

Final Exam (2023 Fall)

PHYS 205B: UNIVERSITY PHYSICS

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

Date: 2023 Dec 11

(Name)

(Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 4.
2. Total time = 120 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 positive charge is placed in the electric field described by the electric field lines in Figure 1. Where should it be placed so that it experiences the largest magnitude of force.

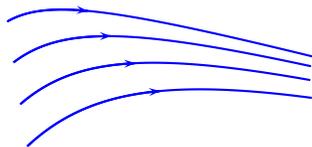


Figure 1: Problem 1

2. (5 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 $R = 30.0\text{ k}\Omega$. Determine the current passing through each resistor.

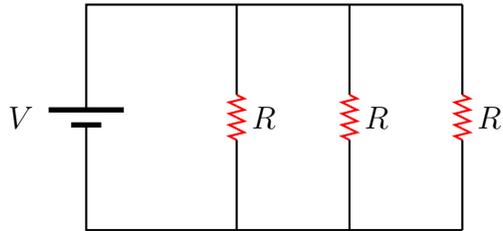


Figure 2: Problem 2

3. (5 points.) Figure 3 shows a snapshot of a rectangular coil being pushed through a uniform magnetic field directed into the page. Determine the direction of induced current in the loop at the instance shown in the figure. Given $L = 10.0\text{ cm}$, $v = 5.0\text{ m/s}$, and $B = 1.2\text{ T}$,

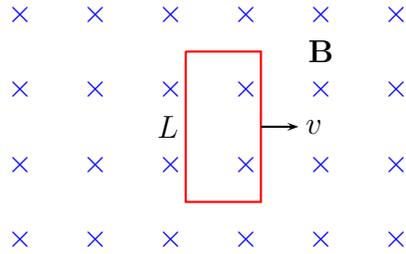


Figure 3: Problem 3.

4. (5 points.) Is the image formed by a flat mirror real or virtual?

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 ratio of the potential differences V_1 and V_2 across the capacitors.

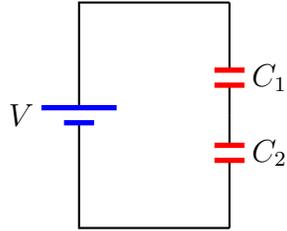


Figure 4: Problem 5

6. (10 points.) A 1.0 cm object is placed upright at a distance 15 cm away from a convex mirror. The mirror's focal length is 10.0 cm.
- (a) What is the mirror's radius of curvature?
 - (b) Calculate the image distance. Is the image real or virtual?
 - (c) What is the magnification? Is the image inverted or upright?
 - (d) Determine the height of the image.
 - (e) Confirm your results by drawing a ray diagram for the above case. Choose the scale for the two relevant directions appropriately so that the relevant features are illustrated well. Points will be awarded for clarity and accuracy.

7. (10 points.) A 1.0 cm object is placed upright at a distance 25 cm away from a convex lens. The focal length of the lens is 10.0 cm.

- (a) Calculate the image distance. Is the image real or virtual?
- (b) What is the magnification? Is the image inverted or upright?
- (c) Determine the height of the image.
- (d) Confirm your results by drawing a ray diagram for the above case. Choose the scale for the two relevant directions appropriately so that the relevant features are illustrated well. Points will be awarded for clarity and accuracy.