Exam 1

P202 Spring 2009,
Instructor: Prof. Abanov

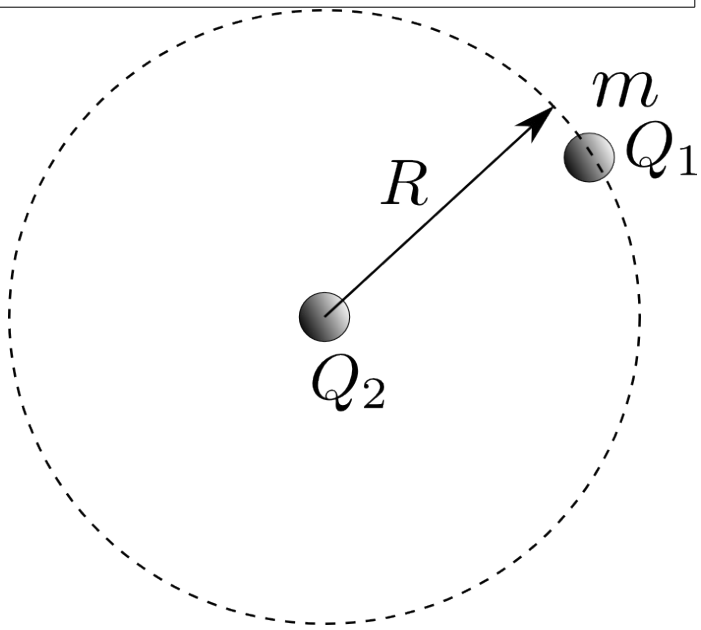
02/05/09

Name_____ Section_____

(print)

Your grade:

Problem 1.



Charges $Q_1 = +11\mu C$ and $Q_2 = -11\mu C$ are at distance $R = 1\text{m}$ from each other. The mass of charge Q_1 is $m = 1\text{kg}$.

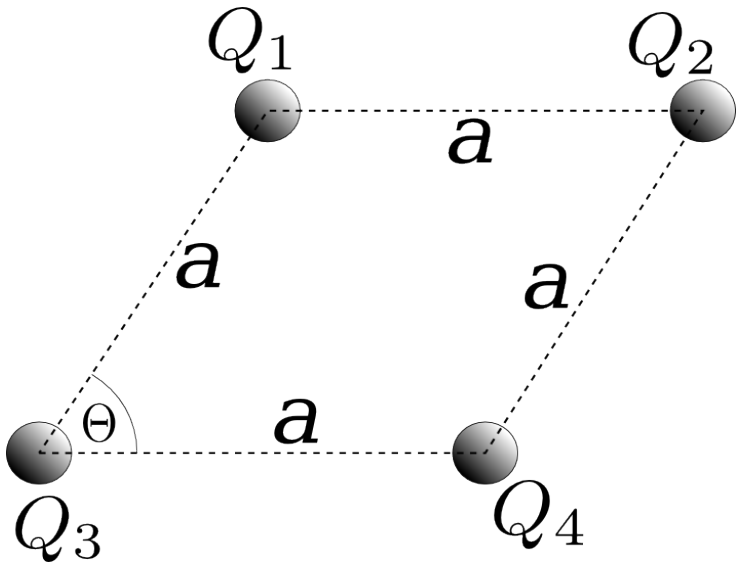
What is the magnitude and the direction of the force which acts on the charge Q_1 ?
_____(show direction on the figure)

What is velocity the charge Q_1 must have in order to stay in orbit of radius R ?
_____

How should the velocity be changed in order for the orbit to have radius 4R ?

Problem 2.

Four charges Q1, Q2, Q3, and Q4 are positioned in the corners of a rhombus with sides measures a=0.5m and angle $\Theta = 60°$. Q1=+2.0mC, Q4=+ 2.0mC, and Q2= +1.0mC is positive.



