Physics 230 B01 / EB01 Final Exam PART I

Date: Friday, April 21, 2006 Time: 9:00 a.m. – 11:00 a.m.
Instructor: Dr. Mark Freeman Place: Main Gym

Instructions:

Very Important: The exam is stapled into two parts. Put your name and ID# on the cover of both parts!

Attempt all six problems. The total is 100 points. Problems 1-4 are each worth 15 points. Problems 5 and 6 are worth 20 points each.

Keep in mind that if you cannot solve an entire problem, you may be able to do parts of it. Show your work, and neatly cross out anything you do not want to have graded. Use the flip side of the question page if you run out of space.

You are allowed a calculator and a two-sided formula sheet.

Name: _____

Student ID#: _____

Signature: _____

Part I

Useful information:

permittivity of free space $\varepsilon_o = 8.85\times10^{-12}\,\frac{C}{V\cdot m}$

permeability of free space $\mu_o = 4\pi\times10^{-7}\,\frac{T\cdot m}{A}$

electron charge $e = -1.60\times10^{-19}\,C$

electron mass $m_e = 9.1\times10^{-31}\,kg$

proton mass $m_p = 1.67\times10^{-27}\,kg$

integrals $\int\frac{dx}{x^2+a^2} = \frac{1}{a}\arctan\frac{x}{a}$

$$\int\frac{dx}{(x^2+a^2)^{3/2}} = \frac{1}{a^2}\frac{x}{\sqrt{x^2+a^2}}$$

$$\int\frac{xdx}{(x^2+a^2)^{3/2}} = -\frac{1}{\sqrt{x^2+a^2}}$$

1. (15 Points)

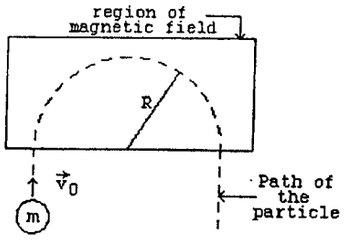
A 49 m long wire has radius 1.1 mm over half of its length and radius 2.2 mm over the other half. The potential difference between the two ends (49 m apart) is 2.6 V, and the wire carries a current of 2.5 A.

a) What is the resistivity ρ of the material of which the wire is made?

b) How much power is dissipated in the narrow section of wire?

2. a) **(8 points)** A proton is sent with velocity 4.7×10^4 m/s in the x-direction into a region where there is a uniform electric field of magnitude 720 V/m in the y direction. What is the magnitude and direction of the uniform magnetic field in the region, if the proton is to pass through undeflected? Assume that the magnetic field has no x-component. Neglect gravitational effects.

b) **(7 points)** A small particle of charge $q = -8.5 \times 10^{-6}$ C and mass 3.1×10^{-12} kg has velocity $v_o = 2.5 \times 10^3$ m/s as it enters a region of uniform magnetic field. The particle is observed to travel in the semicircular path shown below, with radius R = 5.0 cm. Calculate the magnitude and direction of the magnetic field in the region.



3. **(15 points)** A parallel-plate capacitor with circular plates of radius R = 99.00 cm and separated by a distance of 4.00 mm is being charged. The conduction current in the wires is I_c = 6.40 A. Calculate the magnitude and direction of the induced magnetic field at point "a", which is located between the plates, 3.00 cm above the central axis as illustrated below.