Recitation 9

Chapter 23

Problem 1. A flat loop of wire consisting of a single turn of cross-sectional area $A = 8.00\ \text{cm}^2$ is perpendicular to a magnetic field that increases uniformly in magnitude from $B_i = 0.500$ T to $B_f = 2.50$ T in 1.00 s. What is the resulting induced current if the loop has a resistance of $R = 2.00\Omega$.

Problem 7. An $N = 30$ turn circular coil of radius $r = 4.00$ cm and resistance $R = 1.00\Omega$ is placed in a magnetic field directed perpendicular to the plane of the coil. The magnitude of the magnetic field varies with time according to $B = 0.0100t + 0.0400t^2$, where t is in seconds and B is in teslas. Calculate the induced emf in the coil at $t = 5.00$ s.

Problem 10. A piece of insulated wire is shaped into a figure eight as shown in Figure P23.10. The radius of the upper circle is $r_s = 5.00$ cm and that of the lower circle is $r_b = 9.00$ cm. The wire has a uniform resistance per unit length of $\lambda = 3.00\ \Omega/\text{m}$. A uniform magnetic field is applied perpendicular to the plane of the two circles, in the direction shown. The magnetic field is increasing at a constant rate of $dB/dt = 2.00$ T/s. Find the magnitude and direction of the induced current in the wire.

Problem 13. Figure P23.12 shows a top view of a bar that can slide without friction. The resistor is $R = 6.00\Omega$, and a $B = 2.50$ T magnetic field is directed perpendicularly downward, into the paper. Let $l = 1.20$ m. (a) Calculate the applied force required to move the bar to the right at a constant speed $v = 2.00$ m/s. (b) At what rate is energy delivered to the resistor?

Problem 22. A rectangular coil with resistance R has N turns, each of length l and width w as shown in Figure P23.22. The coil moves in a uniform magnetic field $\mathbf{B}$ with constant velocity v. What are the magnitude and direction of the total magnetic force on the coild as it (a) enters, (b) moves within, and (c) leaves the magnetic field.

Problem 53. A particle with a mass of $m = 2.00 \cdot 10^{-16}$ kg and a charge of $q = 30.0$ nC starts from rest, is accelerated by a strong electric field, and is fired from a small source inside a region of uniform constant magnetic field $B = 0.600$ T. The velocity of the particle is perpendicular to the field. The circular orbit of the particle encloses a magnetic flux of $\Phi_B = 15.0\ \mu\text{Wb}$. (a) Calculate the speed of the particle. (b) Calculate the potential difference through which the particle accelerated inside the source.

Problem 64. A novel method of storing energy has been proposed. A huge, underground, superconducting coil, $d = 1.00$ km in diameter, would be fabricated. It would carry a maximum current of $I = 50.0$ kA through each winding of an $N = 150$ turn Nb_3Sn solenoid. (a) If the inductance of this huge coil were $L = 50.0$ H, what would be the total energy stored? (b) What would be the compressive force per meter length acting between two adjacent windings $r = 0.250$ m apart?