What is the magnitude and direction of the force with which charge Q1 acts on charge Q2?_____ (show direction on the figure)

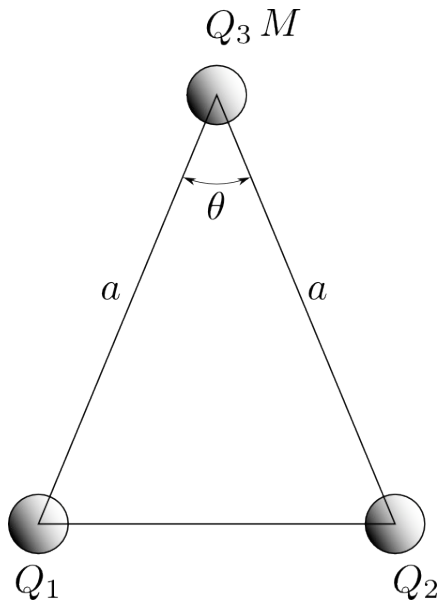
What is the magnitude and direction of the force with which charge Q4 acts on charge Q2?_____ (show direction on the figure)

if Q3 is zero what is the magnitude and direction of the total force which acts on charge Q2?_____ (show direction on the figure)

What does Q3 have to be so that the total force on Q2 to be zero?_____

What will be the total force acting on Q2 if we double Q3?_____

Problem 3.



Three charges Q_1 , Q_2 , and Q_3 are positioned in the corners of a triangle whose side measures a=0.5m and angle $\theta = 60°$ $Q_1 = Q_2 = +2.0\text{mC}$ and $Q_3 = +1.0\text{mC}$.

What is the magnitude and direction of the force with which charge Q_1 acts on charge Q_3 ?_____ (show direction on the figure)

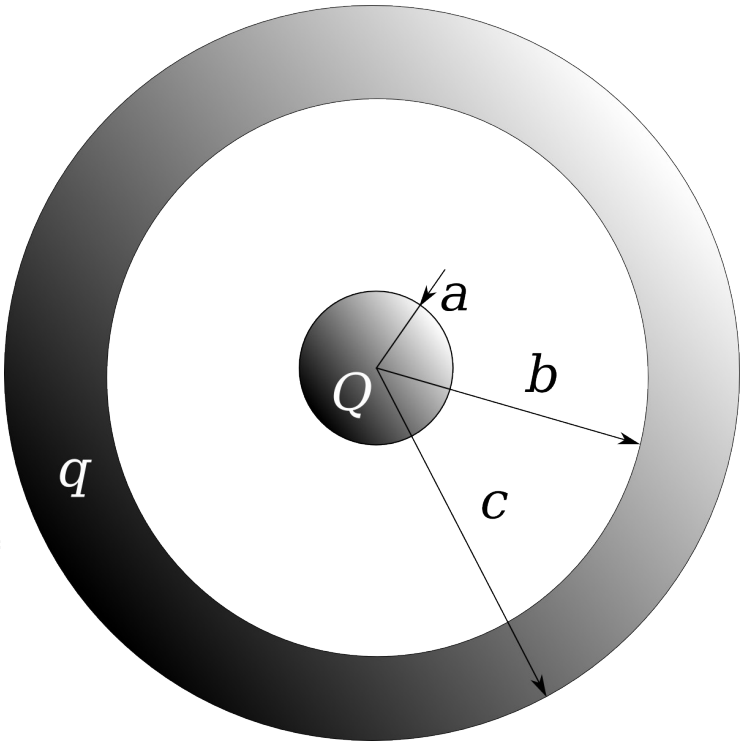
What is the magnitude and direction of the force with which charge Q_2 acts on charge Q_3 ?_____ (show direction on the figure)

What is the magnitude and direction of the total force which acts on charge Q_3 ? _____ (show direction on the figure)

What would be the magnitude and direction of the total force which acted on charge Q_3 , if charge $Q_2 = -2.0\text{mC}$?_____ (show direction on the figure)

Problem 4.

A solid, conducting sphere of radius *a* =4.0cm carries an excess charge of $Q=+8\mu C$. This sphere is located at the center of a hollow, conducting sphere with an inner radius of *b* = 12.0cm and an outer radius of *c* = 14.0cm as shown. The hollow sphere carries a total excess charge of $q=-6\mu C$.



What is the magnitude and direction of the electric field at a distance 3.8cm from the center?_____

What is the magnitude and direction of the electric field at a distance 5cm from the center?_____

What is the magnitude and direction of the electric field at a distance 13cm from the center?_____

What is the magnitude and direction of the electric field at a distance 15cm from the center?_____

What is the total charge at the outer surface of the hollow sphere?_____

Problem 5.

Four protons are initially at rest in the corners of a square of side $a = 0.8\text{nm}$. All four are released simultaneously.

