Midterm Exam No. 01 (2016 Fall)

PHYS 205B: University Physics

Date: 2016 Sep 15

(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.**) Three positive charges and one negative charge of equal magnitude Q are placed at the corners of a square of length L. Find the magnitude and direction of the force on the negative charge.

2. (**10 points.**) Two identical conducting spheres each having a radius of 0.250 cm are connected by a light 2.00 m long conducting wire. A charge of 5.00 μC is placed on one of the conductors, which then distributes on the two conductors. Assume the surface distribution of charge on each sphere is uniform. Determine the tension in the wire.

3. (**10 points.**) A small, 2.00 g plastic ball is suspended by a 25.0 cm-long string in a uniform electric field $E = 1.00 \times 10^3$ N/C as shown in Figure 3. If the ball is in equilibrium when the string makes a 10.0° angle with the vertical, what is the net charge on the ball?

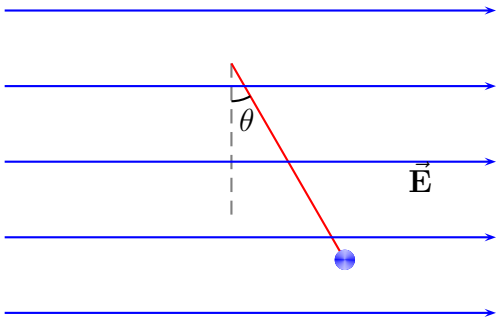

Figure 1: Problem 3.

4. (**10 points.**) Two charges of magnitude 1.0 nC, one positive and other negative, are separated by a distance 2.00 cm. Determine the magnitude and direction of the electric field along the bisector, a distance $y = 2.50$ cm above the charges.

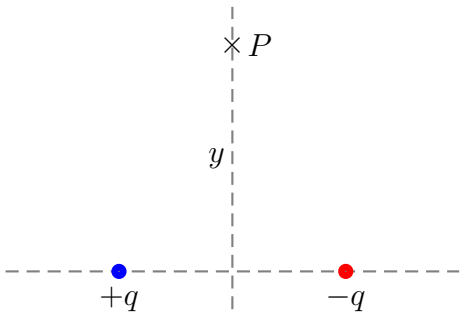

Figure 2: Problem 4.

5. (**10 points.**) See Figure 3. Two charges $q_1 = +2.0\,\mu\text{C}$ and $q_2 = -8.0\,\mu\text{C}$ are fixed to a line separated by a distance $d = 10.0\,\text{cm}$. At what point on the line is the electric field zero?

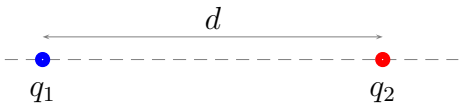

Figure 3: Problem 5.

6. (**10 points.**) Recollect that the proton and the electron have the same magnitude of charge on them. Further, the proton is 1836 times heavier than the electron.

   (a) A proton and an electron are released from rest in a uniform gravitational field $\vec{\mathbf{g}} = -\hat{\mathbf{z}}\, g$. Find the ratio of the times taken for them to move a distance y.

   (b) A proton and an electron are released from rest in a uniform electric field $\vec{\mathbf{E}} = -\hat{\mathbf{z}}\, E$. Find the ratio of the times taken for them to move a distance y.

7. (**10 points.**) An electric field of magnitude 4.00 kN/C is applied along the $-\hat{\mathbf{y}}$ axis. Calculate the electric flux through a rectangular plane 0.300 m wide and 0.400 m long if its normal makes an angle of 30° with respect to the $+\hat{\mathbf{x}}$ axis.

8. (**10 points.**)

(a) Plot the electric field of a charged conducting solid sphere, of radius R and total charge Q, as a function of the radial distance r, $0 < r < \infty$, from the center.

(b) Plot the electric field of a uniformly charged nonconducting solid sphere, of radius R and total charge Q, as a function of the radial distance r, $0 < r < \infty$, from the center.