Exam 1 – white version

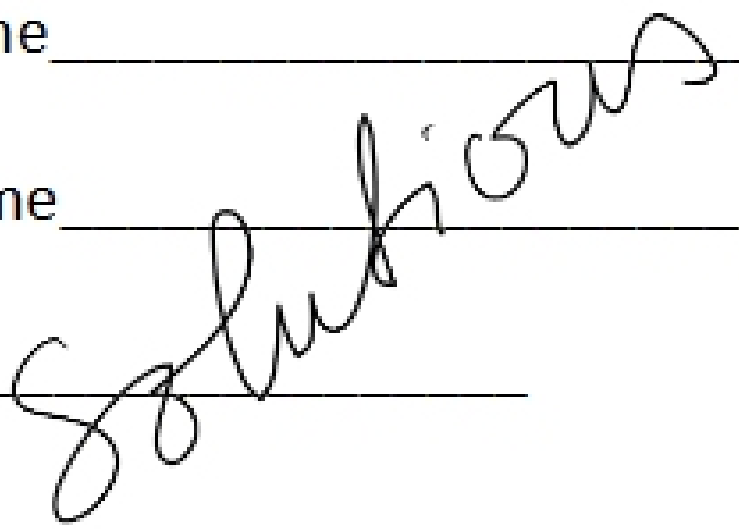
Physics 2760

FS 2008

Last Name_____

First Name_____

ID # _____



This is a closed book exam. I understand, pursuant to University Regulations on academic honesty, that I am not to use any notes or information other than what is in the official, non-annotated formula sheet.

Signature_____

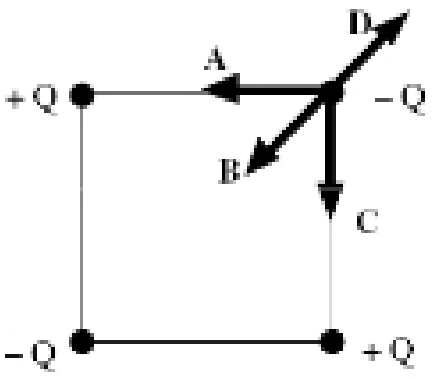
For multiple choice questions, please make sure that you circle the letter for the answer which you believe to be correct and only that answer. If more than one answer is circled for the same problem, you will not receive credit for it. Don't get hung up on questions. They should take only one or two minutes each. If you find yourself spending more than a few minutes on a multiple choice question you are probably looking at it the wrong way. You should skip it for now and come back to it later.

For full credit show your work for solutions to questions that require calculations. Explain from where you start to solve the problem and show your math flowing from it for full credit. **No shown work, no credit!**

Relax, read carefully, think – and then read everything again.

During the exam, if you have questions please raise your hand and the TA or the instructor will come to you and provide help.

1. (5 points) Four point charges, each of the same magnitude, with varying signs are arranged at the corners of a square as shown. Which of the arrows labeled A, B, C, and D gives the correct direction of the net force that acts on the charge at the upper right corner?

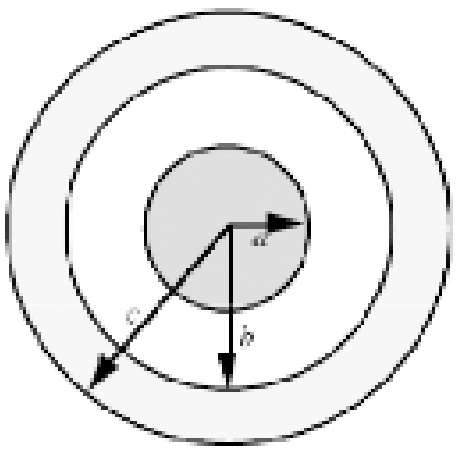


a) A (b) B c) C
d) D e) The net force on that charge is zero.

