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 << +8
(E) quadrupled
(F) 8 times the original

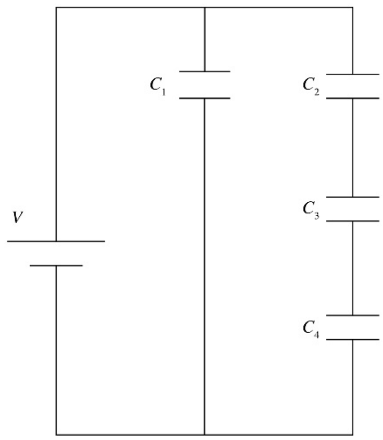
2) *Parallel-plate capacitor with dielectric* [*8 pts.*] A charged air-filled capacitor charged is connected to a 12 V battery. A sheet of dielectric with κ=5 is inserted completely filling the volume between its plates. As a result, the electric energy stored in the capacitor is:

(A) 1/25 of the original
(B) 1/5 of the original
(C) unchanged
(D) 5 times the original << +8
(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 << +8
(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 << +10
(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 << +8
(E) 1.1 * 10^{-3} m/s
(F) 3.5 * 10^{-2} m/s

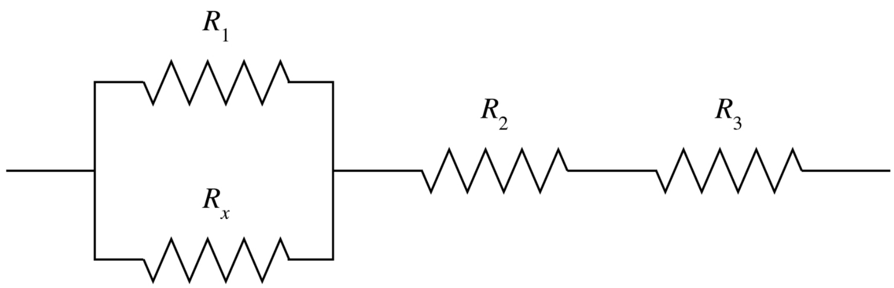
6) terminal voltage [*8 pts.*] A battery has an EMF of 12.00 V. When you draw a current of 1.200 A from it, the terminal voltage is 10.64 V. What is terminal voltage when you draw a current of 0.600 A?

(A) 5.30 V
(B) 9.96 V
(C) 10.48 V
(D) 11.32 V << +8
(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

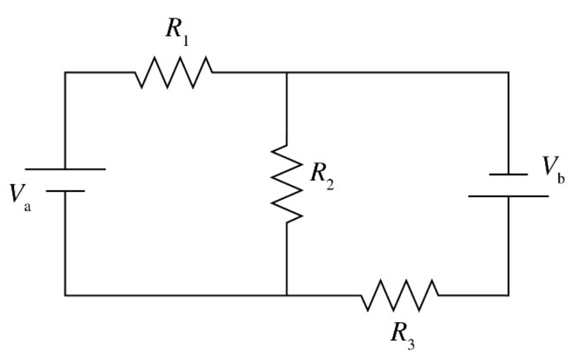
resistance R_x.

(A) $R_x = R/4$
(B) $R_x = R/3$
(C) $R_x = R/2$ << +10
(D) $R_x = 2/3\ R$
(E) $R_x = R$
(F) $R_x = 2R$



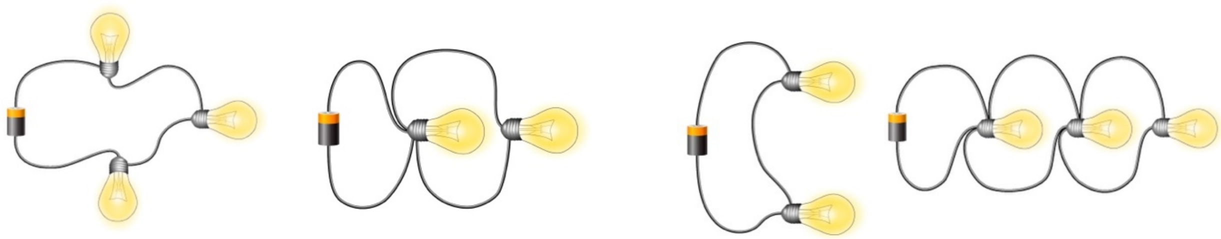
8) *battery-resistor network [8 pts.]* Consider the circuit shown below, with the current I_1 through R_1 going from left to right, the current I_2 through R_2 from top down and I_3 through R_3 from right to left. When applying the Kirchhoff loop rule to the left and to the right loop, respectively, 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 $V_b - I_3 R_3 + I_2 R_2 = 0$ << +8
(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.

1 2 3 4



(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 << +8

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 << +8
(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 << +8
(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 < +8
(D) V/2R
(E) V/3R
(F) 0 +2