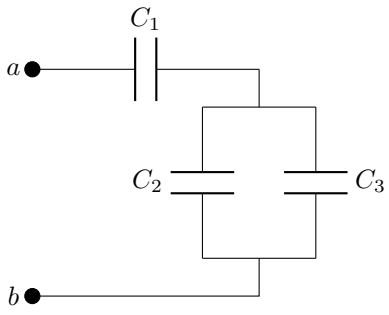
Make sure to fill out the grading sheet completely including your name, instructor, exam flavor and UIN. You are allowed to write and work on this exam copy, but your answers must be bubbled in on the grading sheet to receive credit. Your bubbled responses are the only responses that will be considered for the grade.

Physics 207 Exam 2 – Flavor 1

Problem 1 (8 points) Three capacitors, with capacitances $C_1 = 4.0\ \mu$F, $C_2 = 3.0\ \mu$F , and $C_3 = 2.0\ \mu$F, are connected to a 9.0-V voltage source, as shown in the figure. What is the charge on capacitor C_2?

A) $20\,\mu$C [4 points]
B) $12\,\mu$C [8 points]
C) $10\,\mu$C
D) $8\,\mu$C [4 points]
E) $4\,\mu$C
F) $2\,\mu$C

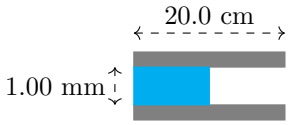


Problem 2 (8 points) A parallel-plate capacitor with plate separation of 2.0 cm has square plates, each with an area of 6.0×10^{-2} m^2. A dielectric material with a dielectric constant of $K = 2.4$ is placed between the plates, completely filling them. What is the potential energy stored in the capacitor when a 4.0 V potential difference is applied?

A) 1.2×10^{-10} J
B) 1.9×10^{-10} J
C) 2.1×10^{-10} J [4 points]
D) 4.7×10^{-10} J
E) 5.1×10^{-10} J [8 points]

Problem 3 (8 points) In the figure below square plates with sides of length 20.0 cm are separated by a distance of 1.00 mm. There is a dielectric with constant $\kappa = 3.80$ that fills half the volume. What is the capacitance of this system?

A) 1.77×10^{-10} F
B) 3.54×10^{-10} F
C) 4.69×10^{-10} F
D) 6.73×10^{-10} F [5 points]
E) 8.50×10^{-10} F [8 points]
F) 1.35×10^{-9} F [4 points]
G) 2.85×10^{-9} F
H) 5.57×10^{-9} F

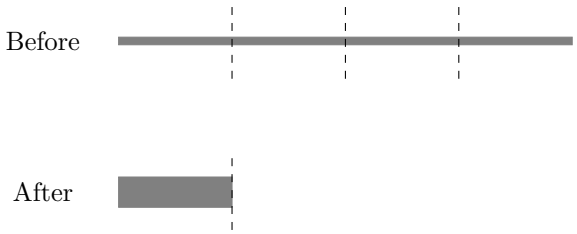


Problem 4 (8 points) The current in a wire varies with time according to the equation $I(t) = 6.00 + 4.80t$, where t is in seconds. Approximately how many electrons pass a cross section of the wire in the time period between $t = 0.00$ and $t = 3.00$ s?

A) 25×10^{19} [8 points]
B) 20×10^{19}
C) 15×10^{19}
D) 10×10^{19}

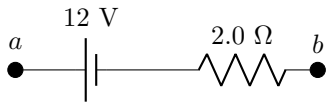
Problem 5 (5 points) A metal wire, which has a specific power rating, can carry a maximum current I. The wire is then cut into 4 equal pieces that are then connected side by side to form a new wire whose length is equal to one-fourth the original length. What maximum current can the newly formed wire carry?

A) $16I$ [2 points]
B) $4I$ [5 points]
C) $2I$
D) $I/2$
E) $I/4$
F) $I/16$



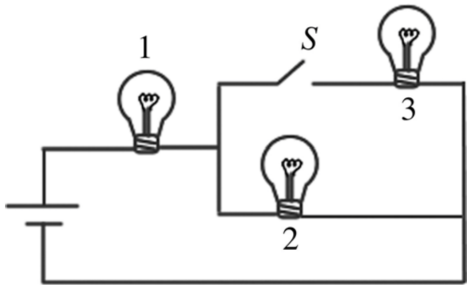
Problem 6 (8 points) In the figure, when the voltage difference $V_b - V_a = 20$ V, how much current passes through, including its direction?

