Printed Name

Nine-digit GT ID

signature

Spring 2021   **PHYS 2212 G**   **Test 03**

- Put nothing other than your name and nine-digit GT ID in the blocks above. Print clearly so that OCR software can properly identify you. Sign your name on the line immediately below your printed name.

Test Form:

3A

- Free-response problems are numbered I–III. Show all your work clearly, including all steps and logic. Write darkly. Blue or black ink is recommended. Do not make any erasures in your free-response work. Cross out anything you do not want evaluated. Box your answer.

- Multiple-choice questions are numbered 1–6. For each, select the answer most nearly correct, circle it on your test, and fill the bubble for your answer on this front page.

- Initial the odd pages in the top margin, in case the pages of your quiz get separated.

- A standard formula sheet is provided as the cover page for this test. Please remove it from the test before you submit it to the proctor.

- If the page for a free-response problem has insufficient space for your work, ask a proctor for an additional sheet. If you wish this work to be evaluated, put your name on the sheet and make a note on the problem page, so graders know where to find your work. Place any added pages at the **back** of your test, when submitting your exam.

- You may use a calculator that cannot store letters, but no other aids or electronic devices.

- Scores will be posted when your test has been graded. Test grades become final when the next is given.
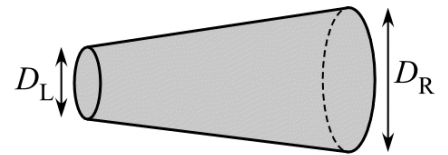
Question value 8 points

(01) A copper wire has n_1 mobile electrons per cubic millimeter and diameter D. At a junction point, the wire is spliced to two identical silver wires having $n_2 = 0.68\, n_1$ mobile electrons per cubic millimeter. For what diameter of the aluminum wires will the drift speed of electrons be the same on both sides of the splice?
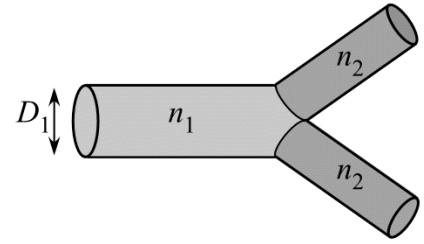
    (a) $D_2 = 1.17\, D_1$
    (b) $D_2 = 0.86\, D_1$
    (c) $D_2 = 0.74\, D_1$
    (d) $D_2 = 1.21\, D_1$
    (e) $D_2 = 0.54\, D_1$
    (f) $D_2 = 1.85\, D_1$
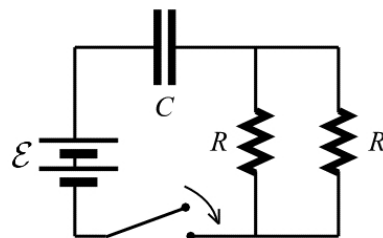
Question value 8 points

(02) An aluminum wire has a varying diameter, increasing uniformly from diameter D on the left to diameter $2D$ on the right. A current I_L flows into the wire on the left. The magnitude of the electric field in the wire at that point is E_L. What is the current and the electric field magnitude at the right end of the wire?

    (a) $I_R = I_L/2$ and $E_R = E_L/2$

    (b) $I_R = I_L/4$ and $E_R = E_L/4$

    (c) $I_R = I_L$ and $E_R = E_L/4$

    (d) $I_R = I_L$ and $E_R = E_L/2$

    (e) $I_R = I_L/2$ and $E_R = E_L/4$

   (f) $I_R = I_L$ and $E_R = E_L$

Question value 8 points

(03) In the circuit below, the capacitor is initially uncharged. After the switch is closed, how much time must elapse for the capacitor to reach 2/3 of its final charge value?

