Exam-2 Phys-207 Spring '20

1) *Parallel-plate capacitor energy [8 pts.]* A parallel-plate capacitor with a non-zero charge is disconnected from any battery. If the separation of its plates is doubled, the electric energy stored in the capacitor is:

(A) ¼ of the original
(B) ½ of the original
(C) unchanged
(D) doubled
(E) quadrupled
(F) 8 times the original

2) *Parallel-plate capacitor with dielectric* [*8 pts.*] A charged air-filled capacitor charged is connected to a 12 V battery. A sheet of dielectric with κ=5 is inserted completely filling the volume between its plates. As a result, the electric energy stored in the capacitor is:

(A) 1/25 of the original
(B) 1/5 of the original
(C) unchanged
(D) 5 times the original
(E) 9 times the original
(F) 25 times the original

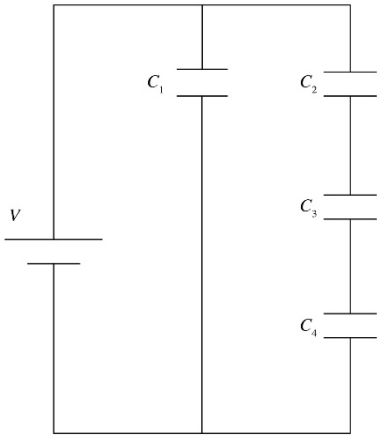
3) Capacitor electric field [*8 pts.*] A fully charged parallel-plate capacitor with a plate separation of 12.5 mm and a capacitance of 10 μF stores 8 mJ of energy. Find the electric field strength inside the capacitor.

(A) 42 V/m
(B) 320 V/m
(C) 1250 V/m
(D) 2260 V/m
(E) 3200 V/m
(F) 4200 V/m

4) Capacitor circuit [*10 pts.*] Consider the circuit shown with voltage V and 4 capacitors with equal capacitance C. Calculate the total capacitance and the final charge on capacitor 2, which is the top right-hand capacitor in the figure.

(A) C_{tot} = 1/3 C , Q_2 = 1/3 CV
(B) C_{tot} = 2/3 C , Q_2 = 2/3 C V
(C) C_{tot} = 3/4 C , Q_2 = (3/4) (V/C)
(D) C_{tot} = 4/3 C , Q_2 = 1/3 CV

(E) C_{tot} = 4/3 C , Q_2 = 2/3 V
(F) C_{tot} = 5/3 C , Q_2 = 1/3 C V



5) *wire current density [8 pts.]* A current density of 1.6 * 10^6 A/m^2 flows through a wire with a conduction electron density of 8.5 * 10^{28} /m^3. What is the drift speed of the electrons?

(A) 9.4 * 10^{-7} m/s
(B) 4.2 * 10^{-6} m/s
(C) 3.3 * 10^{-5} m/s
(D) 1.2 * 10^{-4} m/s
(E) 1.1 * 10^{-3} m/s
(F) 3.5 * 10^{-2} m/s

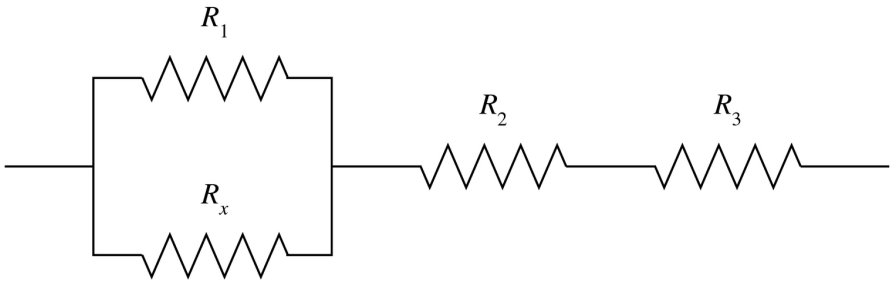
6) terminal voltage [*8 pts.*] A battery has an EMF of 12.00 V. When you draw a current of 1.200 A from it, the terminal voltage is 10.64 V. What is terminal voltage when you draw a current of 0.600 A?

(A) 5.30 V
(B) 9.96 V
(C) 10.48 V
(D) 11.32 V
(E) 11.68 V
(F) 11.94 V

7) *resistor network [10 pts.]* For the configuration shown below a total resistance of R_{tot} = 2.33 R is measured. The resistances R_1 = R_2 = R_3 = R are also known. Determine the value of the unknown resistance R_x.