A) 16 A, from a to b [6 points]
B) 6 A, from a to b
C) 4 A, from a to b [4 points]
D) 16 A, from b to a [8 points]
E) 6 A, from b to a [2 points]
F) 4 A, from b to a [2 points]



Problem 7 (5 points) The figure shows three identical lightbulbs connected to a battery having a constant voltage across its terminals. What happens to the brightness of lightbulb 1 when the switch S is closed?

A) The brightness increases permanently. [5 points]
B) The brightness will increase momentarily then return to its previous level.
C) The brightness decreases permanently. [1 points]
D) The brightness will decrease momentarily then return to its previous level.
E) The brightness remains the same as before the switch is closed.

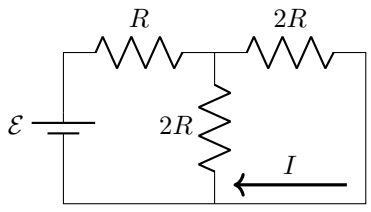


Problem 8 (5 points) A parallel-plate capacitor filled with air has a capacitance C_0 and is connected to a battery and allowed to fully charge. The battery is then removed and a dielectric material of dielectric constant κ is used to fill the space between the plates. What is the sign of work done by an external force to insert the dielectric?

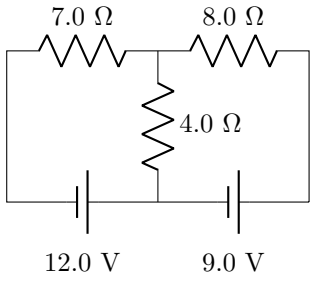
A) The work done by an external force is positive [1 points]
B) The work done by an external force is zero
C) The work done by an external force is negative [5 points]

Problem 9 (8 points) For the circuit shown in the figure, $I = 0.50$ A and $R = 12\ \Omega$. What is the value of the emf?

A) 6.0 V
B) 12 V [3 points]
C) 18 V [2 points]
D) 24 V [8 points]
E) 48 V

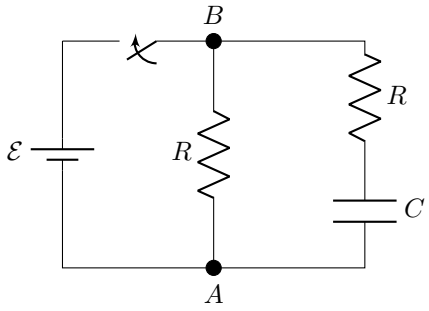


Problem 10 (8 points) For the circuit shown in the figure, determine the current in the 7.0-Ω resistor.



A) 1.6 A [8 points]
B) 2.3 A
C) 2.7 A [3 points]
D) 3.9 A
E) 4.1 A

Problem 11 (8 points) In the following circuit the switch has been open for a long time. The resistors have $R = 330\ \Omega$, the capacitor is $C = 470\ \mu$F and the battery is $\mathcal{E} = 1.50$ V. How much time does it take for the capacitor to reach 75% of its maximum charge after the switch is closed?



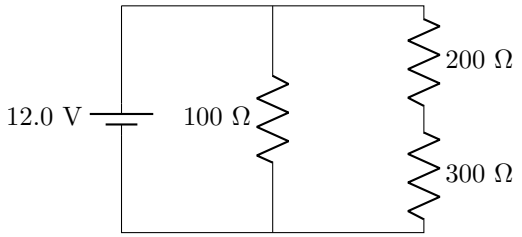
A) 0.0446 s [4 points]
B) 0.0767 s
C) 0.108 s [5 points]
D) 0.215 s [8 points]
E) 0.318 s
F) 0.430 s [5 points]
G) 0.652 s
H) 0.899 s

Problem 12 (8 points) If the switch in the previous problem has been closed for a long time, what would the current magnitude and direction be right after the switch was opened?

A) 9.09 mA from A to B [3 points]
B) 9.09 mA from B to A [5 points]
C) 6.24 mA from A to B
D) 6.24 mA from B to A [2 points]
E) 4.66 mA from A to B [2 points]
F) 4.66 mA from B to A [4 points]
G) 2.27 mA from A to B [6 points]
H) 2.27 mA from B to A [8 points]

Problem 13 (8 points) What is the power dissipated across the 200 Ω resistor?

A) 2.04 W
B) 1.73 W [4 points]
C) 1.44 W
D) 0.623 W
E) 0.472 W
F) 0.253 W
G) 0.173 W
H) 0.115 W [8 points]



Problem 14 (5 points) What is the potential across the capacitor in the following circuit after the switch has been closed for a very long time?

A) 0 V
B) 3 V
C) 6 V [5 points]
D) 9 V
E) 10.5 V
F) 12 V [1 points]
G) 15 V
H) 18 V