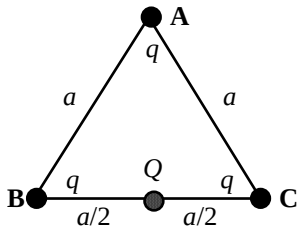
Name:_____

Phys.116 Exam I
8 February 2006

Please do not turn the page until you are told to do so. Make sure that you have all six problems on your copy of the test. In order to get credit on a problem, you must show your work. If you only write down an answer without the work leading up to it, you will get no credit for it, even if it is the right answer.

1. The figure shows an equilateral triangle **ABC**. A positive point charge $+q$ is located at each of the three vertices **A**, **B**, and **C**. Each side of the triangle is of length a.

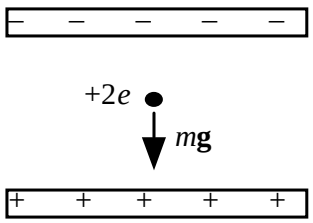
   A point charge Q (that may be positive or negative) is placed at the mid-point between **B** and **C**.



a. (6 points) Is it possible to choose the value of Q (*that is non-zero*) such that the force on Q is zero? Explain why or why not.

b. (7 points) Determine an expression for the magnitude and sign of Q so that the net force on the charge at **A** is zero newtons. Write your answer in terms of q, k, and a.

2. (7 points) A helium nucleus is located between the plates of a parallel-plate capacitor as shown. The nucleus has a charge of +2e and a mass of 6.6×10^{-27} kg. What is the magnitude of the electric field such that the electric force exactly balances the weight of the helium nucleus so that it remains stationary?



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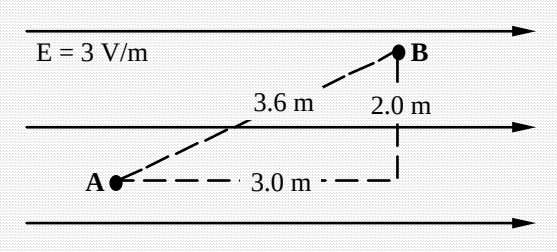
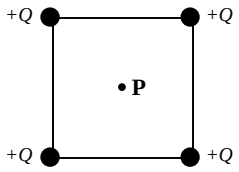
3. (5 points) A +1.0 μC point charge is moved from point **A** to **B** in the uniform electric field as shown. By how much does the electric potential of the point charge change during the move? Does it increase or decrease?



4. Four point charges are individually brought from infinity and placed at the corners of a square as shown in the figure. Each charge has the identical value $+Q$. The length of the diagonal of the square is $2a$. Write your answers to the following questions in terms of k, Q and a.



a. (5 points) The *first two* charges are brought from infinity and placed at adjacent corners. What is the **electric potential energy** of these two charges?

b. (5 points) What is the magnitude of the **electric field at P**, the center of the square after all four charges are in place?

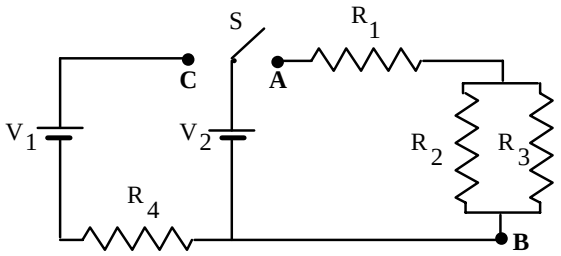
c. (5 points) What is the **electric potential at P**, the center of the square when all four charges are in place?

5. The figure shows a circuit. The switch S can be closed on either point **A** or **C**, but not both at the same time. Use the following quantities:

$V_1 = V_2 = 12$ V

$R_1 = R_4 = 1.0\ \Omega$

$R_2 = R_3 = 2.0\ \Omega$



a. (7 points) What is the equivalent resistance between the points **A** and **B**?

b. (6 points) Determine the current through R_4 when the switch **S** is closed on **C**.

6. (7 points) The figure shows a simple RC circuit consisting of a 100.0-V battery in series with a 10.0-μF capacitor and a resistor. Initially, the switch S is open and the capacitor is uncharged. Two seconds after the switch is closed, the voltage across the capacitor is 37 V. Determine the numerical value of the resistance *R*.