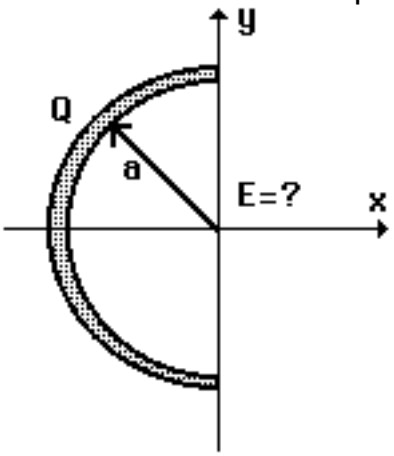
Name:_____ Posting Code: ___ ___ ___

Physics 4B FINAL EXAM
Spring 1987

Solve the following problems in the space provided. Use the back of the page if needed. Each problem is worth 10 points. You must show your work in a logical fashion starting with the correctly applied physical principles. Your score will be maximized if your work is easy to follow because partial credit will be awarded.

1. The earth has a total charge of - 451 kC. (a)Is there net electric flux landing on earth or leaving earth ? (b)Find the total amount of this electric flux. (c)Find the flux that leaves or enters Bidwell Park which has an area of 2400 acres (9.7 km^2). The radius of the earth is 6.4 x 10^6 m. What do you need to assume to do part (c) ?

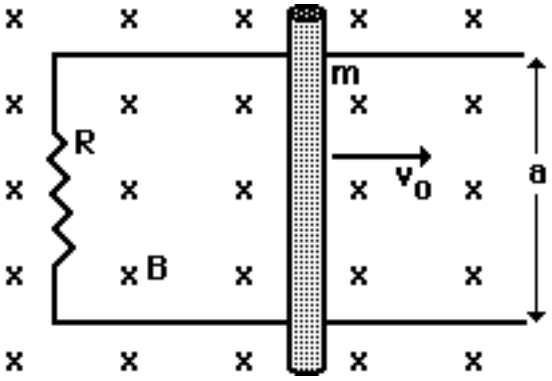
2. Find (a)the electric potential at the center of the semi-circular ring of radius, a, and total charge,Q, shown below and (b)the electric field at this point.



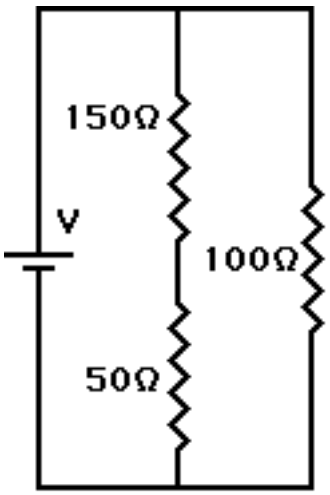
3. A machine is designed to produce a 1.0mA beam of protons (m = 1.7×10^{-27} kg and q = $+1.6 \times 10^{-19}$ C) moving at 3.0×10^{5} m/s. Find (a)the potential difference through which the protons were accelerated, (b)the energy of each proton, (c)the number of protons that leave the machine per second, and (d)the total energy that the protons carry out of the machine per second. (e)Compare the result of part (d) with the product of the current and the potential difference of part (a).

4. A proton is moving in a circular orbit of radius 14cm in a magnetic field of magnitude 0.35T directed perpendicular to the velocity of the proton. Find (a)the speed of the proton, (b)the acceleration of the proton, and (c)the force on the proton.

5. A bar of mass, m, and length, a, moves on two frictionless parallel rails of total resistance, R, in the presence of a uniform magnetic field, B, directed into the paper. The bar is given an initial velocity, v_0, to the right and is released. Sometime later when the bar is moving at a speed, v, find (a)the direction and magnitude of the current induced in the bar, (b)the direction and magnitude of the force on the bar, (c)the acceleration of the bar, and (d)the speed of the bar as a function of time.



6. In the circuit below, the current through the 50Ω resistor is 20mA. Find (a)the current through the 150Ω resistor, (b)the battery voltage, (c)the current through the 100Ω resistor, and (d)the total current provided by the battery.


150Ω
V
100Ω
50Ω

7. An RC circuit contains a 10kΩ resistor and a 5.0μF capacitor initially uncharged. At t=0s, the circuit is connected to a 1.5V battery. Find (a)the maximum charge on the capacitor, (b)the maximum current in the circuit, (c)the time required for the capacitor to become half charged, and (d)the current at this time.

8. An inductor is connected to a power supply with a peak voltage that is measured to be 6.0 ± .1V at a frequency of 1.00 ± .04kHz. The resulting current through the inductor is 7.0 ± .3mA. Find (a)the inductance of the inductor and (b)the uncertainty in the inductance. The manufacturer of the inductor claim's its inductance to be 140mH. (c)Do these results confirm this claim ? Explain.

9. An LRC series circuit which contains a 40Ω resistor, a 185mH inductor, and a 65μF capacitor is connected to a 110V rms power supply. Find (a)the resonance frequency. Find (b)the rms current in the circuit at this frequency. Find the rms voltage across (c)the inductor, (d)the capacitor, and (e)the resistor at this frequency.

10. A helium-neon laser intended for instructional use operates at a typical power of 3.5mW. (a)Determine the maximum value of the electric field at a point where the cross section of the beam is $8.0mm^2$. (b)Calculate the electromagnetic energy in a 1.0m length of the beam.