Practice Exam

1. A singly charged ion of mass m is accelerated from rest by a potential difference \( \Delta V \) and deflected by a uniform magnetic field B (perpendicular to the ion’s velocity) into a circular path of radius R. A doubly charged ion of mass m’ is accelerated through the same \( \Delta V \) and is deflected by the same magnetic field into a circular path of radius R’=2R. What is the ratio of the masses of the ions?
2. An infinitely long wire with current I=2 A is curved as shown below. Suppose an electron is located at point P and is moving with velocity $\vec{v} = -v_0 \hat{y}$ at time $t_0$, where $v_0 = 3 \times 10^4$ m/s. Determine the magnetic force (magnitude and direction) on the electron at time $t=t_0$. 
3. A long cylindrical shell with inner radius $a$ and outer radius $b$ carries total current $I_1$ with a uniform current density. A long wire with current $I_2$ ($|I_2| = 2|I_1|$) in the opposite direction is located at the center of the cylindrical shell. Compute the magnetic field (magnitude and direction) everywhere.
4. In the circuit below, the switch S has been closed for a long time and the circuit carries a constant current. Take $C_1 = 6.00 \, \mu F$, $C_2 = 2.00 \, \mu F$, $R_1 = 2.00 \, k\Omega$, and $R_2 = 5.00 \, k\Omega$. The power delivered to $R_2$ is 3.20 W.
(a) Find the charge on $C_1$ and $C_2$.
(b) Now the switch is opened. After equilibrium is reached in the circuit, what are the charges on $C_1$ and $C_2$?
(c) Suppose now the battery is disconnected from the circuit while S is kept open. What is the total charge stored on the capacitors as a function of time?