Midterm Exam 01 (2017 Spring)

PHYS 203B: College Physics

Date: 2017 Feb 9

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
2. Total time = 75 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.**) Two conducting spheres A and B of same radii carry equal and opposite charge. 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.

   (a) As a result, what is the charge on A, if it was originally $+Q$.

   (b) As a result, what is the charge on B, if it was originally $-Q$.

   (c) As a result, what is the magnitude of the electrostatic force between A and B, if it was originally F.

2. (**10 points.**) Three identical positively charged spheres, each with charge $2.0\,\mu$C, are placed at the corners of an equilateral triangle of side 3.0 cm. Calculate the magnitude of the net force on any one of the charges.

3. (**10 points.**) The drawing shows three charges, $q_1 = +1.0\,\mu\text{C}$, $q_2 = -2.0\,\mu\text{C}$, $q_3 = +3.0\,\mu\text{C}$, that are placed on the x and y axes. 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.

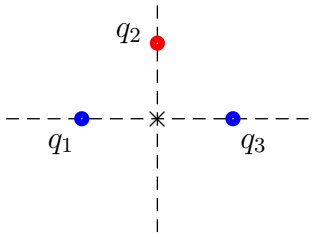

Figure 1: Problem 3.

4. (**10 points.**) A proton and an electron are moving due East in a constant electric field that points due East. The electric field has a magnitude of $7.0 \times 10^4\,\mathrm{N/C}$. Determine the ratio of the magnitude of the acceleration of the electron and the proton,

$$\frac{a_e}{a_p}. \tag{1}$$

5. (**10 points.**) The drawing shows an edge-on view of a planar surface of area $2.0\,\mathrm{m}^2$. Given $\theta = 30^\circ$. The electric field vector $\vec{\mathbf{E}}$ in the drawing is uniform and has a magnitude of $3.0 \times 10^2\,\mathrm{N/C}$. Determine the electric flux across the planar surface.

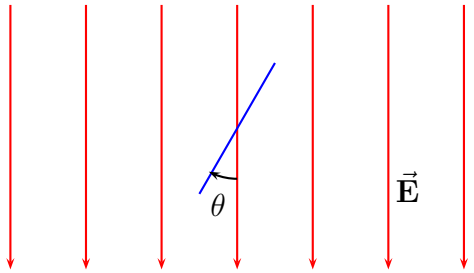

Figure 2: Problem 5.

6. (**10 points.**) Consider a perfectly conducting sphere of radius $R = 7.0\,\text{cm}$ with charge $Q = 1.0\,\mu\text{C}$. Plot the magnitude of the electric field inside and outside the sphere, as a function of the radial distance from the center of the sphere.

7. (**10 points.**) The drawing shows six point charges arranged in a rectangle. The value of q is $9.0\,\mu$C, and the distance d is $0.10\,$m. Find the total electric potential at location P, which is at the center of the rectangle.

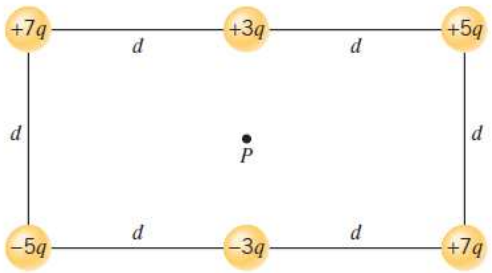

Figure 3: Problem 7.

8. (**10 points.**) Charges of $q_1 = -1.0\,\mu\text{C}$, $q_2 = -2.0\,\mu\text{C}$, and $q_3 = +3.0\,\mu\text{C}$ are brought in from infinity and assembled as shown in Fig. 4. Given $a = 2.0\,\text{m}$ and $b = 1.0\,\text{m}$. Determine the electric potential energy of the configuration of the assembled charges.

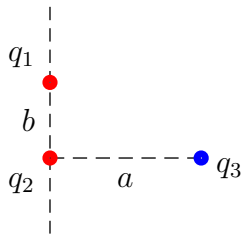

Figure 4: Problem 8.