

# Final Exam (2023 Spring)

## PHYS 205B: UNIVERSITY PHYSICS

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

Date: 2023 May 11

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(Name)

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### Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 5.
2. Total time = 120 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.)** What is the response of an electric dipole when it is placed in a uniform electric field?

2. (5 points.) Draw the magnetic field lines of a straight wire carrying a uniform current.

3. (5 points.) Figure 1 shows a conducting rod being pulled along horizontal, frictionless, conducting rails at a constant speed  $v$ . A uniform magnetic field  $\mathbf{B}$  fills the region in which the rod moves. Determine the direction of the induced current in the loop.

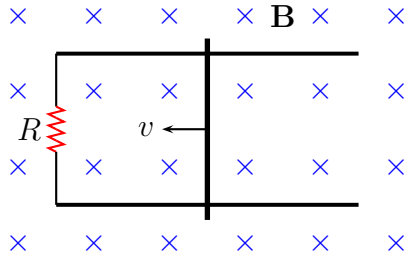


Figure 1: Problem 3

4. (**5 points.**) Where is the image formed when an object is placed (infinitely) far in front of a concave mirror?

5. (10 points.) Find the electric potential at the point marked  $\times$  at the origin in Figure 2. Given  $q_1 = -1.0 \text{ nC}$ ,  $q_2 = +2.0 \text{ nC}$ ,  $s = 2a$ ,  $y = 4a$ ,  $a = 1.8 \text{ cm}$ .

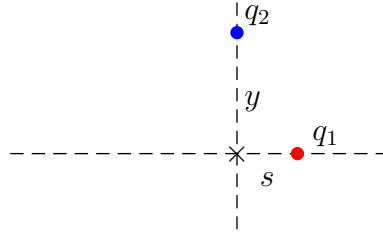


Figure 2: Problem 5

6. (10 points.) A loop in the shape of a right triangle of sides  $a = 8.0$  cm and  $b = 6.0$  cm, carrying a current  $I = 2.0$  A, is placed in a magnetic field 0.30 T as shown in Figure 3. Determine the magnitude and direction of the force on side 1 of the triangle.

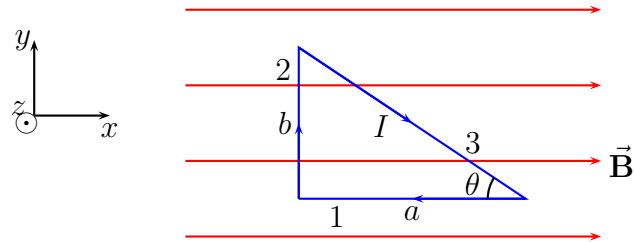


Figure 3: Problem 6

7. (10 points.) A 1.0 cm object is placed upright at a distance 15 cm away from a concave 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.