| Printed Name | Nine-digit GT ID |
|---|---|
| | |

*signature*

**Fall 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.
- 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.

Test Form:

**3A**

- Multiple-choice questions are numbered 1–6. For each, select the answer most nearly correct, circle it on yourtest, 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.
- 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.

*Fill in bubbles for your Multiple Choice responses HERE*
*Mark answers answers darkly and neatly.*
*If you wish to change an answer, draw a clear "X" through the non-answer!*

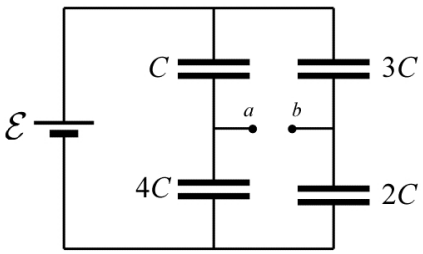
1. ⓐ ⓑ ⓒ ⓓ ⓔ ⓕ
2. ⓐ ⓑ ⓒ ⓓ ⓔ ⓕ
3. ⓐ ⓑ ⓒ ⓓ ⓔ ⓕ
4. ⓐ ⓑ ⓒ ⓓ ⓔ ⓕ
5. ⓐ ⓑ ⓒ ⓓ ⓔ ⓕ
6. ⓐ ⓑ ⓒ ⓓ ⓔ ⓕ

*Extra Worksapace: If you use this space for a free-response problem, be sure to point it out on that problem's page!*

*The following problem will be hand-graded. Show all supporting work for this problem.*

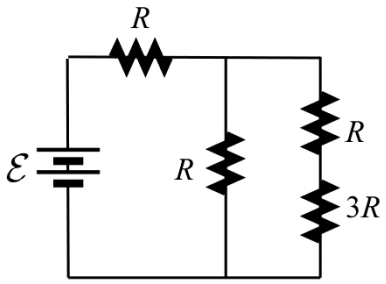
**[I]** *(20 points)* Four capacitors—$C, 2C, 3C$, and $4C$—are arranged in the network shown at right, and attached to an ideal battery having emf $\mathcal{E}$. Determine the potential difference across gap $a - b$. Be sure to specify which side of the gap, $a$ or $b$, is at high potential. Express your answer as a fraction of $\mathcal{E}$.

*Hint: analyze the network and then consider a loop rule expression for a loop including the gap.*



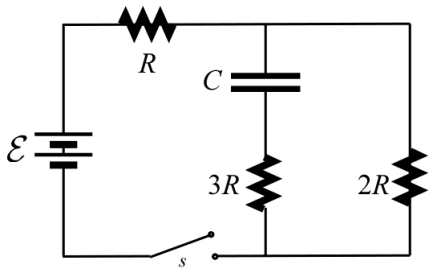
*The following problem will be hand-graded. Show all supporting work for this problem.*

**[II]** *(20 points)* In the resistor network at right, determine the power consumed by resitor $3R$. Express your answer in terms of $\mathcal{E}$ and $R$.



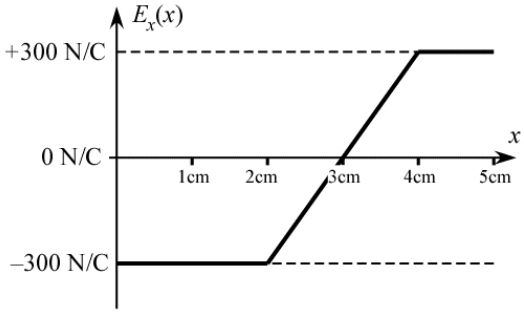
*The following problem will be hand-graded. Show all supporting work for this problem.*

**[III]** *(20 points)* In the resistor-capacitor circuiot at right, switch *S* has been closed for a very long time. At time $t = 0$, the switch is opened and the capacitor begins to discharge. How much time must elapse in order for the potential difference across the capacitor to drop to $\mathcal{E}/6$? Express your answer in terms of $\mathcal{E}$, $R$, and $C$, as needed.



*Question value 4 points*

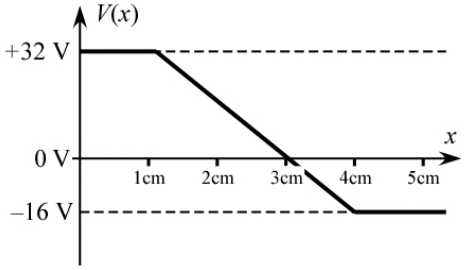
(1) The graph at right depicts the $x$-component of the electric field in the vicinity of the origin. If the electric potential at the origin is –3 volts, what is the electric potential at $x$ = 4 cm?




(a) –6 volts
(b) –9 volts
(c) 0 volts
(d) +6 volts
(e) +3 volts
(f) –3 volts

*Question value 4 points*

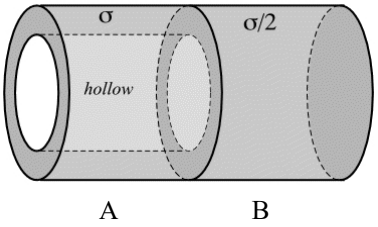
(2) The graph at right depicts the electric potential as a function of x, in the vicinity of the origin. What is the x-component of the electric field at $x$ = 5 cm?




