Midterm Exam No. 01 (Fall 2025)

PHYS 203B-001: COLLEGE PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale
Date: 2025 Sep 18

_____   _____
(Name)   (Signature)

Instructions

1. Seating direction: In alternate rows, B, D, F, ..., on even-numbered seats.

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. 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. Academic misconduct will lead to a failing grade in the course.

1. (**5 points.**) Two identical conducting spheres A and B carry equal charge q. They are separated by a distance much larger than their diameters. A third identical conducting sphere C is uncharged. Sphere C is first touched to A, then to B, and finally removed. As a result, what is the charge on C, if it was originally neutral.

2. (**5 points.**) What is the electric field inside a conductor?

3. (**5 points.**) A point charge $q = +8.9\,\text{nC}$ is enclosed in a cube of sidelength $2.0\,\text{cm}$. What is the total electric flux crossing the surface of the cube.

4. (**5 points.**) Consider a configuration of a single point charge $q = +1.0 \, \text{nC}$ at the origin. Draw an equipotential surface for this configuration.

5. (**10 points.**) Three charges $q_1 = +q$, $q_2 = +q$, and $q_3 = -q$, with $q = 1.0\,\mathrm{nC}$, are placed at three corners of a square of side $L = 3.0\,\mathrm{cm}$. Refer Figure 1. Calculate the magnitude and direction of the total electric force on charge q_2.
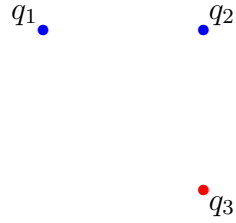
q_1

q_2

q_3

Figure 1: Problem 5

6. (**10 points.**) Two charges, $q_1 = +1.0 \, \mu C$ and $q_2 = -9.0 \, \mu C$, are separated by a distance of 10.0 cm. See Figure 2. Find the spot on the line shown where the net electric field is zero.
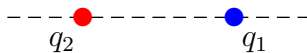

Figure 2: Problem 6.

7. (**10 points.**) Two charges $q_1 = +q = +1.0\,\text{nC}$ and $q_2 = -q$ are placed at diagonally opposite corners of a square of side $L = 3.0\,\text{cm}$. Refer Figure 3. What is the electric potential difference between the points A and B marked in the figure. Point A is a vertex of the square and point B is the center of the square.
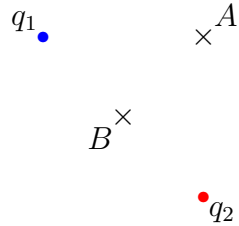
q_1 •

$\times A$

$B \times$

• q_2

Figure 3: Problem 7