(a) $0.81\ RC$

(b) $0.33\ RC$

(c) $1.11\ RC$

(d) $0.55\ RC$

(e) $0.67\ RC$

(f) $0.20\ RC$

Question value 8 points

(04) Three capacitors are arranged in the network shown below. They are attached to an emf $\mathcal{E}$ and allowed to reach equilibrium. Rank, from greatest to least, the energies stored by each of the three capacitors.
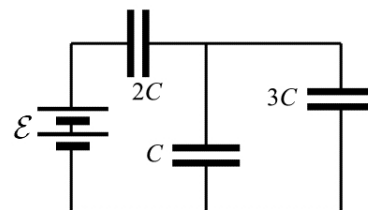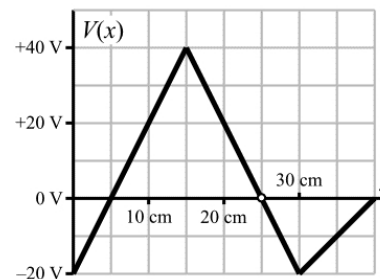
(a) $U_3 = U_1 > U_2$

(b) $U_2 > U_3 > U_1$

(c) $U_3 > U_2 > U_1$

(d) $U_2 > U_3 = U_1$

(e) $U_2 = U_3 = U_1$

Question value 4 points

(5.1) In the graph at right, the electric potential is plotted as a function of position along the x-axis.

(a) $E = 400$ N/C in the positive x-direction

(b) $E = 200$ N/C in the negative x-direction

(c) $E = 200$ N/C in the positive x-direction

(d) $E = 0$ N/C

(e) $E = 400$ N/C in the negative x-direction

Question value 4 points

(5.2) In the graph at right, the x-component of the electric field is plotted as a function of position along the x-axis. The y- and z-components of the field are identically zero. If the electric potential at the origin is $V = +20$ volts, what is the electric potential at $x = 30$ cm?
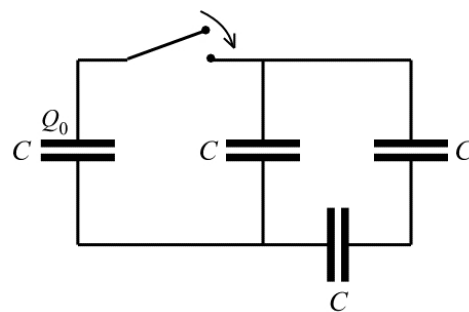

(a) $V = +20$ volts

(b) $V = -15$ volts

(c) $V = +35$ volts

(d) $V = 0$ volts

(e) $V = +5$ volts

(f) $V = -20$ volts
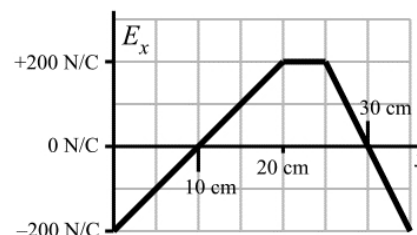
The following problem will be hand-graded. Show all supporting work for this problem.

(06)   *(20 points)* In the figure at right, capacitor C is initially charged up to store a total charge Q_0. The other capacitors in the network, having the indicated multiples of capacitance C, are initially uncharged. The switch is then closed and the network is allowed to reach equilibrium.

Find the final charge stored on the capacitor at bottom right. Express your answer as a fraction of Q_0.

The following problem will be hand-graded. <u>Show all supporting work for this problem</u>.

(07) *(20 points)* A real battery having known emf $\mathcal{E}$ and unknown internal resistance r is hooked up to the network of four unknown but identical resistances R shown at right. An ammeter records the current flowing out of the batter as I_0. A voltmeter place across resistor #3 measures a voltage drop $\Delta V = -\mathcal{E}/6$.

Determine the value of the external resistances R and the internal resistance r. In each case, express your answer in terms of $\mathcal{E}$ and I_0.
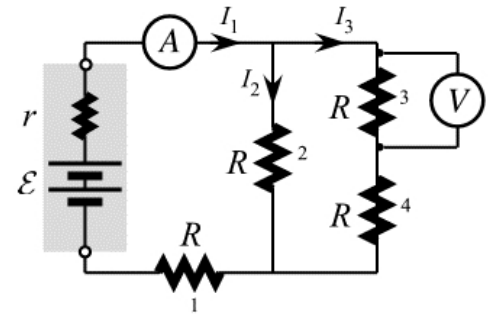
The following problem will be hand-graded. <u>*Show all supporting work for this problem.*</u>

(08) *(20 points)* Two resistors are constructed out of equal volumes of nickel-chromium alloy. The first is extruded to form a cylindrical resistor of length L. The second is extruded to form a cylindrical resistor of length $2L$. Assume both resistors are Ohmic.

Determine the ratio of the power dissipation of the two resistors, P_2/P_1, when they are connected **in series** across an emf $\mathcal{E}$.