PHYS 122: Homework #02

January 21, 2009

Homework #02 is due in Box outside of Rock 207: 5:00 PM Sharp, Monday, January 26, 2009

Announcements:

- Note that the due date on this homework comes up fast. This homework is relatively short. However, it counts the same 20 points that every other homework counts.
- Mr. Covault's Office Hours will generally be Mondays: 11 AM to noon and 1:30 PM to 4:00 PM, Thursdays: 1:15 PM to 2:30 PM and 3 PM to 4 PM, and Fridays: 10:45 AM to 12:15 PM.
- First Hour Exam (worth five percent of your grade) will be given Friday, February 6, **9:30 AM** in lecture. The exam is closed book, no books or notes – but you may bring one $8\frac{1}{2} \times 11$ sheet of paper (front and back) with any *hand-written* notes that you like. Simple calculators are okay – no programmable calculators, PDA's, phones, Blackberries, etc. Details will be announced in handout distributed next week.
- Don't forget: Even labs this week.

Homework Assignment continues next page....

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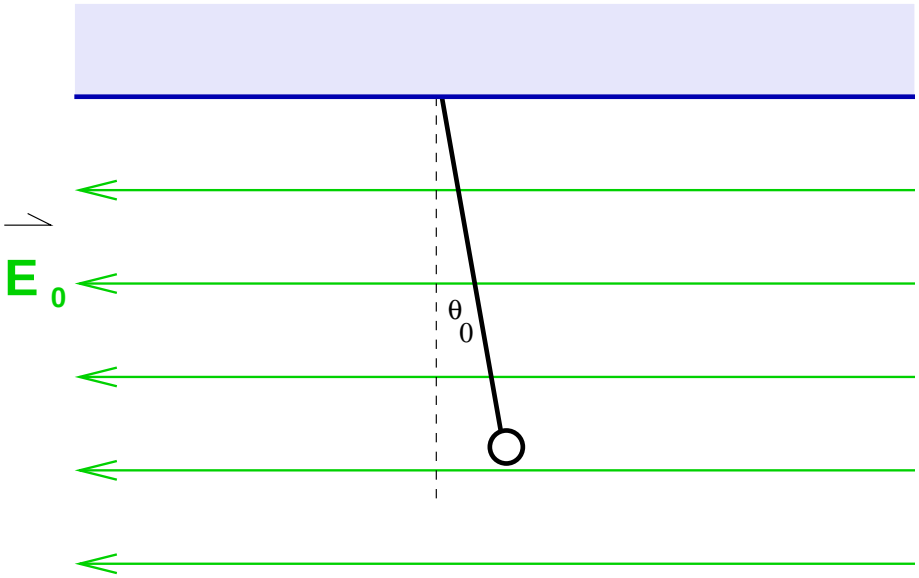
Problem 1: A small charged sphere of mass m_0=50.0 grams is suspended at rest by means of a thin (massless) thread of length ℓ=40.0 cm in a uniform electric field of magnitude E_0=200.0 N/C directed as indicated in the figure below. Note that the string is deflected from vertical by an angle of θ_0=10 degrees.



a) What is the sign of the charge on the sphere? How do you know? Explain.

