Midterm Exam (2015 Summer)

PHYS 203B: College Physics

Date: 2015 Jun 26

(Name) (Signature)

Instructions

1. Total time = 60 minutes.
2. There are 8 questions in this exam.
3. Equation sheet is provided separately.
4. To obtain partial credit for your work you need to show your work in detail and organize it clearly.
5. A simple calculator (with trignometric functions) is allowed.

1. (**10 points.**) Determine the dimensions of electric permittivity of vacuum, ε_0, in terms of length, mass, time, and charge.

2. (**10 points.** Cutnell and Johnson, Example 5 in Chap. 18.)
Fig. 1 shows three point charges that lie in the x-y plane. Given $q_1 = -4.0\,\mu\text{C}$, $q_2 = +6.0\,\mu\text{C}$, $q_3 = +5.0\,\mu\text{C}$, charges q_1 and q_2 are separated by a distance of 4.0 cm, and charges q_1 and q_3 are separated by a distance of 6.0 cm. Find the magnitude and direction of the net electrostatic force on charge q_1.

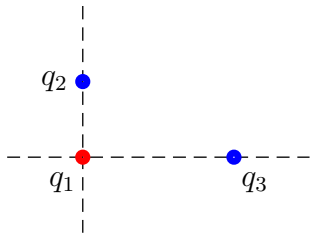

Figure 1: Problem 2

3. (**10 points.** Cutnell and Johnson, Example 11 in Chap. 18.)
Two positive charges, $q_1 = +16\,\mu\text{C}$ and $q_2 = +4\,\mu\text{C}$, are separated by a distance of 3.0 m. Find the spot on the line between the charges where the net electric field is zero.

4. (**20 points.**) An electron is released from rest at the negative plate of a parallel plate capacitor and accelerates to the positive plate. The plates are separated by a distance of 1.8 cm, and the electric field within the capacitor has a magnitude of 4.3×10^6 V/m. What is the velocity of the electron just as it reaches the positive plate?

5. (**10 points.**) A proton is placed at the center of a cube. Determine the electric flux through one face of the total six faces of the cube.

6. (**10 points.** Cutnell and Johnson, Example 8.)
Three point charges initially are infinitely far apart, $q_1 = +15.0\,\mu\text{C}$, $q_2 = +25.0\,\mu\text{C}$, $q_3 = -20.0\,\mu\text{C}$. Then, they are brought together and placed at the corners of an equilateral triangle. Each side of the triangle has a length of 0.50 m. Determine the electric potential energy of the triangular group.

7. (**10 points.**) Two electrons and two protons are placed at the corners of a square of side 5 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.**) The electric potential energy stored in the capacitor of a defibrillator is 69 J, and the capacitance is 121 μF. What is the potential difference that exists across the capacitor plates?