

Physics 325 Homework 2

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Due: 9/18/02 by 430 PM

For Problems 1 and 2, note that complex impedances in series add:

$$Z_{eff} = Z_1 + Z_2$$

and that the reciprocals of complex impedances in parallel sum to the reciprocal of the total:

$$(Z_{eff})^{-1} = (Z_1)^{-1} + (Z_2)^{-1}$$

Problem 1

- Find the effective impedance for the circuit shown in Figure 1.
- Find the resonant frequency ω_o in terms of L, R and C.
- Find Z_{eff} at resonance.

Problem 2

- Find the effective impedance for the circuit shown in Figure 2.
- Find the resonant frequency ω_o in terms of L, R and C.
- Find ω when the angle of Z is equal to 45 degrees.

Problem 3.

A plane (linearly polarized) electromagnetic wave propagates in a vacuum along the z-axis. The electric field is given by:

$$E_x = E_o e^{-i(\omega t - kz)} \text{ and } E_y = E_z = 0$$

A square loop of wire with sides of length L is used to detect the wave by measuring the voltage V(t) appearing between the two ends (see Figure 3). The loop is parallel to the x-z plane.

- Calculate $\oint_c \vec{E} \cdot d\hat{l} = V(t)$ for this loop.
- For which lengths L is V(t) equal to 0?