Massachusetts Institute of Technology *Spring Term 2005*

8.02X Electricity and Magnetism

Problem Set 7

Issued: **Thu, March 24**
Due: **Mon, April 4, 4PM <- note Date & Time!**

Reading suggestions (from Young & Freedman)

Mon, 3/28 Magnetic Field, Lorentz Force
Wed,3/30 Source of Magnetic Fields, Law of Biot-Savart
Fri, 4/1 Ampere's Law

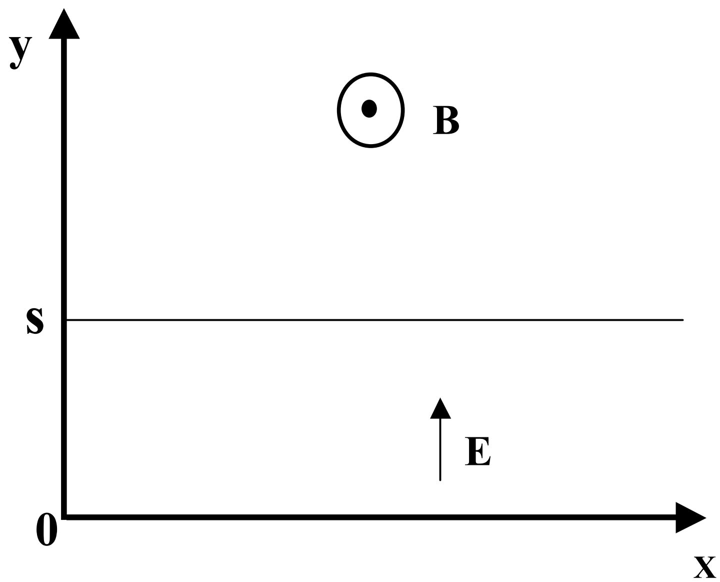
Note that the next experiment is EB (Electric Breakdown). The EB questions will be posted in a separate document. The EB experiment will be due on Monday, April 4.

Problem 1 (5 points):
A charged particle is moving through a uniform magnetic field. If an electric field that points in the same direction as the magnetic field is turned on, describe the path the charged particle will take (use a sketch).

Problem 2 (5 points):
Can you set a resting electron into motion with a constant magnetic field? Explain how (or why not).

Problem 3 (10 points):
See drawing: An ion of mass M and charge q is initially at rest at the origin (x=0) at t=0. A region of uniform electric field E pointing in the y direction extends from y=0 to y=s. Above y=s, there is a region of magnetic field B, pointing in the z direction.

(a) When and where does the ion first cross the x-z plane located at y=s?
(b) What is the ions trajectory in the B-field region? Where does it cross the x-z plane at y=s for the second time?
(c) Where does the ion come to rest?



Problem 4 (10 points):
Shown below is the cross section of a long coaxial cable consisting of an inner core with radius r_0 and an outer shell of radius r_1, both centered at r=0. The inner core carries a current I going into the paper plane, the outer shell carries the same current I in the opposite direction. Using Ampere's law, find the magnitude of the magnetic field B(r) in the region $r_0 < r < r_1$ and $r > r_1$.