Midterm Exam No. 02 (2023 Fall)

PHYS 205B: UNIVERSITY PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale

Date: 2023 Oct 17

(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 4 short questions and 3 homework-style problems in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to present your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of smart devices, including smart watches, is strictly prohibited. They should stay out of reach during the exam.
8. Restroom breaks are allowed. Under questionable circumstances this might lead up to a Makeup Exam.
9. Academic misconduct will lead to a failing grade in the course.

1. (**5 points.**) A 'zero-watt' bulb consumes about 12 watts of power. In early days this was too low power and it came to be known as zero-watt bulb. How much energy (in Joules) is consumed by a zero-watt bulb in one year if it is left on continuously.

2. (**5 points.**) Figure 1 shows three resistors connected in parallel to a battery. The battery has a voltage of $V = 10.0\,\mathrm{V}$, and the resistors have equal resistances of $R = 30.0\,\mathrm{k\Omega}$. Determine the current passing through each resistor.

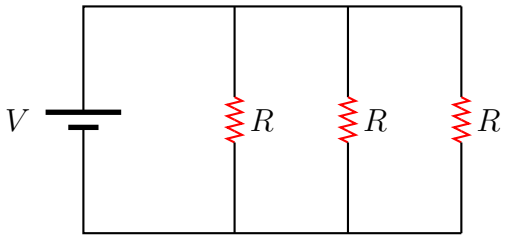

Figure 1: Problem 2

3. (**5 points.**) Determine the equivalent resistance in Figure 2 in terms of R.

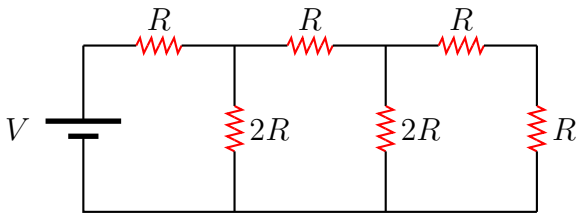

Figure 2: Problem 3

4. (**5 points.**) Electric field and the magnetic field in a region deflect a charged particle. See Figure 3. Given $\mathbf{E} = -\hat{\mathbf{j}}\,E$ and $\mathbf{B} = -\hat{\mathbf{k}}\,B$. Based on the observation that the charge gets deflected downwards, is the electric force or the magnetic force larger in magnitude.

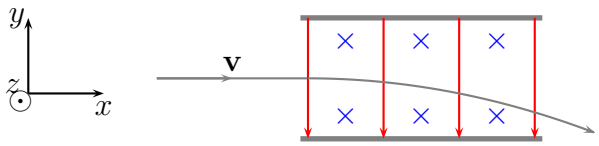

Figure 3: Problem 4

5. (**10 points.**) A potential difference $V = 10.0\,\text{V}$ is applied across a capacitor arrangement with two capacitances connected in series, $C_1 = 10.0\,\mu\text{F}$ and $C_2 = 20.0\,\mu\text{F}$. See Figure 4. Find the charges Q_1 and Q_2 on each of the capacitors.

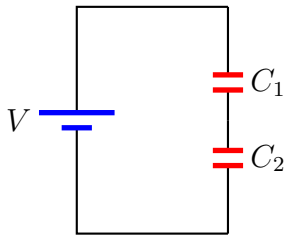

Figure 4: Problem 5

6. (**10 points.**) Consider the circuit in Figure 5 with $V_1 = 10.0\,\mathrm{V}$, $V_2 = 20.0\,\mathrm{V}$, $R_1 = R_2 = R_3 = 10.0\,\Omega$. Find the current passing through resistance R_1.

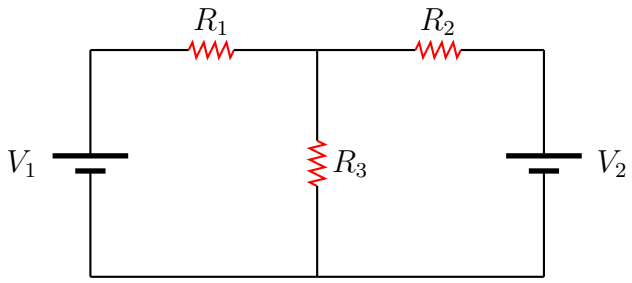

Figure 5: Problem 6

7. (**10 points.**) A loop in the shape of a right triangle of sides $a = 4.0\,\text{cm}$ and $b = 3.0\,\text{cm}$, carrying a current $I = 2.0\,\text{A}$, is placed in a magnetic field $0.30\,\text{T}$ going into the page. See Figure 6. Determine the magnitude and direction of the force on side 1 of the triangle.

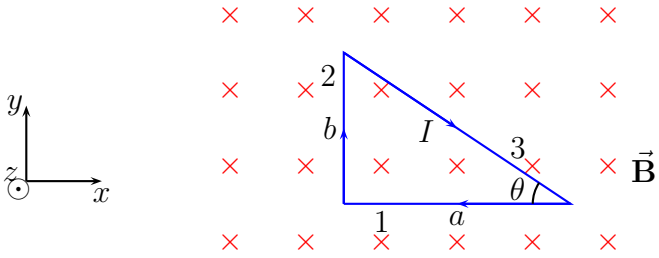

Figure 6: Problem 7.