Phsx 2220 - Homework #8

32-1. The magnetic field of Earth can be approximated as the magnetic field of a dipole, with horizontal and vertical components, at a point a distance r from Earth's center, given by

$$B_h = \frac{\mu_0 \mu}{4\pi r^3} \cos\lambda_m, \qquad B_v = \frac{\mu_0 \mu}{2\pi r^3} \sin\lambda_m,$$

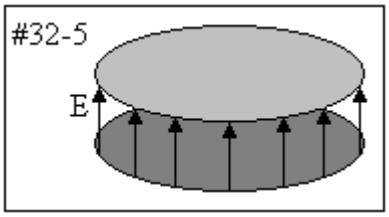
where λ_m is the magnetic latitude (latitude measured from the geomagnetic equator toward the north or south geomagnetic pole.) Assume that Earth's magnetic dipole moment is $\mu = 8.00 \times 10^{22}$ A·m^2. Find the magnitude and inclination of Earth's magnetic field (the angle the magnetic field makes with the horizontal) at (a) the geomagnetic equator; (b) a point at geomagnetic latitude 60°; (c) the north geomagnetic pole.

32-2. Measurements in mines and boreholes indicate that Earth's interior temperature increases with depth at the average rate of 30 °C/km. Assuming a surface temperature of 10 °C, at what depth does iron cease to be ferromagnetic? (The Curie temperature of iron varies very little with pressure.)

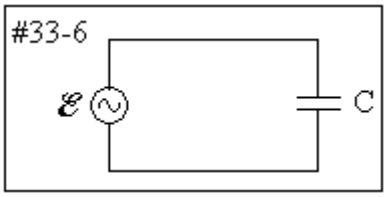
32-3. The induced magnetic field 6.0 mm from the central axis of a circular parallel-plate capacitor and between the plates is 2.0×10^{-7} T. The plates have radius 3.0 mm. At what rate d**E**/dt is the electric field between the plates changing?

32-4. At what rate must the potential difference between the plates of a parallel-plate capacitor with a 2.0 μF capacitance be changed to produce a displacement current of 1.5 A?

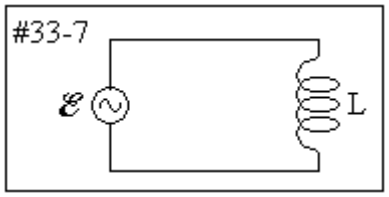
32-5. The magnitude of the electric field between the two circular plates of the parallel-plate capacitor shown at right is $E = (4.0 \times 10^5) - (6.0 \times 10^4\ t)$, with E in volts per meter and t in seconds. At t = 0, the field is upward as shown. The plate area is 4.0×10^{-2} m^2. For $t \geq 0$, (a) what are the magnitude and direction of the displacement current between the plates and (b) is the direction of the induced magnetic field clockwise or counter-clockwise around the plates?



33-6. A 1.5 μF capacitor is connected as shown at right to an ac generator with $\mathscr{E}_m$ = 30.0 V. What is the amplitude of the resulting alternating current if the frequency of the emf is (a) 1.00 kHz and (b) 8.00 kHz?



33-7. A 50.0 mH inductor is connected as shown at right to an ac generator with $\mathscr{E}_m$ = 30.0 V. What is the amplitude of the resulting alternating current if the frequency of the emf is (a) 1.00 kHz and (b) 8.00 kHz?



33-8. Can the amplitude of the voltage across an inductor be greater than the amplitude of the generator emf in an RLC circuit? Consider an RLC circuit with $\mathscr{E}_m$ = 10 V, R = 10 Ω, L = 1.0 H, and C = 1.0 μF. Find the amplitude of the voltage across the inductor at resonance.

33-9. A coil of inductance 88 mH and an unknown resistance and a 0.94 μF capacitor are connected in series with an alternating emf of frequency 930 Hz. If the phase constant between the applied voltage and the current is 75°, what is the resistance of the coil?

33-10. An air conditioner connected to a 120 V rms ac line is equivalent to a 12.0 Ω resistance and a 1.30 Ω inductive reactance in series. (a) Calculate the impedance of the air conditioner. (b) Find the average rate at which power is supplied to the appliance.

33-11. An electric motor has an effective resistance of 32.0 Ω and an inductive reactance of 45.0 Ω when working under load. The rms voltage across the alternating source is 420 V. Calculate the rms current.

33-12. A generator supplies 100 V to the primary coil of a transformer of 50 turns. If the secondary coil has 500 turns, what is the secondary voltage?