

PHYS 122: Homework #01

January 12, 2009

**Homework #01 is due in Box outside of Rock 207:
5:00 PM Sharp, Wednesday, January 21, 2009**

Announcements:

- Be sure you read all course Handouts for today (Documents #01, #02, #03, #04, and #05, plus the Lab Handout).
- Note: All homework assignments and other Handout documents will be posted *online only*. No hard copy will be provided in lecture. You must get the documents from the course web page:

<http://www.phys.case.edu/courses/p122>

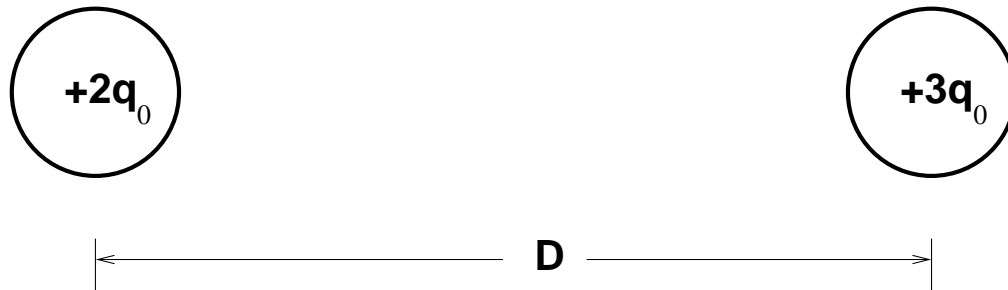
- **Important!** Lab Odd week experiments start **this week**. Be very sure that you know exactly where and when your lab meets. See Dr. Diana Driscoll, Lab Director, immediately if you are not satisfactorily registered for the lab. Students who are not properly registered for the lab are not registered for the course as a whole. If you need a permit or override, see Dr. Driscoll, not Mr. Covault.
- Be sure to purchase your textbook, your Interwrite “Cricket” clicker, and your lab manual and a proper laboratory notebook as soon as possible.
- Register your clicker by email before Friday to participate in Clicker Questions in lecture. See “Clicker Registration” link on the main web page.
- Mr. Covault’s Office Hours will be Thursday, Friday, and Monday, Rock 207, times To Be Determined. Check the web page,
- First Hour Exam (worth five percent of your grade) will be given Friday, February 6, **9:30 AM** in lecture. Put all exam dates in your calendar today.

Homework Assignment continues next page....

**This homework due in Box outside of Rock 207:
5:00 PM Sharp, Wednesday, January 21, 2009**

Important! Read and Follow the handout entitled “Homework Rules and Examples” (Handout #04 posted online) before you start this homework assignment!

Problem 1.



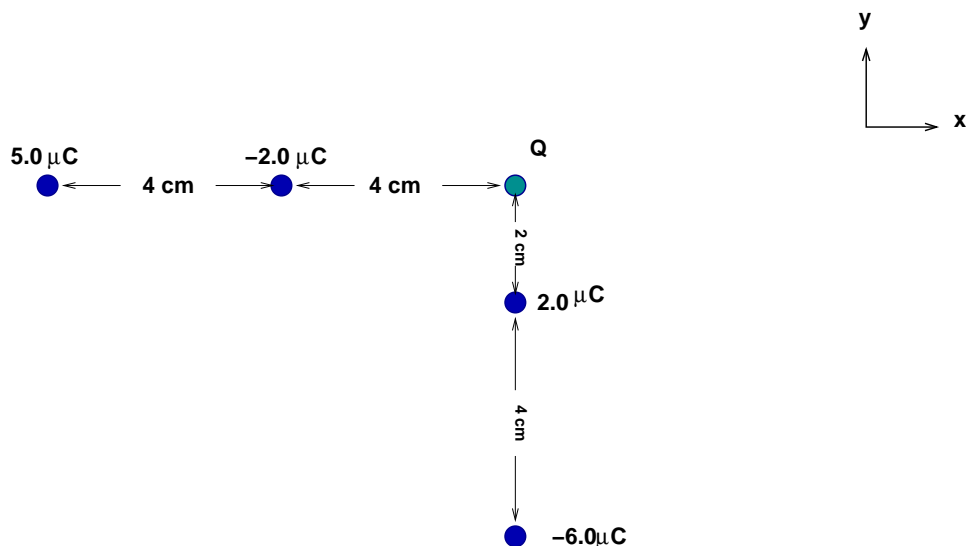
Two pucks are placed on a frictionless table as shown above. Each puck has mass m . A positive charge of $+2q_0$ is placed on the left charge and a charge of $+3q_0$ is placed on the right puck. The pucks are released at rest and the distance D between the two pucks.

