Physics 200

Chapter 31 Faraday's Law (Homework)

1. A single loop of wire has an area, A, and is perpendicular to a magnetic field that is changing from B_0 to 5 B_0 in "t" seconds. What is the induced current if the loop has a resistance, R?

2. A metal rod with mass, m, and length, L, rod is sliding down a ramp, which is inclined at an angle, θ, to the horizontal. The ramp consists of two metal rails that are connected at the bottom. The loop formed by the rails and rod has a resistance, R. What is the terminal speed of the rod if there is a vertical magnetic field, B, through out the region of the loop?

3. A solenoid has length, L, radius, a, "N" turns and carries a current, I, in each turn. Calculate the flux through a loop that is perpendicular to and centered on the solenoid's axis. The loop has a radius, a.

4. A metal rod is perpendicular to a magnetic field, B. The rod has length, L, and spins about one end at the rate "N" revolutions per minute. What is the induced emf between the ends of the rod?

5. A metal rod is perpendicular to a magnetic field, B. The rod has length, L, and is falling with speed, v. What is the induced emf between the ends of the rod?

6. Two metal rails are a distance, a, apart and are connected together by a resistor, R. There is a magnetic field in the area between the metal rails. A current carrying wire that is parallel to the rails causes the field. The wire lies in the same plane as the rails and carries a current, I_1. The wire is a distance, a, from one of the rails and a distance, 2a, from the other one. A piece of copper lies across the rails. At what constant speed is the piece of copper moving if there is a current, I_2, through the resistor?

7. A solenoid has a radius, a, and "N" turns per meter. The current in the solenoid's turns is $I_0 e^{-\alpha t}$. Calculate the induced electric field strength a distance, r, from the axis of the solenoid as a function of time.

8. A square loop of wire is moving away from an infinitely long wire that lies in the same plane as the square. The square is length, a, on a side, has a resistance, R, and is moving at speed, v. The long wire has a current, I_1. Calculate the induced current in the square at the instant the near side of the square is a distance, 2a, from the long wire.

9. A solenoid with a radius, a, and "N" turns per meter. The current in the solenoid's turns is $I_0 e^{-\alpha t}$. Calculate the induced electric field strength a distance, r, from the axis of the solenoid as a function of time.

10. An electromagnet has a magnetic field, B, and a cross sectional area, A. If we place a coil with "N" turns and a total resistance, R, around the magnet, and then turn off the magnet in "t" seconds, what will be the induced current in the coil?