Massachusetts Institute of Technology *Spring Term 2005*

8.02X Electricity and Magnetism

Quiz #1

Tuesday, Feb 22 10:05-10:55am Room 26-100

The quiz has four questions. It is a closed book quiz. No calculators are allowed. A letter-size formula sheet can be used, but has to be signed and submitted together with the quiz.

LAST NAME

FIRST NAME

MIT ID#

RECITATION SECTION

			MARK YOURS
Rec01	MW11	B. Zeng	
Rec02	MW12	B. Zeng	
Rec03	MW1	D. Nagaj	
Rec04	TR11	G. Benedek	
Rec05	TR1	G. Benedek	
Rec06	TR2	G. Benedek	
Rec07	TR3	Daniel Nagaj	

Problem #1	
Problem #2	
Problem #3	
Problem #4	
TOTAL	

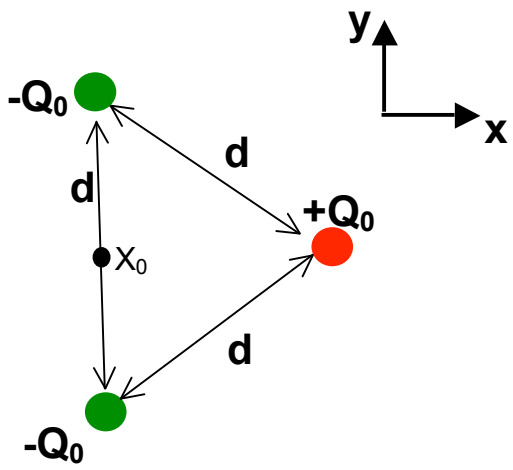
Problem 1 (25 points)

Consider the configuration of point charges shown below, with two negative charges $-Q_0$ and a positive charge $+Q_0$ forming a equilateral triangle (all sides have length d) in the x-y plane.

(a) What is the direction and magnitude of the force on the positive charge $+Q_0$ in terms of the given quantities?

(b) What is the direction and magnitude of the electric field at point x_0 halfway in between the two negative charges?

(c) Now, assume that the two negative charges are fixed in space and that $+Q_0$ is freely movable. Describe the motion $+Q_0$ would undergo if released from rest from the original position shown below (2-3 sentences)



Problem 2 (25 points)

In lecture, you saw that an electrically charged plexiglass rod could be used to attract electrically neutral objects like a balloon made out of conducting foil.

(a) In a few sentences, explain the origin of the force between a charged object like the rod and an electrically neutral conducting object.

(b) Attraction can also be seen between a charged object and electrically neutral insulators. For example, the rod can be used to pick up pieces of confetti. How does this differ from the process described in (a)?

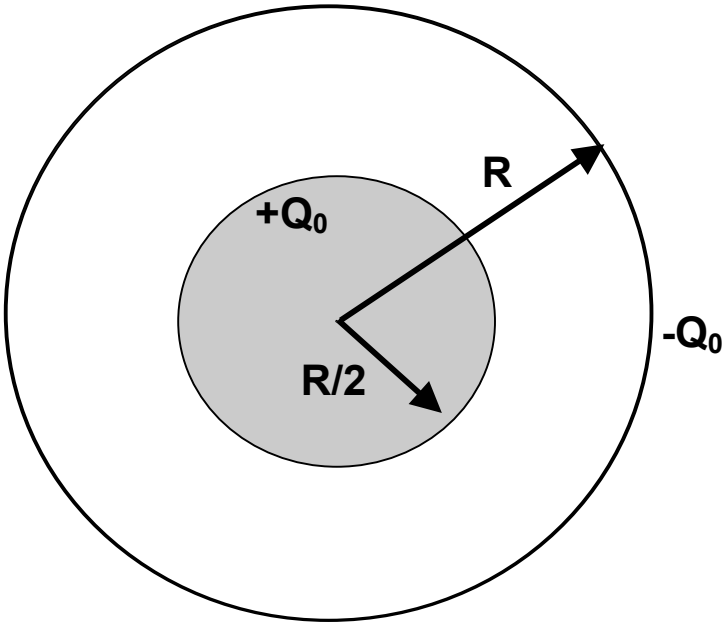
Problem 3 (25 points)

Shown below is the cross-section of a conducting sphere of radius R/2, surrounded by a very thin conducting spherical shell of radius R. The inner sphere carries a charge $+Q_0$ and the outer shell carries a charge $-Q_0$.

(a) On the figure, indicate the distribution of charge on the inner sphere.

(b) Using Gauss's Law, find the strength of the electric field E(r) as a function of r from r=0 to r > R, where r is the distance from the center of the sphere. Results without work will not receive credit.

(c) On the figure, show your solution to (b) using field lines



Problem 4 (25 points)

Shown below is the cross-section of two large parallel plates carrying charges +Q (top) and -Q (bottom). Each plate has area A. Vertically between the plates, a small charged particle with charge q and mass m is suspended at y=d/2, i.e. the force of gravity F_G = -m*g and the electrostatic force on the particle cancel.

(a) What is the sign of the small particles charge q?

(b) Determine q in terms of the other quantities given. Neglect fringe effects for the electric field created by the two plates.

(c) Sketch the electric potential energy U_E of the charged particle as a function of y from y=0 to y=d, assuming U_E = 0 at y=0.

(d) Sketch the total potential energy U_T of the particle as a function of y from y=0 to y=d.

(e) Sketch the electric potential V between the plates (ignore the charge q) from y=0 to y=d.