Physics 116b Practice Test 1
Due September 21, 2005, 7 p.m. (before Review session)
Enter Answers in Web Assign ONLY (no hand ins graded)

Here is the preamble I usually include:

This is a 75 minute, closed book examination. Put answers in the boxes provided (if any). If numerical answers are needed, you must include units. Any work needed to justify the answer must be shown in the space provided, or as indicated on a separate piece of paper or elsewhere on the test. A correct answer without the necessary justifying work may not receive any credit. You may tear the formula sheet off the back of the exam.

Total points for each problem will appear in the table below and in ( ) beside each problem number. Do what is easiest first. AVOID glancing at anyone else's paper during the exam. No means of communication between other students or outside parties is allowed. **The honor code is in effect.**

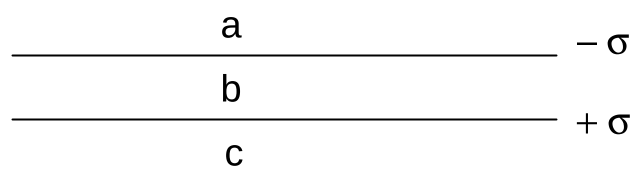
You must select 3 of the 4 problems offered. If you do more and do not indicate which 3 I should grade, there is no guarantee I will grade the ones you like best. (Grade is based on the 3 problems you choose.)

Problem	Description	Max Score	Score
1	Short Answer	Webassign	Webassign
2	Force and Potential	Webassign	Webassign
3	Gold Foil	Omit!	XXXXX
4	Capacitors	Webassign	Webassign
Total	3 out of 4	XXXXX	XXXXX

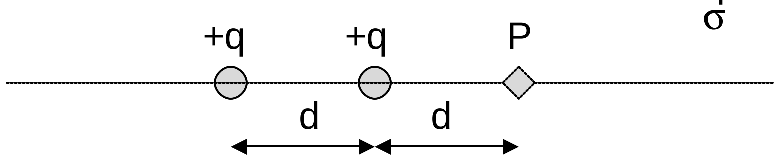
1) Short Answer (points)

a) At what distance is the force between 2 electrons equal to 5.0 nN?

b) Describe, briefly, the electric field at the points indicated on the figure to the right. Each horizontal line represents an infinite sheet of charge with equal but opposite sign charge densities. (Not in Webassign)



c) Suppose there are 2 positive charges with charge of +q, separated by a distance d as shown below. Where should a third positive charge of +q be placed so that the electric field vanishes at the point P? (use d = 1.0m)

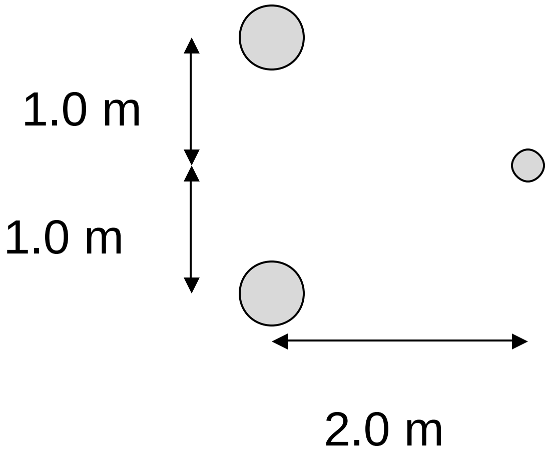


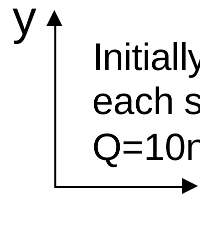
d) Estimate the capacitance of the earth? (5 pts) (hint: Assume the earth is a spherical conductor, put some charge on it an calculate the electric potential.) The radius of the earth is 6.4E6 meters.

e) At what points in space is the electric field due to the potential:
$V=a(x-1)^2+b(y+2)^2$ Equal to zero?

2) Force and Potential (points)

3 charged, conducting spheres are arrayed as shown below:





Initially, the charge on each sphere is the same Q=10nC

What is the force on the little sphere, due to the 2 big spheres?

Fx= ()

Fy= ()

Next, all three sphere's are connected together with a thin wire and charge is redistributed. If the little sphere has ½ the radius of the big spheres, what is the force now? And what is the charge on the little sphere?

Fx= ()

Fy= ()

Q_{small}= ()

3) Gold Foil (25 points)

OMIT!