(a) For each puck, what is the magnitude and direction of the electric force at the instant just after they are released?

(b) For each puck, what is the magnitude and direction of the acceleration at the instant just after they are released?

(c) If $m = 0.800$ kg and $d = 5.333$ meters, what is the value of q_0 that would yield an acceleration of the right pucks of 2.000 Gees.

Problem 2. A set of five charges is arranged as show. The value of the charge Q is precisely negative 3 micro-coulombs.

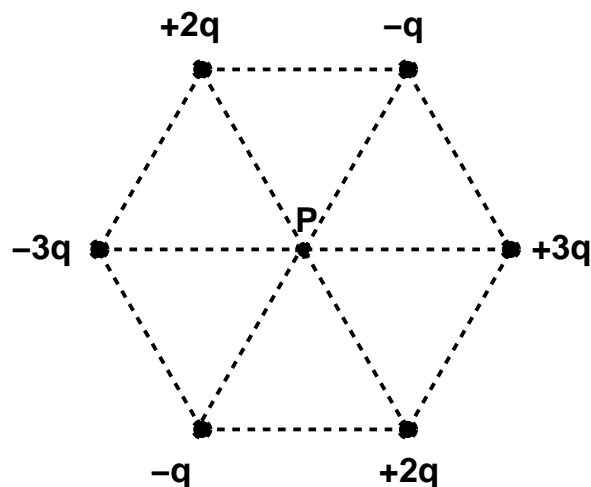


Using the coordinate system given, calculate the value of the electric field at the position of charge Q . Write your answer in *vector notation*. Important: You need to solve the problem symbolically first, and then you need to solve it algebraically. Hint: Choose a value $q = 1.0\mu\text{C}$ and $D = 2.0\text{ cm}$ and then restate the problem in terms of symbolic variables q and D and then determine the field in terms of these symbolic variables. This is not an optional step. Only after you have done this should you (finally) plug in numerical values for q and D to calculate the value of the electric field.

Also determine the electric force on charge Q . Again, give your answer symbolically first, then plug in numbers.

Problem 3. Suppose you and a friend are each given a small box containing exactly one Coulomb of charge. Assume you approach each other on foot across a very large empty field. Estimate how close you can get to each other while you each hold a box of charge. Note, you will have to *estimate* how much electric force you can practically overcome as you try to approach each other. Note: for this problem you can (unrealistically) ignore the electrical effects that these large charges would have on any nearby materials. Assume that the only electric forces that come into play are the forces between the two charges in the small boxes.

