Midterm Exam No. 02 (2023 Spring)

PHYS 205B: UNIVERSITY PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale
Date: 2023 March 9

_____   _____
(Name)   (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 5.

2. Total time = 75 minutes.

3. There are 4 conceptual questions and 3 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.**) Determine the magnitude and direction of current passing through resistor R_1 in Figure 1. Given $V_1 = 10.0\,\text{V}$, $V_2 = 20.0\,\text{V}$, $R_1 = 100.0\,\Omega$, and $R_2 = 200.0\,\Omega$.
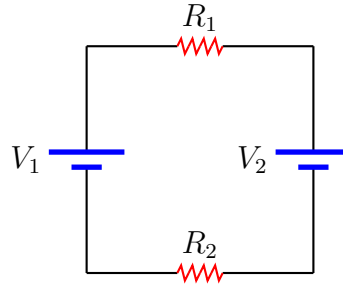

Figure 1: Problem 1

2. (**5 points.**) Is the drift velocity of electrons in copper larger than or smaller than $1\,\mathrm{m/s}$?

3. (**5 points.**) Determine the equivalent capacitance between points A and B in the circuit in Figure 2. Given $C_1 = 1.0\,\mu\text{F}$, $C_2 = 2.0\,\mu\text{F}$, $C_3 = 3.0\,\mu\text{F}$, $C_4 = 4.0\,\mu\text{F}$, and $C_5 = 5.0\,\mu\text{F}$.
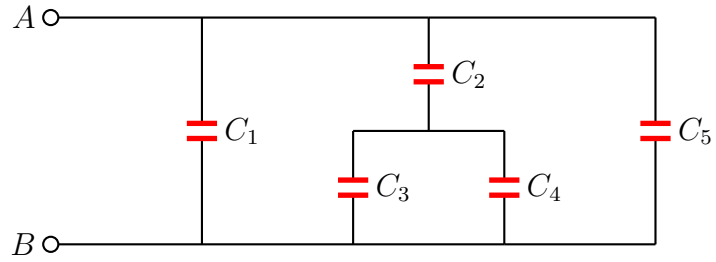

Figure 2: Problem 3

4. (**5 points.**) What is the dimension of the quantity

$$RC, \tag{1}$$

where R is resistance and C is capacitance.

5. (**10 points.**) Determine the currents in each resistor in the circuit shown in Figure 3. Given $V = 10.0\,\text{V}$ and $R = 5.0\,\text{k}\Omega$.
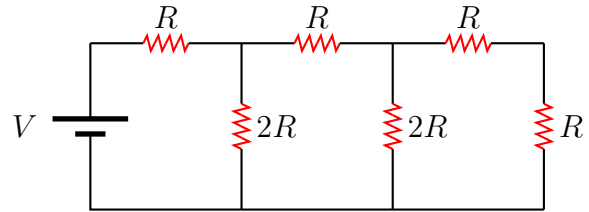

Figure 3: Problem 5

6. (**10 points.**) Consider the circuit in Figure 4. Given $V_1 = 10.0\,\mathrm{V}$, $V_2 = 20.0\,\mathrm{V}$, $R_1 = 10.0\,\Omega$, $R_2 = 20.0\,\Omega$, and $R_3 = 30.0\,\Omega$. Determine the current I_3 (with direction) through resistance R_3.
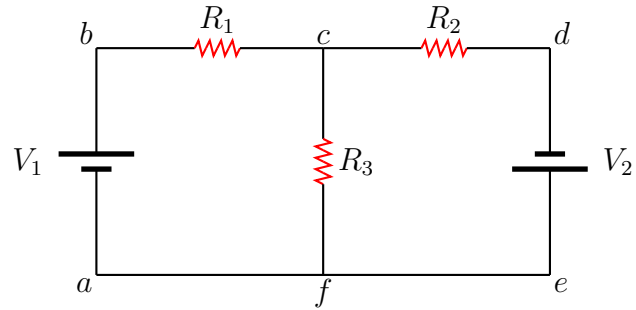

Figure 4: Problem 6

7. (**10 points.**) A loop in the shape of a right triangle of sides $a = 8.0\,\text{cm}$ and $b = 6.0\,\text{cm}$, carrying a current $I = 2.0\,\text{A}$, is placed in a magnetic field $0.30\,\text{T}$ as shown in Figure 5. Determine the magnitude and direction of the force on side 3 of the triangle.
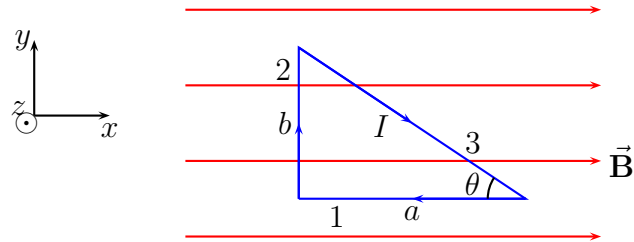

Figure 5: Probelm 7