

## Section 5: Electromagnetism II

### 1. Refraction (Snell's Law)

A light ray travels from air ( $n=1.00$ ) into glass ( $n=1.50$ ). If the angle of incidence is  $30^\circ$ , what is the angle of refraction?

### 2. Lorentz Force

A charged particle with charge  $q = 2 \times 10^{-19}$  C and mass  $m = 4 \times 10^{-27}$  kg enters a magnetic field of  $B = 0.5$  T at a speed of  $v = 10^6$  m/s perpendicular to the field. What is the magnitude of the Lorentz force acting on the particle?

### 3. Photon Energy

The human eye is most sensitive to light with a wavelength of about 550 nm (in vacuum). What is the frequency of this light? What is its energy in electron-volts (eV)?

### 4. EM Wave Analysis

An electromagnetic wave has its electric field component described by  $E_y(x,t) = 100 \sin(10^7 x - \omega t)$  V/m. What is the direction of propagation? What is the wavelength  $\lambda$ ? What is the angular frequency  $\omega$ ? What is the equation for the magnetic field component?

### 5. Ampere's Law Application

Two long, parallel wires are 10 cm apart and carry currents of 5 A in opposite directions. Calculate the magnitude and direction of the magnetic field at a point midway between the wires.

### 6. Transformer Ratio

A transformer is used to step down the voltage from 120 V AC to 9.0 V AC. If the primary coil has 400 turns, how many turns must the secondary coil have?

### 7. Magnetic Torque

A rectangular loop of wire with dimensions 10 cm by 5 cm carries a current of 2 A. A uniform magnetic field of  $B = 0.3$  T is applied parallel to the plane of the loop. What is the magnitude of the magnetic torque on the loop?

### 8. Speed of Light in Media

What is the speed of light in a diamond, which has an index of refraction  $n = 2.42$ ?

### 9. EM Spectrum

List the following types of electromagnetic radiation in order of increasing energy per photon: Infrared, Ultraviolet, Microwaves, X-rays, Radio waves, Gamma rays.

### 10. Capacitor Energy Storage

A parallel-plate capacitor with plate area  $0.1 \text{ m}^2$  and plate separation 1 mm is connected to a 12 V battery. Calculate the capacitance of the capacitor and the energy stored in it.