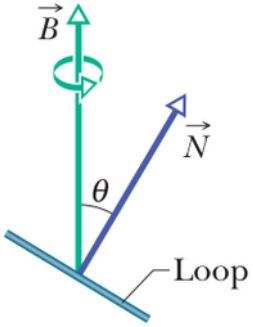
07 – Induction (Ch. 30)

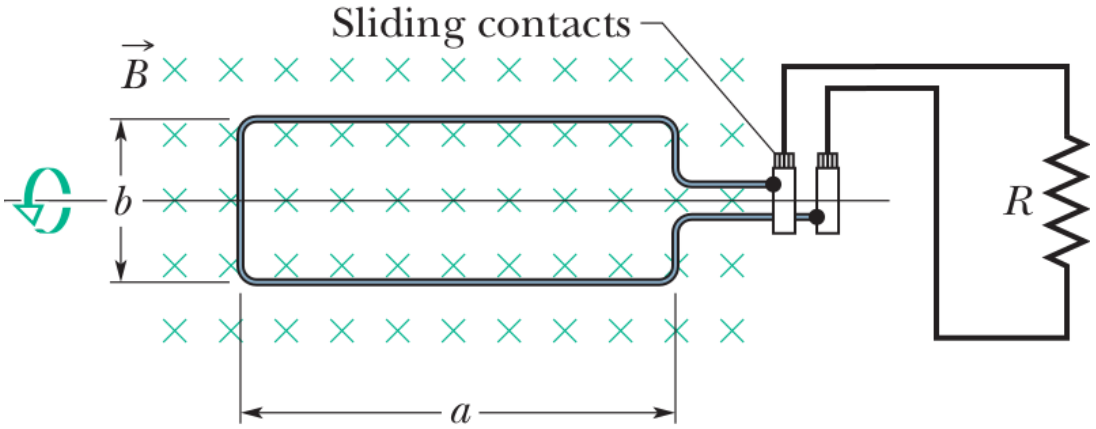
$e = 1.60 \cdot 10^{-19}$ C; $m_p = 1.673 \cdot 10^{-27}$ Kg; $m_e = 9.109 \cdot 10^{-31}$ Kg



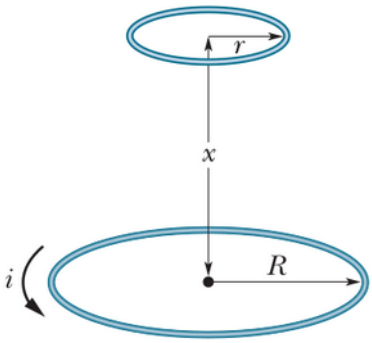
1) In the figure, a circular loop of wire 10 cm in diameter (seen edge-on) is placed with its normal **N** at an angle θ = 30° with the direction of a uniform magnetic field **B** of magnitude 0.50 T. The loop is then rotated such that **N** rotates in a cone about the field direction at the rate 100 rev/min; angle u remains unchanged during the process. What is the emf induced in the loop?

2) A certain elastic conducting material is stretched into a circular loop of 12.0 cm radius. It is placed with its plane perpendicular to a uniform 0.800 T magnetic field. When released, the radius of the loop starts to shrink at an instantaneous rate of 75.0 cm/s. What emf is induced in the loop at that instant?

11) A rectangular coil of N turns and of length *a* and width *b* is rotated at frequency *f* in a uniform magnetic field **B**, as indicated in figure. The coil is connected to co-rotating cylinders, against which metal brushes slide to make contact. (a) Show that the emf induced in the coil is given (as a function of time *t*) by $emf = 2\pi f NabB \sin(2\pi f t) = \text{emf}_0 \sin(2\pi f t)$. This is the principle of the commercial alternating-current generator. (b) What value of *Nab* gives an emf with $\text{emf}_0 = 150$ V when the loop is rotated at 60.0 rev/s in a uniform magnetic field of 0.500 T?



23) The figure shows two parallel loops of wire having a common axis. The smaller loop (radius *r*) is above the larger loop (radius *R*) by a distance $x >> R$. Consequently, the magnetic field due to the counterclockwise current *i* in the larger loop is nearly uniform throughout the smaller loop. Suppose that *x* is increasing at the constant rate $dx/dt = v$. (a) Find an expression for the magnetic flux through the area of the smaller loop as a function of *x*. In the smaller loop, find (b) an expression for the induced emf and (c) the direction of the induced current.



$$\vec{B} = \frac{\mu_0 i R^2}{2x^3}\hat{i}$$

72) Coil 1 has L_1 = 25 mH and N_1 = 100 turns. Coil 2 has L_2 = 40 mH and N 2 = 200 turns. The coils are fixed in place; their mutual inductance *M* is 3.0 mH. A 6.0 mA current in coil 1 is changing at the rate of 4.0 A/s. (a) What magnetic flux Φ_{12} links coil 1, and (b) what self-induced emf appears in that coil? (c) What magnetic flux Φ_{21} links coil 2, and (d) what mutually induced emf appears in that coil?