Midterm Exam No. 02 (2014 Fall)

PHYS 205B: University Physics

Date: 2014 Oct 9

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(Name)   (Signature)

Instructions

1. Total time = 75 minutes.

2. There are 10 questions in this exam.

3. Equation sheet is provided separately.

4. To obtain partial credit for your work you need to show your work in detail and organize it clearly.

1. (**10 points.**) A proton accelerates from rest in a uniform electric field of $620\,\text{N/C}$. At some time later, its speed is $1.40 \times 10^6\,\text{m/s}$. How far has it moved in this time interval?

2. (**10 points.**) Calculate the electric potential $0.300\,\mathrm{cm}$ from an electron.

3. (**10 points.**) One hundred identical capacitors, each with capacitance C, are connected in series. What is the equivalent capacitance of this arrangement?

4. (**10 points.**) In Figure 1 a potential difference $V = 10\,\text{V}$ is applied across a capacitor arrangement with capacitances $C_1 = 10.0\,\mu\text{F}$, $C_2 = 20.0\,\mu\text{F}$, and $C_3 = 30.0\,\mu\text{F}$. Find the charge Q_1 on the capacitor C_1.
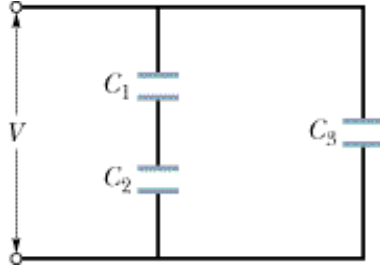

Figure 1: Problem 4.

5. (**10 points.**) The average cost of electricity in the United States, for residential users, is about 0.10 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?

6. (**10 points.**) A wire of Nichrome (a nickel-chromium-iron alloy commonly used in heating elements) is $1.9\,\mathrm{m}$ long and $2.0\,\mathrm{mm}^2$ in cross-sectional area. It carries a current of $3.7\,\mathrm{A}$ when a $2.0\,\mathrm{V}$ potential difference is applied between its ends. Calculate the resistivity ρ of Nichrome.

7. (**10 points.**) A student kept her 60 Watt 120 Volt study lamp turned on for 12 hours. How much charge in coulombs went through it?

8. (**10 points.**) Figure 2 shows three resistors connected in parallel to a battery. The battery has a voltage of $V = 10.0\,\text{V}$, and the resistors have equal resistances of $R = 300.0\,\Omega$.

(a) Determine the equivalent resistance across the battery.

(b) Determine the voltage across each of the resistor.

(c) Determine the current passing through each resistor.
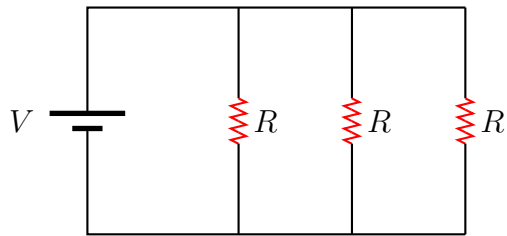
(d) Determine the power consumed by each resistor.

Figure 2: Problem 8

9. (**10 points.**) Consider the circuit in Figure 3 with $V_1 = 10\,\text{V}$, $V_2 = 20\,\text{V}$, $R_1 = 10\,\Omega$, $R_2 = 20\,\Omega$. For what resistance R_3 is the current in R_1 zero?
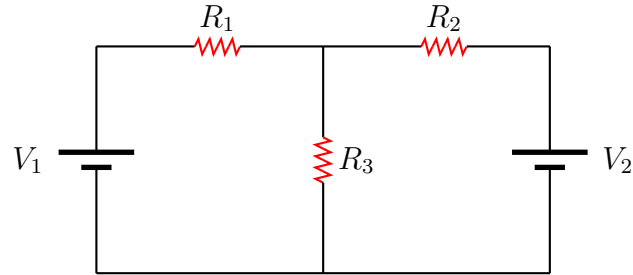

Figure 3: Problem 9

10. (**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?