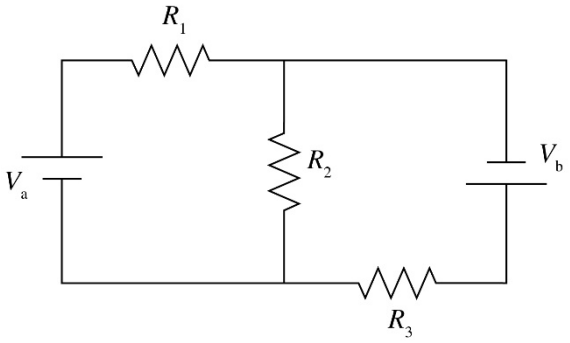
(A) R_x = R/4
(B) R_x = R/3
(C) R_x = R/2

(D) $R_x = 2/3\ R$
(E) $R_x = R$
(F) $R_x = 2R$

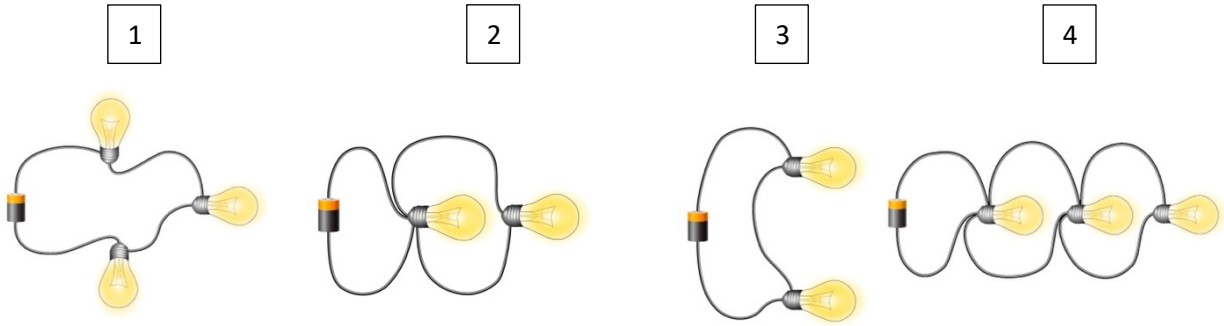


8) *battery-resistor network [8 pts.]* Consider the circuit shown below, with the current I_1 through R_1 going from left to right, the current I_2 through R_2 from top down and I_3 through R_3 from right to left. When applying the Kirchhoff loop rule to the left and to the right loop, respectively, one obtains:

(A) $V_a - I_1 R_1 - I_2 R_2 = 0$ and $V_b - I_3 R_3 - I_2 R_2 = 0$
(B) $V_a - I_1 R_1 - I_2 R_2 = 0$ and $V_b - I_3 R_3 + I_2 R_2 = 0$
(C) $V_a + I_1 R_1 - I_2 R_2 = 0$ and $V_b - I_1 R_1 - I_2 R_2 = 0$
(D) $V_a + I_1 R_1 - I_2 R_2 = 0$ and $V_b - I_1 R_1 - I_3 R_3 = 0$
(E) $V_a + I_1 R_1 - I_3 R_3 = 0$ and $-V_b + I_3 R_3 + I_2 R_2 = 0$
(F) $V_a + I_1 R_1 - I_2 R_2 = 0$ and $V_b - I_3 R_3 + I_2 R_2 = 0$



9) *lightbulb-circuits [8 pts.]* Order the circuits shown below according to their power output, from highest to lowest. All batteries have the same voltage, and all light bulbs have the same resistance.



(A) 1 > 2 > 3 > 4
(B) 1 > 3 > 4 > 2
(C) 2 > 3 > 1 > 4
(D) 2 > 4 > 1 > 3
(E) 3 > 4 > 2 > 1
(F) 3 > 1 > 2 > 4
(G) 4 > 1 > 2 > 3
(H) 4 > 2 > 3 > 1

10) *appliances power [8 pts.]* A 120 V outlet is protected by a 20 A circuit breaker. Select the pair of appliances with the maximum power output that can be operated at the same time from the same outlet.

(A) a 1150 W waffle iron and a 1300 W space heater
(B) a 1100 W playstation and a 850 W flat iron
(C) a 1300 W microwave and a 1000 W waffle iron
(D) a 1500 W blow dryer and a 850 W flat-iron
(E) a 1200 W toaster and a 1050 W leaf blower
(F) a 1300 W microwave and a 900 W waffle iron

11) capacitor charging [*8 pts.*] You charge an initially uncharged capacitor through a 400 Ω resistor by means of a battery. After 0.1 s the capacitor reaches 90% of its maximum charge. What is the capacitance of the capacitor?
(A) 109 μF
(B) 220 μF
(C) 92 μF
(D) 2200 μF
(E) 1100 μF
(F) 550 μF

12) RC network [*8 pts.*] Consider the RC circuit shown in the diagram, with a battery voltage V. The 3 resistances are equal (R1 = R2 = R3 = R) and the 2 capacitances are also equal (C1 = C2 = C). What is the magnitude of the current supplied by the battery a long time after the switch is closed ?

(A) 3V/R

(B) 2V/R
(C) V/R
(D) V/2R
(E) V/3R
(F) 0