Midterm Exam No. 02 (2017 Spring)

PHYS 205B: University Physics

Date: 2017 Mar 9

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 4.
2. Total time = 75 minutes.
3. There are 8 questions in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to show your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (**10 points.**) The average cost of electricity in the United States, for residential users, is about 0.12 USD/kWh (10 cents per kiloWatt-hour). At this rate your electricity bill for a month came out to be 50.00 USD. How much electric energy (in Joules) did you use in the month?

2. (**10 points.**) A capacitor has a plate area of $2.5\,\mathrm{cm}^2$ and an electric field of magnitude $1500\,\mathrm{V/m}$ between its plates. What is the charge on the capacitor?

3. (**10 points.**) A cylindrical copper rod has resistance R. It is reformed to thrice its original length with no change of volume. What is its new resistance in terms of the original resistance R?

4. (**10 points.**) A potential difference $V = 10.0\,\mathrm{V}$ is applied across a capacitor arrangement with two capacitances connected in series, $C_1 = 10.0\,\mu\mathrm{F}$ and $C_2 = 20.0\,\mu\mathrm{F}$.

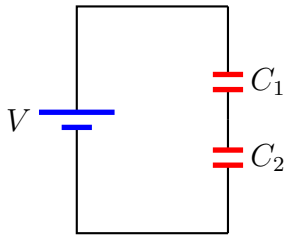

Figure 1: Problem 4

(a) Find the equivalent capacitance.

(b) Find the charges Q_1 and Q_2 on each of the capacitors.

(c) Find the voltages V_1 and V_2 across each of the capacitors.

(d) Find the potential energies U_1 and U_2 stored inside each of the capacitors.

5. (**10 points.**) In the circuit in Figure 2 determine the charge on capacitor C_3. Let $V = 10.0\,\mathrm{V}$, $C_1 = 10.0\,\mathrm{nF}$, $C_2 = 20.0\,\mathrm{nF}$, and $C_3 = 30.0\,\mathrm{nF}$.

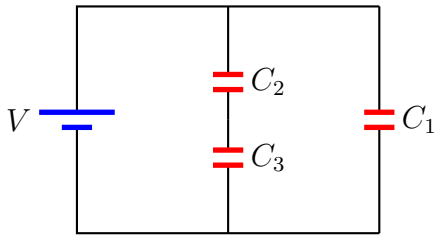

Figure 2: Problem 5.

6. (**10 points.**) Consider the circuit in Figure 3. Given $V_1 = 10.0\,\text{V}$, $R_1 = 10.0\,\Omega$. Further, current I_1 through resistance R_1 is measured to be 2.0 A flowing from point b to point c. Determine the current I_3 (with direction) through resistance $R_3 = 30.0\,\Omega$.

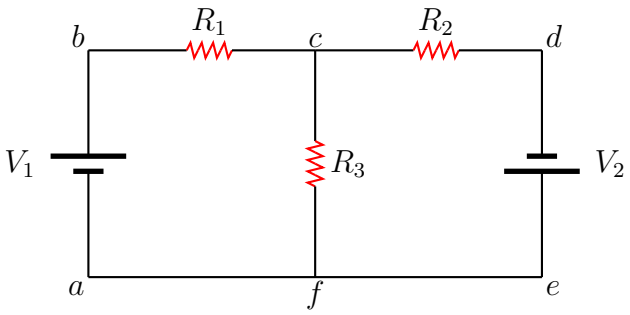

Figure 3: Problem 6

7. (**10 points.**) Consider the circuit in Figure 4 with $V_1 = 10.0\,\text{V}$, $V_2 = 20.0\,\text{V}$, $R_1 = 10.0\,\Omega$, $R_2 = 20.0\,\Omega$, $R_3 = 30.0\,\Omega$. Find the current I_3 (with direction) through resistor R_3.

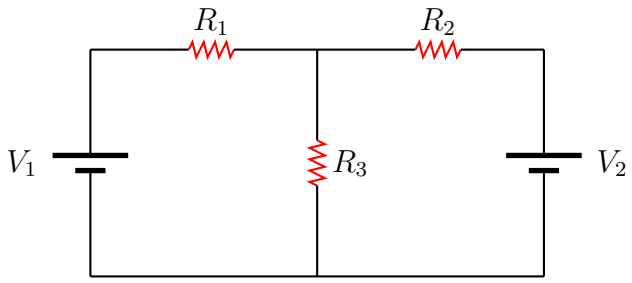

Figure 4: Problem 7

8. (**10 points.**) A capacitor with initial charge Q_0 is discharged through a resistor. In terms of the time constant τ, how long does it take for the capacitor to lose the first two-third of its charge?