(a) 1600 N/C, to the right
(b) zero
(c) 2400 N/C, to the left
(d) 1600 N/C, to the left
(e) 2400 N/C, to the right

*Question value 8 points*

(3) Wire A (conductivity $\sigma$) is hollow, with inner radius $R$ and outer radius $1.5R$. It is spliced to solid wire B (conductivity $\sigma/2$), with radius $1.5R$. Determine the relative electric field strengths in the two wires when a current flows through the junction.




(a) $E_B = \frac{5}{2} E_A$

(b) $E_B = \frac{5}{9} E_A$

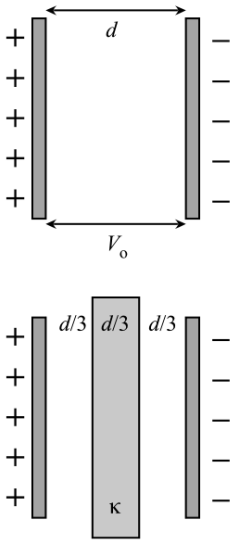
(c) $E_B = \frac{9}{10} E_A$

(d) $E_B = \frac{9}{2} E_A$

(e) $E_B = \frac{10}{9} E_A$

*Question value 8 points*

(4) An isolated, vacuum-filled capacitor has a charge $Q$ placed on it, resulting in a potential difference $V_o$ across the plates. An insulating slab having thickness $d/3$ and dielectric constant $\kappa = 1.5$ is inserted between the plates, as shown at bottom right. In terms of the original vacuum potential $V_o$, what is the new potential difference across the plates?




(a) $V = \frac{3}{2} V_o$

(b) $V = \frac{8}{9} V_o$

(c) $V = \frac{2}{9} V_o$

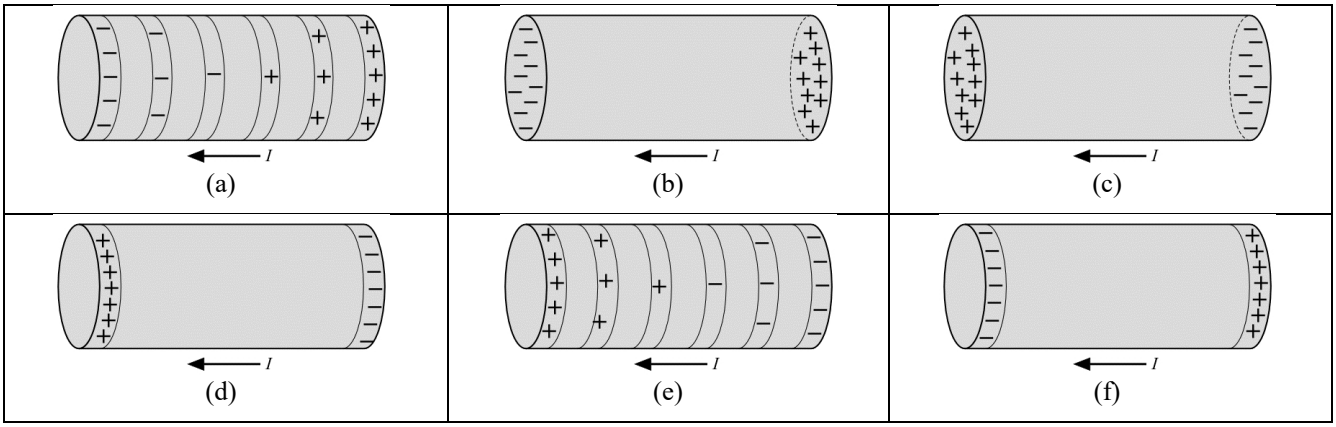
(d) $V = \frac{2}{3} V_o$

(e) $V = \frac{9}{8} V_o$

(f) $V = \frac{9}{4} V_o$

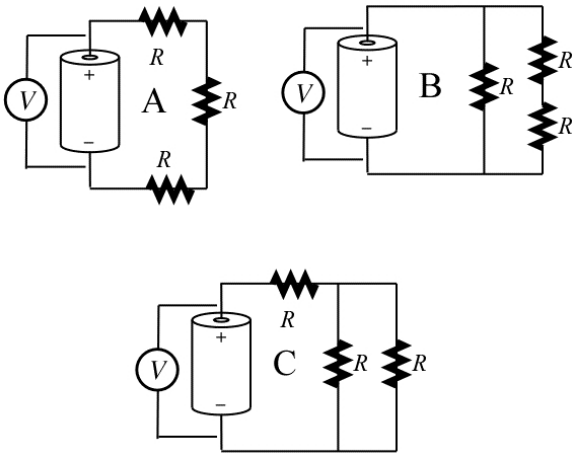
*Question value 8 points*

(5) A cylindrical wire of length $L$ and diameter $D$ carries a right-to-left current $I$. Which of the figures below best represents the distribution of charges on the wire that "shepherd" the flow of current in the wire?




*Question value 8 points*

(6) A real battery having emf $\mathcal{E}$ and internal resistance $r$ is connected in turn to each of the three 3-resistor networks shown at right. Rank, from greatest to least, the terminal potential across the battery when placed connected to each network.




(a) $V_A > V_C > V_B$

(b) $V_A > V_B = V_C$

(c) $V_A = V_C = V_B$

(d) $V_B > V_C > V_A$

(e) $V_B = V_C > A$

(f) $V_C > V_B > A$