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°, 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 λ? What is the angular frequency ω? 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 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.