# Midterm Exam No. 01 (2021 Fall)

## PHYS 205B: University Physics

Date: 2021 Sep 7

(Name) (Signature)

## Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 4.
2. Total time = 75 minutes.
3. There are 5 conceptual questions and 5 problems in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to show your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (**5 points.**) Two positive charges and two negative charges are placed on the corners of a square. Each of the four charges is of the same strength. When the charges are let go, do the charges tend to move inward (implode) or outward (explode)?

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.**) Draw the electric field lines for two oppositely charged parallel conducting plates with uniform charge distribution on each plate.

4. (**5 points.**) Three identical conducting spheres $A$, $B$, $C$, carry equal charge. They are separated by a distance much larger than their diameters. Sphere $C$ is first touched to $A$, then to $B$. As a result, what is the charge on $A$, if it was originally $Q$.

5. (**5 points.**) A point positive charge $q = +8.85 \times 10^{-12}\,\mathrm{C}$ is placed at the origin. What is the total electric flux passing through a Gaussian spherical shell consisting of a sphere of radius $R = 1.00\,\mathrm{cm}$ enclosing the charge $q$ completely.

6. (**10 points.**) Four identical charges of equal magnitude $q$ are placed at the corners of a square of length $L$. Determine the magnitude of the Coulomb force on one of the charges.

7. (**10 points.**) Two charges, $q_1 = +1.00\,\mu\text{C}$ and $q_2 = +4.00\,\mu\text{C}$ are a distance $D$ apart. Refer Figure 1. As a multiple of distance $D$, at what coordinate $x$ on the line connecting the two charges is the total electric field zero?

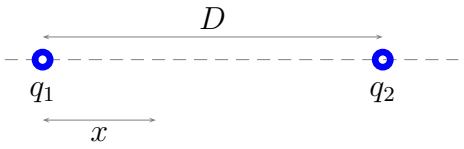


Figure 1: Problem 7

8. (**10 points.**) An electron enters the region of a uniform electric field $E = 2.0 \times 10^3\,\mathrm{N/C}$

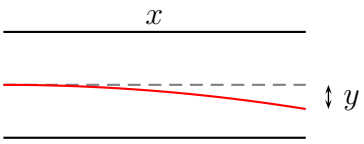


Figure 2: Problem 8

with a speed of $4.0 \times 10^6\,\mathrm{m/s}$. The horizontal distance of the plates is $x = 5.0\,\mathrm{cm}$ and the beam gets deflected vertically by a distance $y$. Refer Figure 2. Calculate the deflection $y$ in centimeters.

9. (**10 points.**) Charges are placed on the $z = 0$ plane such that it forms a square lattice of

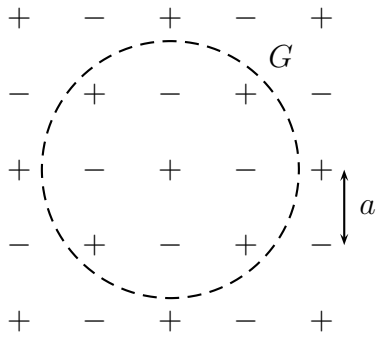


Figure 3: Problem 9

length $a$ that extends to infinity in the plane. Refer Figure 3. The charge on each lattice point has a magnitude of $17.7 \times 10^{-12}$ C. Determine the electric flux through the surface $G$ of a sphere of radius $R = 1.7\,a$ shown in Figure 3.

10. (**10 points.**) A point charge $Q$ sits at the center of a charged spherical shell of radius $R$ with charge $Q'$ uniformly distributed on its surface. Using Gauss's law find the expression for electric field inside and outside the spherical shell.