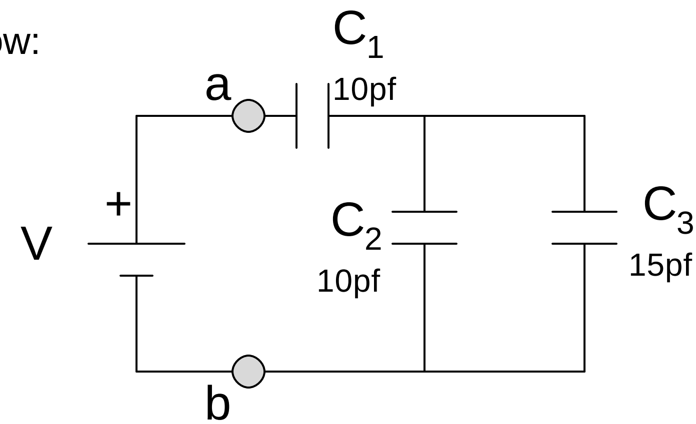
In 1911 or so, Ernst Rutherford found that sometimes [illegible]n a [illegible] nucleus is shot at a gold foil, it bounces right back! He said [illegible]lut[illegible]ncredible! Let’s see. Treat a He nucleus as a partic[illegible] with [illegible]x10^{-1}[illegible] and mass 4 times the mass of a proton. Now s[illegible]oot i[illegible]ctly [illegible]onary (i[illegible]does not move) point charge of 79e. If th[illegible] nucl[illegible] starts ou[illegible]h a kinet[illegible]nergy of 8.48x10^{-13}J , how cle[illegible]es it [illegible]he 7[illegible]harge? [illegible] is an up[illegible]r limit to the radius of a gold n[illegible] No[illegible]ace [illegible]9e with [illegible]eet of unknown surface [illegible]ensity [illegible]pe[illegible] expe[illegible]t to get [illegible]ame res[illegible]or the distanc[illegible]face [illegible] de[illegible]ty [illegible]l you [illegible]d? Conv[illegible]is surfa[illegible]harge density [illegible] volu[illegible] mas[illegible]n[illegible]y [illegible]as[illegible]ming [illegible] the she[illegible] 1.0 nm thick and ea[illegible] of cha[illegible] has [illegible] m[illegible] ma[illegible] of th[illegible]oton. Ho[illegible]oes your sheet compar[illegible] lead (v[illegible]e d[illegible]ity [illegible]35[illegible]m^3) [illegible]te: a typical nuclear distance [illegible]10^{-15} a[illegible] typi[illegible] ato[illegible] dist[illegible]e is [illegible]m, nuclear matter typically is very ve[illegible]nse!)

Distance=	(15)
σ=	(5)
ρ=	(5)

4) Capacitors ()

Consider the circuit shown below:

(Before the battery was attached, all the capacitors were uncharged. Now the circuit is at electrostatic equilibrium)



a) For each capacitor, mark the plate that has positive charge with a "+" sign, and the plate that has a negative charge with a "-" sign. ()

b) If the charge on C_1 is 5.0 pC, what is V?

V= ()

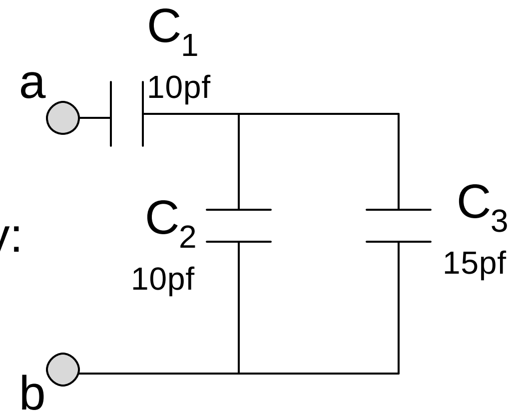
c) What is the charge on C_2?

Q_2= ()

d) What is the equivalent capacitance between points a and b?

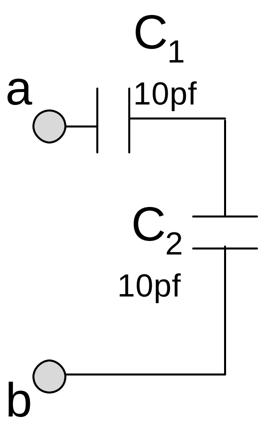
C= ()

4) Capacitors (25 points contd.)

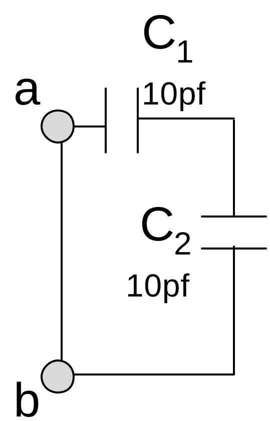


Now, were going to remove the battery:

Then we are removing C_3



And putting a conducting wire from a to b.



At this point, the charge on capacitors 1 and 2 is the same as in part a)-d)

e) After the charge has redistributed, what is the new charge on C_2?

$Q_2 =$

()