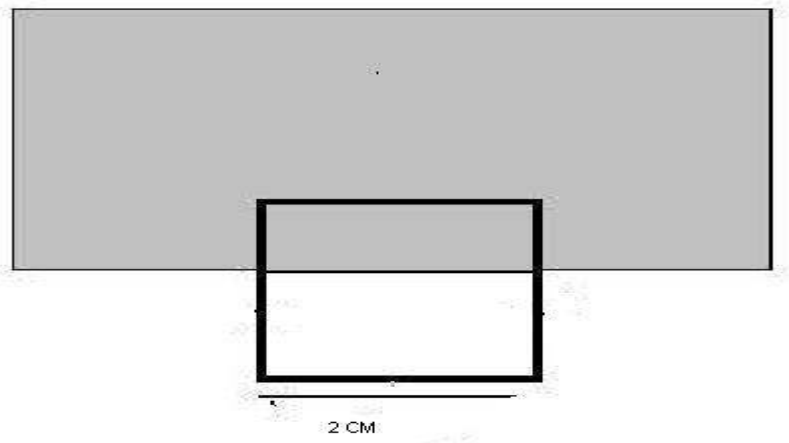
# Fisica II for Mathematica (2007/2008)

Exercise set 2.

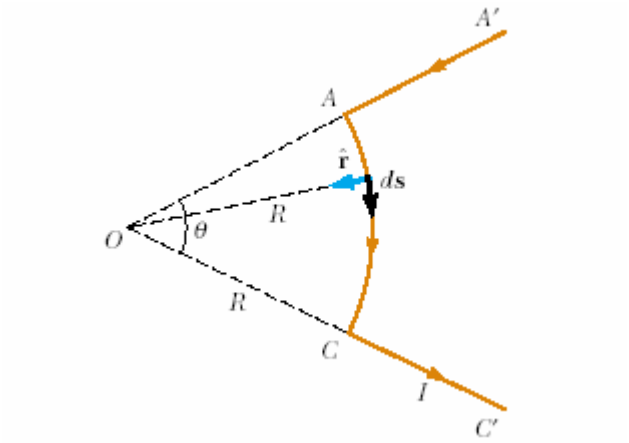
1. A proton moves perpendicular to a uniform magnetic field B at $1.00 \times 10^7$ m/s and experiences an acceleration of $2.00 \times 10^{13}$ m/s$^2$ in the $+x$ direction when its velocity is in the $+z$ direction. Determine the magnitude and direction of the field.
(Mass of P $=1.67\times10^{-27}$ Kg , Charge of P $= 1.6\times10^{-19}$ coulomb)

2. In 1897 J. J. Thomson "discovered" the electron by measuring the charge-to-mass ratio of "cathode rays" (actually, streams of electrons, with charge q and mass m) as follows:
(a) First he passed the beam through uniform crossed electric and magnetic fields E and B (mutually perpendicular, and both of them perpendicular to the beam), and adjusted the electric field until he got zero deflection. What, then, was the speed of the particles (in terms of E and B)?
(b) Then he turned off the electric field, and measured the radius of curvature, R, of the beam, as deflected by the magnetic field alone. In terms of E, B, and R, what is the charge-to-mass ratio (q/m) of the particles?

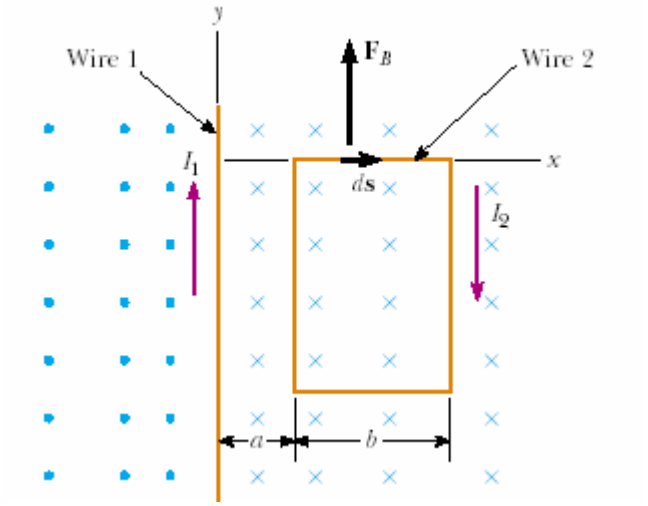
3. A rectangular loop of wire, of mass 2 g, hangs vertically with one end in a uniform magnetic field B = 1T, which points into the page in the shaded region of the picture. For what current I, in the loop, would the magnetic force upward exactly balance the gravitational force downward? What should be the direction of the current (clockwise or anti-clockwise)?




4. Calculate the magnetic field at point O for the current- carrying wire segment shown in Figure. The wire consists of two straight portions and a circular arc of radius $R$, which subtends an angle $\theta$. The arrowheads on the wire indicate the direction of the current.



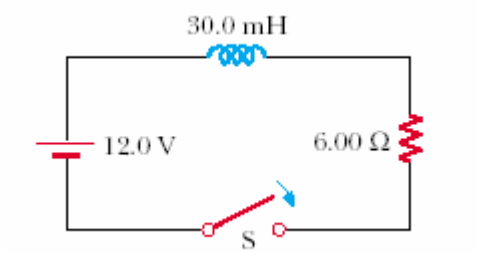

5. Wire 1 in Figure  is oriented along the *y* axis and carries a steady current $I_1$. A rectangular loop located to the right of the wire and in the *xy* plane carries a current $I_2$. Find the magnetic force exerted by wire 1 on the top wire of length *b* in the loop, labeled "Wire 2 " in the figure.




6. A sinusoidally varying voltage is applied across an 8.00- μF capacitor. The frequency of the voltage is 3.00 . kHz, and the voltage amplitude is 30.0 V. Find the displacement current in the capacitor.

7. A long, straight wire of radius *R* carries a steady current I that is uniformly distributed through the cross section of
the wire. Calculate the magnetic field inside and outside the wire. Draw a diagram magnetic field against distance.

8.




(a) Find the time constant of the circuit (b) The switch in the Figure is closed at t=0. Calculate the current in the circuit at t= 2.00 ms.