Physics 211 Quiz 2

April 25, 2005

Your name:

ID number:

Time given: 60 minutes

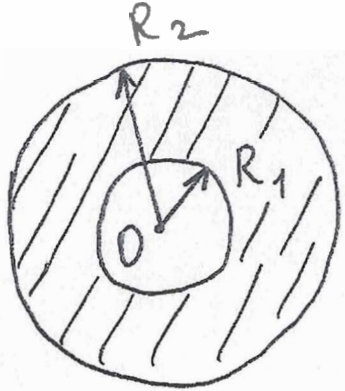
Please provide your reasoning for each step of your solution (providing an answer without a solution is not enough)

Problem 1 (40 pts)

A spherical conducting shell with the internal and the external radii equal to R_1 and R_2 has a non-constant resistivity which grows linearly with the distance r from the origin O: $\rho(r) = \alpha r$ $(R_1 \leq r \leq R_2)$ where α is a given constant.

a)Find the total resistance between the inner and the outer surfaces of the shell

b)Find the current density $\vec{j}(r)$ as a function of r if a potential difference between the inner and the outer surfaces is equal to ΔV



$\rho(r) = \alpha r$

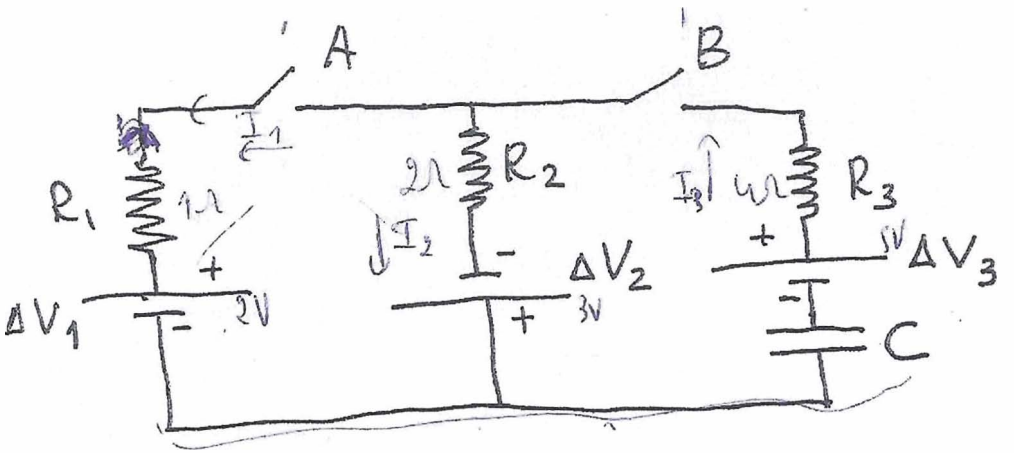
$(R_1 \leq r \leq R_2 \,,\ \alpha = const)$

Problem 2 (40 pts)

In the circuit shown on the Figure 1, the resistances are $R_1 = 1\Omega, R_2 = 2\Omega, R_3 = 4\Omega$ and the voltages of the batteries $\Delta V_1 = 2V, \Delta V_2 = 3V, \Delta V_3 = 5V$. The capacitance C of the capacitor is unknown. The switches A and B are turned on simultaneously at $t = 0$.

a)Find the currents I_1, I_2, I_3 through the resistors R_1, R_2, R_3 at $t = 0$, i.e. immediately after the switches are closed.

b)Find the currents I_1, I_2, I_3 through all of the resistors at $t = \infty$, i.e. after the switches would have been closed for a very long (infinite) time.



Problem 3 (20 pts)

A non-uniform magnetic field has the form: $\vec{B}(x,y,z) = yz\vec{i} + 2xz\vec{j} + 3xy\vec{k}$ (T) At a certain moment a charged particle moving with the velocity $\vec{v} = \vec{i} + \vec{j} + \vec{k}$ $(\frac{m}{s})$is passing through the point A with the coordinates $10\vec{i} + y\vec{j} + z\vec{k}$(m) where the values of y and z are unknown. Find the coordinates of the point A if it is known that the force exerted on the particle by the magnetic field is zero at the moment the particle is passing the point A.