

## Chapter 32 – MAGNETISM OF MATTER; MAXWELL'S EQUATIONS

### Dipole Moment

An electron has spin orbital angular momentum  $h/4\pi$  and orbital angular momentum  $2.11 \times 10^{-34}$  Js. Find (a) the  $z$ -component of the spin magnetic dipole moment, (b) the  $z$ -component of the orbital magnetic dipole moment, and (c) the classical velocity of the electron's orbit assuming its radius is 1 nm.

### Magnetic Materials

A solenoid has an open space inside it so that different materials can be placed inside. Describe what happens when (a) a diamagnetic material is inserted, (b) a paramagnetic material is inserted, and (c) a ferromagnetic material is inserted.

### The Ampere-Maxwell Law

A circular capacitor with radius  $R = 1.0$  cm is being charged by a current of 0.50 A. Find the (a) rate that the total electric flux changes in the capacitor, (b) total displacement current, (c) the displacement current density, (d) the induced magnetic field at 0.5 cm, and (e) the induced magnetic field at 1.5 cm.

## Chapter 33 – ELECTROMAGNETIC OSCILLATIONS AND ALTERNATING CURRENT

### LC Circuits

A 10 mH inductor is connected across a 50  $\mu\text{F}$  capacitor. At some instant of time, the charge on the capacitor is 10  $\mu\text{C}$  and the current in the inductor is 2.0 A. Find the (a) resonant frequency of the circuit, (b) phase angle  $\phi$ , (c) the total energy in the circuit, (d) the maximum charge on the capacitor, and (e) the maximum current in the inductor.

### RLC Circuits

A single loop circuit consists of a 7.20  $\Omega$ , a 12.0 H inductor, and a 3.20  $\mu\text{F}$  capacitor. Initially the charge on the capacitor is 6.20  $\mu\text{C}$ . Find (a) the resonant frequency of the circuit, (b) the charge on the capacitor at 10  $\mu\text{s}$ , (c) the current at 15  $\mu\text{s}$ , and (d) the energy in the circuit after 20 microseconds.

### Driven RLC Circuits

A single loop circuit consists of a 7.20  $\Omega$ , a 12.0 H inductor, and a 3.20  $\mu\text{F}$  capacitor. The circuit is connected to a 120 V, 60 Hz power supply. Find (a) the reactance of the capacitor, (b) the reactance of the inductor, (c) the impedance of the circuit, (d) the phase angle  $\phi$ , (e) the current in the circuit, (f) the rms potential across the resistor, (g) the rms potential across the inductor, and (h) the rms potential across the capacitor. What is the (i) maximum current and (j) the width of the resonance peak?

### Transformers

The primary of an ideal transformer is connected to a 120 V ac outlet with a 100  $\Omega$  resistor

across the secondary. If the current in the secondary is 2.0 A and the power dissipated in the primary is 480 W, find (a) the potential in the secondary, (b) the turns ratio  $N_s/N_p$ , (c) the current in the primary, and (d) the potential in the secondary.

## Chapter 34 – ELECTROMAGNETIC WAVES

### Electromagnetic Waves

The electric component of an electromagnetic wave is

$$\vec{E} = [(500 \text{ V/m}) \sin((1.27 \times 10^7 \text{ 1/m})(x - ct))]\hat{j}.$$

Find the (a) frequency of the wave. (b) wavelength of the wave, and (c) the equation for the corresponding magnetic field in the wave.

### Poynting Vector and Intensity

The electric component of an electromagnetic wave is

$$\vec{E} = [(500 \text{ V/m}) \sin((1.27 \times 10^7 \text{ 1/m})(x - ct))]\hat{j}.$$

Find (a) the Poynting vector, (b) intensity, (c) the energy that passes through a  $1 \text{ m}^2$  area in one s, and (d) the rms values of electric and magnetic fields.

### Radiation Pressure

Light of intensity of  $10 \text{ W/m}^2$  is incident upon a circle of radius 0.5 cm. Find (a) the total energy incident on the circle. If the light is reflected, calculate the (b) momentum transferred to the patch, the (c) force acting on the patch, and the (d) radiation pressure on the patch. (e) Repeat the above for the situation when the light is reflected. (f) What is the magnitude of the electric field for this intensity?

### Polarization

Unpolarized light with an intensity  $2 \text{ W/m}^2$  is incident upon a polarizer with its polarization axis at  $0^\circ$ . Further polarizing sheets are placed afterwards at  $15^\circ$  and  $47^\circ$ . Find (a) the intensity after the first polarizer, (b) the intensity after the second polarizer, (c) the intensity after the third polarizer, (d) the percentage of the light absorbed in the entire process.

### Reflection and Refraction

A flashlight is dropped into a lake ( $n = 1.33$ ). The light strikes the surface with an incident angle of  $30^\circ$ . What is the angle of the reflected beam and the angle of the refracted beam? What angle is needed for total internal reflection to occur? What incident angle is needed for a sun beam to be polarized after reflecting from the lake's surface?