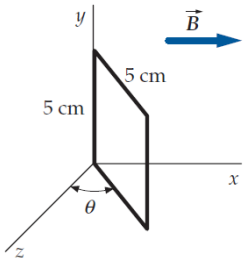
Electromagnetic Induction

1. A uniform magnetic field of magnitude 0.200 T is in the $+x$ direction. A square coil that has 5.00-cm long sides has a single turn and makes an angle θ with the z axis, as shown in Figure. Find the magnetic flux through the coil when θ is (*a*) 0º, (*b*) 30º, (*c*) 60º, and (*d*) 90º.



2. Find the magnetic flux through a solenoid that is 40 cm long, has a radius of 2.5 cm has 600 turns and carries a current of 7.5 A.

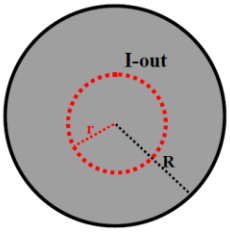
3. A uniform magnetic field makes an angle of 30^0 with the axis of a circular coil that has 300 turns and a radius equal to 4 cm. The magnitude of the magnetic field increases at a rate of 85 T/s, while its direction remains fixed. Find the magnitude of the induced emf in the coil.

4. An 80.0-turn coil that has a radius equal to 5 cm and a resistance equal to 30 Ω sits in a region that has a uniform magnetic field normal to the plane of the coil. At what rate must the magnitude of the magnetic field change to produce a current of 4 A in the coil?

5. The flux through a loop is given by $\varphi_m = 0.10t^2 - 0.40t$, where φ_m is in webers and *t* is in seconds. (*a*) Find the induced emf as a function of time. (*b*) Find both φ_m and $\varepsilon_{induced}$ at $t = 0, t = 2.0\,s, t = 4.0\,s, and\ t = 6.0\,s$.

5. Estimate the maximum possible motional emf between the wingtips of a typical commercial airliner in flight. (*b*) Estimate the magnitude of the electric field between the wingtips. (Assume a speed, relative to Earth's magnetic field, of 500 mi/h or about 220 m/s and a wingspan of 70 m. Assume that Earth's magnetic field is 60 μT).

6. The Figure shows the cross section of a solid cylindrical conductor with radius R. The conductor is carrying a uniformly distributed current I (out of page). Find the magnitude of the magnetic field, B, inside the conductor a distance r = R/4 from the center ($k = \mu_0/4\pi$).



6. A 30.0-cm long rod moves steadily at 8.00 m/s in a plane that is perpendicular to a magnetic field of 50.0 μT. The velocity of the rod is perpendicular to its length. Find (*a*) the magnetic force on an electron in the rod, (*b*) the electrostatic field in the rod, and (*c*) the potential difference between the ends of the rod.