is the maximum power that can be received over a distance of 1 km in free space with a 2.4-GHz circuit consisting of a transmitting antenna with a gain of 20 dB and a receiving antenna with a gain of 10 dB? The transmitted power is 1W.

(背面仍有題目，請繼續作答)

PROBLEM 6 (20 Points)

(a) A $\lambda/4$ transformer of characteristic impedance R is inserted in a 100-ohm line at a distance d from the load Z_L. If $Z_L = 20 + j\,20$ ohm, find the d and R for a match. (b) On the other hand, if the transmission-line transformer is connected directly to the load (i.e., d=0) and its length L is not limited to $\lambda/4$, find the required L and R for a match. (Note: you may use the Smith chart below, temporarily. But don't forget to write down important procedures and results on your answer sheet. Otherwise it will not be graded.)