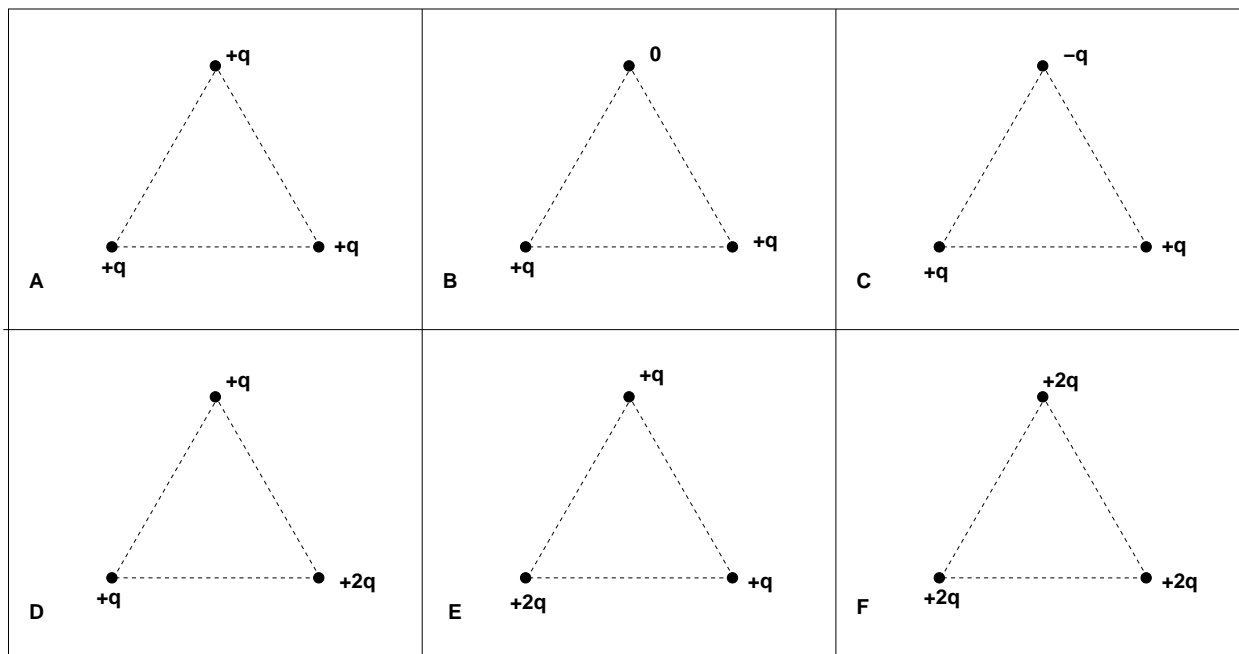
Problem 4. Consider six point charges arranged in a hexagon as shown in the figure below. The length of the each side of the hexagon is d .



a) What is the magnitude and direction of the electric field at point P ? b) What is the electric potential (voltage) at point P ?

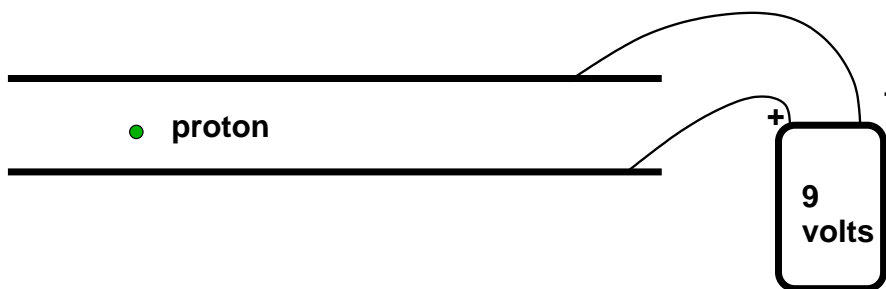
Hint: this problem does not require trigonometry!

Problem 5.



Consider the six charge distributions labeled “A” through “F” above. In each configuration, three points are arranged in an equilateral triangle, with the charge values at each point as shown. Rank the six configurations from highest to lowest in order of the *magnitude of the net electric force* experienced by the single charge that sits in the *lower left-hand corner* of each configuration. **Be sure to explain your result – the correct answer with no explanation is worth zero points.** Note: this is a conceptual problem – working this correctly does not require intricate trigonometry calculations.

Problem 6.



Two parallel conducting plates are held a distance 2.000 centimeters apart. A 9-volt battery is wired so that each plate is connected by a wire to one terminal of the battery. **(a)** What is the electric field between the two plates? **(b)** What is the acceleration that a proton would experience due to the electric field if the proton were placed somewhere between the two plates? Note: ignore gravity and friction here. Note that you will need to look up the mass and charge of the proton.

Problem 7. Two identical conducting spheres are held in a firmly in a fixed position at a distance D apart from each other. The charge on the first sphere is $+3Q_0$. The charge on the second sphere is $+7Q_0$. The electrostatic force between the two spheres is given as 42.0 Newtons. Now, suppose a very thin conducting wire is briefly attached to connect the two spheres and then removed. What is the electrostatic force between the two spheres (in Newtons) after this has been done? Hint: You absolutely do not need a calculator to solve this problem.