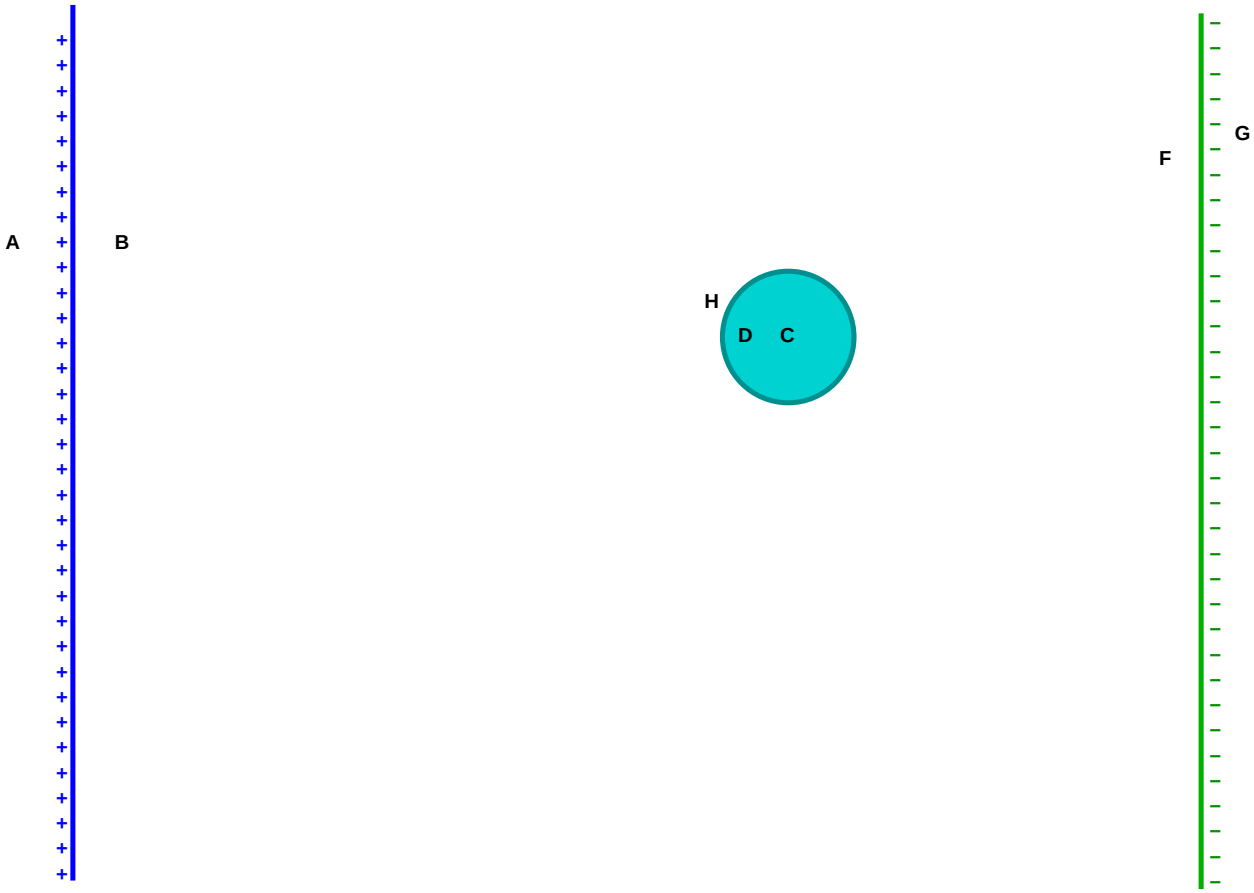
b) Draw a **Free Body Diagram** indicating *all* the forces acting on the little sphere.

c) Find the charge q on the sphere. Be sure to explain your work. **Note:** Here, as always in this course, give your answer *first* in terms of the given parameters using **symbolic variables** and *then* plug in numerical values to get a **numerical** answer. Be sure to use the correct units (your final answer should be in Coulombs) and a reasonable number of significant digits.

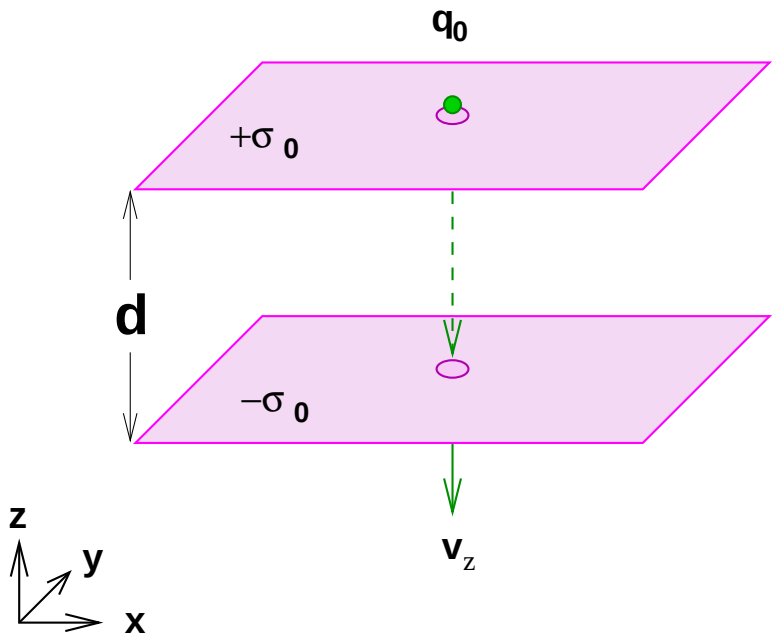
Problem 2:

Two very thin parallel infinite sheets of insulating material are placed as show in the figure. The left sheet has a charge placed on it with uniform surface charge density $+\sigma_0$ and the right sheet has charge placed on it with uniform surface charge density $-\sigma_0$. Located between the two objects is a solid perfectly conducting sphere. The net charge on the sphere is zero. The radius of the sphere R is small compared to the distance between the two charged plates D.

