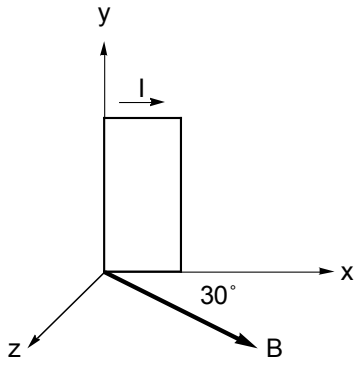
PH 203H213H
S09 Homework – due Tuesday April 29, 2009

1. An alpha particle ($Q = +2e$, $m = 4.00$ u) travels in a circular path of radius 4.50 cm in a uniform magnetic field of strength 1.20 T. Calculate (a) its speed, (b) its period of revolution, (c) its kinetic energy in electron-volts, and (d) the potential difference through which it would have to be accelerated to achieve this energy.

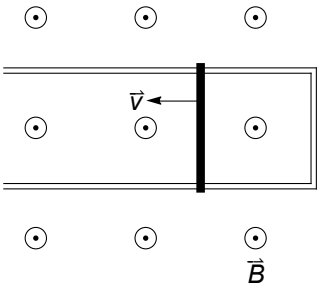
Ans: (b) 1.09×10^{-7} s

2. A rectangular, 20-turn coil of wire is 10 cm by 5.0 cm. It carries a current of 0.10 A and is hinged along the y axis. It is mounted initially in the xy plane. A uniform magnetic field of 0.50 T is perpendicular to the y axis and makes an angle of 30° with the x axis. Find the magnitude and direction of the torque on the coil about the hinge line.



3. A length L of wire carries a current I. The wire can be formed into a circular coil with any number of loops. Show that, when the coil is placed in a magnetic field, the maximum torque occurs with only one loop, and find that maximum torque.

4. A conducting rod of length $L = 10.0$ cm is pulled along horizontal, frictionless conducting rails at a constant speed $v = 5.0$ m/s. A uniform vertical magnetic field $B = 1.2$ T fills the region in which the rod moves. (a) Find the induced emf in the rod. (b) The rod has a resistance of 0.40 Ω, and the conducting rails have negligible resistance. Calculate the current in the conducting loop. (c) Find the energy dissipated in 1.0 second by the current. (d) What external force (magnitude and direction) must be applied to the rod to keep it moving at a constant speed? (e) Find the work done by this external force in moving the rod for 1.0 s. Compare this answer with part (c).



Ans: (b) 1.5 A (d) 0.18 N

5. A rectangular loop of resistance 16 Ω , width 4.0 cm, and length 10.0 cm is being pulled at a constant speed of 1.0 m/s through a region of width 15 cm where there is a uniform magnetic field of 2.0 T. Let x represent the location of the right-hand edge of the loop. As a function of x, plot: (a) the current in the loop, (b) the rate at which energy is dissipated by the current, and (c) the external force that must be applied to keep the loop moving at constant speed.