Midterm Exam 01 (2016 Fall)

PHYS 203B: College Physics

Date: 2015 Sep 15

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(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 9 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 identical conducting spheres A and B carry equal 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 electrostatic force between A and B, if it was originally F.

2. (**10 points.**) Two identical charges, $2.0\,\mathrm{m}$ apart, exert forces of magnitude $4.0\,\mathrm{N}$ on each other. What is the value of either charge?

3. (**10 points.**) The drawing shows four charges, $q_1 = -1.0\,\mu\mathrm{C}$, $q_2 = +2.0\,\mu\mathrm{C}$, $q_3 = -3.0\,\mu\mathrm{C}$, $q_4 = +4.0\,\mu\mathrm{C}$, that are placed on the x and y axes. They are all located at the same distance of $L = 10.0\,\mathrm{cm}$ from the origin marked as $\times$. Determine the magnitude and direction of the net electric field at the origin.
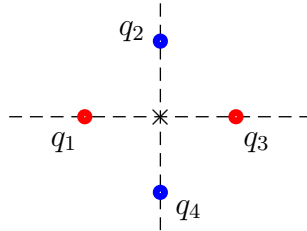

Figure 1: Problem 3

4. (**10 points.**) Two charges, $q_1 = -8.0\,\mu\text{C}$ and $q_2 = -32.0\,\mu\text{C}$, are separated by a distance of 10.0 cm. See Fig. 2. Find the spot on the line where the net electric field is zero.
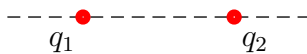

q_1 q_2

Figure 2: Problem 4

5. (**10 points.**) An electron has an initial speed of 6.00×10^6 m/s in a uniform 5.00×10^4 N/C strength electric field. The field deccelerates the electron. How far does the electron travel before coming to rest?

6. (**10 points.**) A proton and an electron is released from rest in a uniform electric field of $\vec{\mathbf{E}}$. Determine the ratio

$$\frac{t_p}{t_e} \tag{1}$$

of the times taken by the proton and electron, t_p and t_e respectively, to travel distance y.

7. (**10 points.**) Two electrons and two protons are placed at the corners of a square of side 5.00 cm, such that the electrons are at diagonally opposite corners.

(a) What is the electric potential at the center of square?

(b) How much potential energy is required to move another proton from infinity to the center of the square?

8. (**10 points.**) Charges of $-q$ and $+2q$ are fixed in place, with a distance of $a = 2.0\,\mathrm{m}$ between them. See Fig. 3. A dashed line is drawn through the negative charge, perpendicular to the line between the charges. On the dashed line, at a distance y from the negative charge, there is at least one spot where the total potential is zero. Find y.
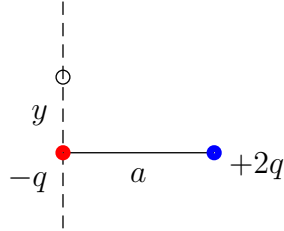

Figure 3: Problem 8

9. (**10 points.**) A particle with a charge of $5.5 \times 10^{-8}\,\mathrm{C}$ is fixed at the origin. A particle with a charge of $-2.3 \times 10^{-8}\,\mathrm{C}$ is moved from $x = 3.5\,\mathrm{cm}$ on the x axis to $y = 4.3\,\mathrm{cm}$ on the y axis. What is the change in potential energy of the two-particle system?