2. (5 points) At which point (or points) is the electric field zero N/C for the two point charges shown on the x axis?

a) The electric field is never zero in the vicinity of these charges.
b) The electric field is zero somewhere on the x axis to the left of the +4q charge.
(c) The electric field is zero somewhere on the x axis to the right of the –2q charge.
d) The electric field is zero somewhere on the x axis between the two charges, but this point is nearer to the –2q charge.
e) The electric field is zero at two points along the x axis; one such point is to the right of the –2q charge and the other is to the left of the +4q charge.

A solid, conducting sphere of radius a carries an excess charge of +6 μC. This sphere is located at the center of a hollow, conducting sphere with an inner radius of b and an outer radius of c as shown. The hollow sphere also carries a total excess charge of +6 μC.



3. (5 points) Determine the excess charge on the inner surface of the outer sphere (a distance b from the center of the system).

a) zero coulombs d) +12 μC
(b) –6 μC e) –12 μC
c) +6 μC

4. (5 points) Determine the excess charge on the outer surface of the outer sphere (a distance c from the center of the system).

a) zero coulombs c) +6 μC e) –12 μC
b) –6 μC (d) +12 μC

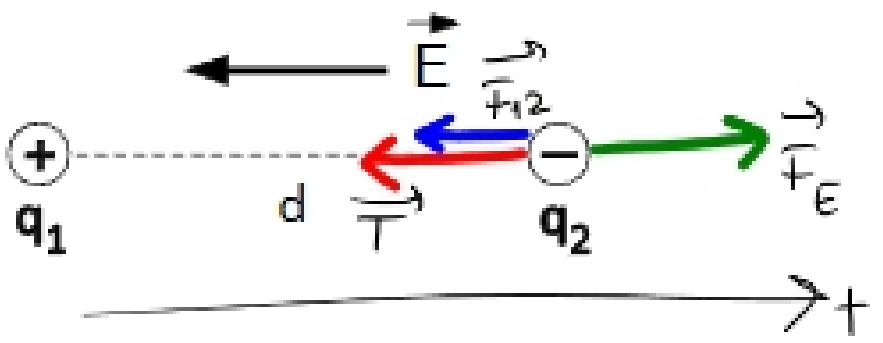
5. (5 points) The First Law of Physics 2760 is:

(a) Dorina is always right.
(b) On exams you always get the only problems you don't know how to solve.
(c) If you discover that Dorina is wrong, you must remember answer (a).
(d) You must accumulate enough points to pass Physics 2760 and not have to take it again.

Problem 6

A positive point charge, $q_1 = +5.0\ \mu C$, is *glued down* on a horizontal frictionless table. It is tied through a light, non-conducting string to a negative point charge, $q_2 = -7.5\ \mu C$. The distance between the two charges is d = 2.5 cm. A uniform electric field of magnitude $E = 2 \times 10^5$ N/C is directed parallel to the string, as shown in the figure. Charge q_2 is in equilibrium. Take $k = 9 \times 10^9\ Nm^2/C^2$.

A) Draw all the forces acting on the negative charge, label them, and explain your labels properly. (6 points)



$\vec{T}$ = tension

$\vec{F}_{12}$ = Coulomb force between q_1 and q_2

$\vec{F}_E$ = electric force applied by electric field.

B) Find the tension in the string. (19 points)

$\Sigma \vec{F} = 0$

$\vec{T} + \vec{F}_{12} + \vec{F}_E = 0$

$F_{12} = k\frac{q_1 q_2}{d^2}$, $F_E = q_2 E$

$-T - F_{12} + F_E = 0 \Rightarrow T = F_E - F_{12}$

$T = q_2 E - k\frac{q_1 q_2}{d^2}$

$T = (7.5\times10^{-6})(2\times10^{8}) - (9\times10^{9})\frac{(5\times10^{-6})(7.5\times10^{-6})}{(2.5\times10^{-2})^2}$

$T = 1500 - 540 \Rightarrow \boxed{T = 960\ N}$