

Midterm Exam No. 01 (2023 Spring)

PHYS 205B: UNIVERSITY PHYSICS

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

Date: 2023 Feb 14

(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.**) A charged conducting sphere is brought close to another neutral conducting sphere. (The spheres are not allowed to touch.) Is the electric force between the spheres zero? If not, is the force attractive or repulsive?

2. (**5 points.**) What is the magnitude and direction of the total electric force on an electric dipole when it is placed in a uniform electric field?

3. (5 points.) Consider a region of uniform electric field

$$\vec{\mathbf{E}} = \hat{\mathbf{i}} 1.0 \times 10^3 \frac{\text{N}}{\text{C}}. \quad (1)$$

Calculate the electric flux through a rectangular plane 0.40 m wide and 0.20 m long if the plane is parallel to the xy plane.

4. (**5 points.**) A configuration consists of two point charges $q_1 = +q$ and $q_2 = -q$ separated by a distance d . What is the electric potential at the midpoint of the line connecting the two charges?

5. (10 points.) Four charges $q_1 = +q$, $q_2 = +q$, $q_3 = -q$, and $q_4 = -q$, are placed at the corners of a square of side L , such that q_1 and q_4 are at diagonally opposite corners. Refer Figure 1. Calculate the magnitude and direction of the total electric force on charge q_4 .

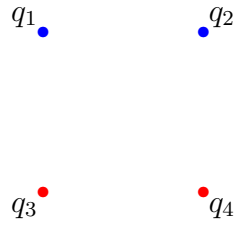


Figure 1: Problem 5

6. (10 points.) An electron and a proton are released from rest in a uniform electric field. The particles travel distances x_e and x_p in a time Δt . Determine the ratio x_e/x_p .

7. (10 points.) Find the electric potential at the point marked \times on the x axis in Figure 2. Given $q_1 = -1.0 \text{ nC}$, $q_2 = +2.0 \text{ nC}$, $s = 2a$, $t = 3a$, $y = 4a$, $a = 1.8 \text{ cm}$.

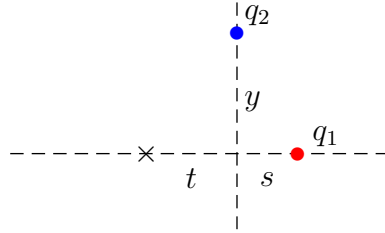


Figure 2: Problem 7