Describe *qualitatively* the magnitude and direction of the electric field at the points A,B,C,D,F,G, and H, as show in the figure.



Problem 3:

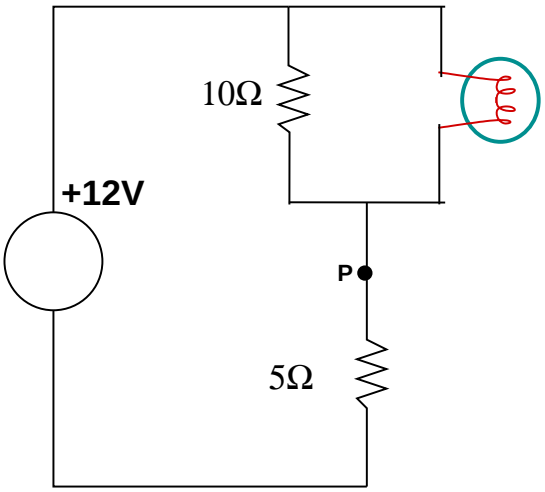


Consider two infinite parallel horizontal charged sheets separated from each other by a vertical distance d. The top sheet has surface charge density $+\sigma_0$ while the bottom sheet has surface charge density $-\sigma_0$.

Suppose a small hole is drilled in each sheet. Suppose a small particle of mass m_0 and charge q_0 is placed at rest at the entrance to the the top hole. The particle falls through the hole and is observed to emerge from the bottom hole.

Calculate the vertical speed v_z of the particle as it emerges from the bottom hole in terms of the given parameters. Note: here do *not* neglect the effects of gravity on the falling particle.

Problem 4: Again from a recent exam:

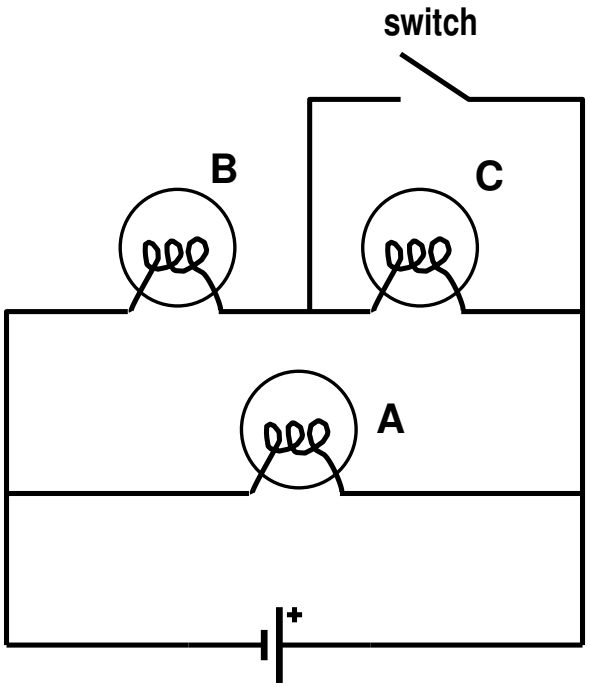


When the circuit is set up as shown above the light bulb glows. Using a voltmeter you measure the voltage at Point P relative to the back of the voltage source is +6 volts. Assume that the bulb acts like a resistor.

a) What is the voltage drop across the bulb? Give your answer in Volts. Be sure to explain how you determined this.

b) What is the current through the bulb? Give your answer in Amps. Be sure to explain how you determined this.

Problem 5: Consider the following circuit. Assume that each of the three light bulbs has the same resistance.



a) Before the switch is thrown, rank the brightness of bulbs A, B, and C. Explain your reasoning.

b) After the switch is thrown, rank the brightness of bulbs A, B, and C. Explain your reasoning.