Midterm Exam 01 (2017 Spring)

PHYS 203B-001: College Physics

Date: 2017 Feb 10

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
2. Total time = 50 minutes.
3. There are 8 questions 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. (**10 points.**) Determine the number of excess electrons in an object that has an electric charge of $1.0\,\mu$C.

2. (**10 points.**) Three objects with electric charges $q_1 = +1.0\,\mu\text{C}$, $q_2 = -2.0\,\mu\text{C}$, and $q_3 = +3.0\,\mu\text{C}$, are placed along a line, as shown in Figure 1. The distances between the charges are described using $a = 10.0\,\text{cm}$ and $b = 30.0\,\text{cm}$. Determine the magnitude and direction of the total electric force on charge q_3.

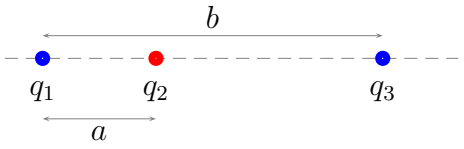

Figure 1: Problem 2.

3. (**10 points.**) The drawing shows three identical charges, each with charge $q = +1.0\,\mu\text{C}$, placed on the x and y axis. They are all located at the same distance of $L = 10.0\,\text{cm}$ from the origin marked as $\times$. Determine the magnitude and direction of the net electric field at the origin.

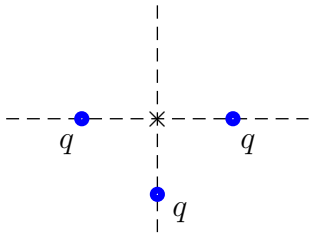

Figure 2: Problem 3.

4. (**10 points.**) Two objects have the same mass ($m_1 = m_2 = 10.0\,\mathrm{g}$) but different amount of charges on them ($q_1 = +1.0\,\mu\mathrm{C}$ and $q_2 = +2.0\,\mu\mathrm{C}$). They are released from rest in a uniform electric field pointing vertically down. Determine the ratio of the times t_1 and t_2,

$$\frac{t_1}{t_2}, \tag{1}$$

the charges take to move (or 'fall') a vertical distance $y = 1.0\,\mathrm{m}$. (Assume that the electric field is large enough that the gravitational effects are negligible.)

5. (**10 points.**) Two charges, $q_1 = +1.0\,\mu\text{C}$ and $q_2 = -4.0\,\mu\text{C}$, are separated by a distance of 10.0 cm. See Fig. 3. Find the spot on the line where the net electric field is zero. Caution: This is not always in between the charges.

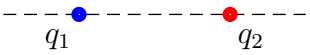

Figure 3: Problem 5.

6. (**10 points.**) A charge Q is located inside a rectangular box. The electric flux through each of the six surfaces of the box is: $\Phi_1 = +1650\,\mathrm{N{\cdot}m^2/C}$, $\Phi_2 = +2220\,\mathrm{N{\cdot}m^2/C}$, $\Phi_3 = +4380\,\mathrm{N{\cdot}m^2/C}$, $\Phi_4 = -1660\,\mathrm{N{\cdot}m^2/C}$, $\Phi_5 = -3750\,\mathrm{N{\cdot}m^2/C}$, $\Phi_6 = -5550\,\mathrm{N{\cdot}m^2/C}$, Determine the charge Q?

7. (**10 points.**) Charges of $q_1 = -1.0\,\mu\text{C}$, $q_2 = +2.0\,\mu\text{C}$ are assembled as shown in Fig. 4. Given $a = 10.0\,\text{cm}$. Determine the electric potential difference between points A and B.

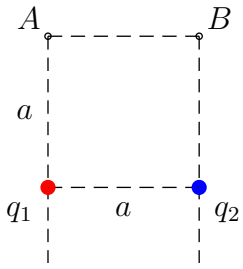

Figure 4: Problem 7.

8. (**10 points.**) Two positive charges and two negative charges of equal magnitude $q = 1.00\,\mu\text{C}$ are placed at the corners of a square of length $L = 10.0\,\text{cm}$, such that like charges are at diagonally opposite to each other. What is the electric potential energy required to assemble this configuration of charges, if the four charges were initially at very large (infinite) distances from each other.