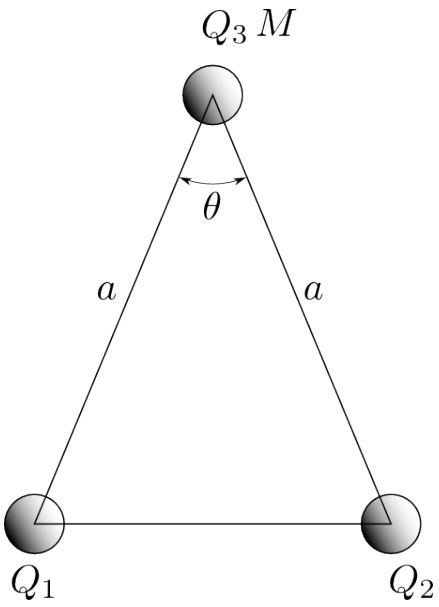
What is the maximum speed each will ever reach?_____

When (at what distance) does this speed occur?_____

What is the maximum acceleration each will achieve?_____

When (at what distance) does this acceleration occur?_____

Problem 6.



Three charges Q_1 , Q_2 , and Q_3 are positioned in the corners of a triangle whose side measures a=0.5m and angle $\theta = 60°$ $Q_1 = Q_2 = +2.0\text{mC}$ and $Q_3 = +1.0\text{mC}$. The mass of charge Q_3 is $M = 10\text{g}$. At initial time the charge Q_3 is released.

What is initial acceleration of the charge Q_3 ?_____

What is the velocity of the charge Q_3 at infinity?_____

What would the velocity at infinity be if charge Q_3 started from midpoint between charges Q_1 and Q_2 ?_____

Problem 7.

The plates of the parallel-plate capacitor are d=1mm apart, and each carries a charge of magnitude Q=8.0μC. The capacitor is connected to the V=1000Volts battery

What is the magnitude of the electric field between the plates?_____

What is the magnitude of the electric field outside?_____

What is the area of each plate?_____

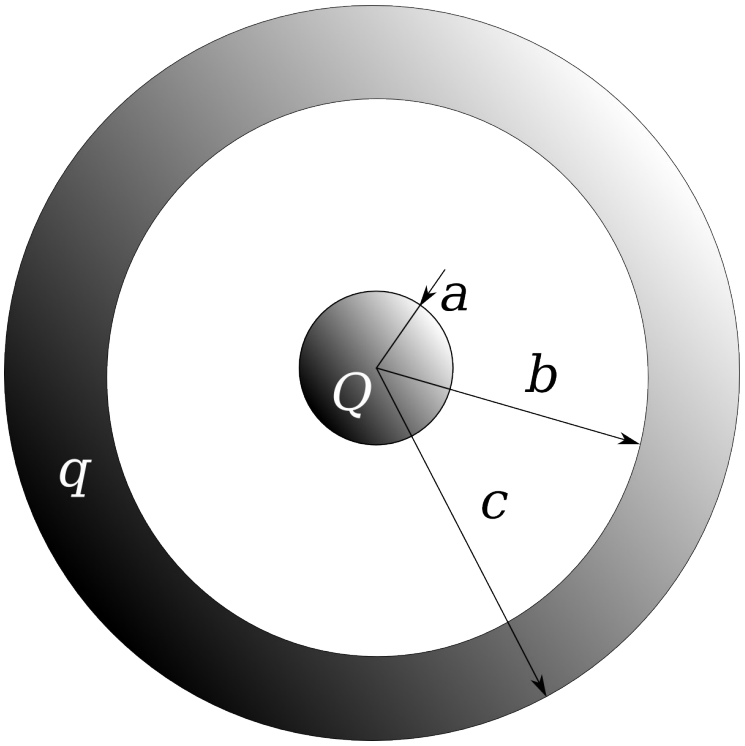
What is the capacitance?_____

What is the energy stored in the capacitor?_____

What will be the charge on the plates if we double the distance between the plates?
_____

Problem 8. (spherical capacitor)

A solid, conducting sphere of radius *a* =3.5cm is located at the center of a hollow, conducting sphere with an inner radius of *b* = 10.0cm and an outer radius of *c* = 12.0cm as shown. The charge of the solid sphere is $Q=-6\mu C$. The hollow sphere carries a total excess charge of $q=+6\mu C$.

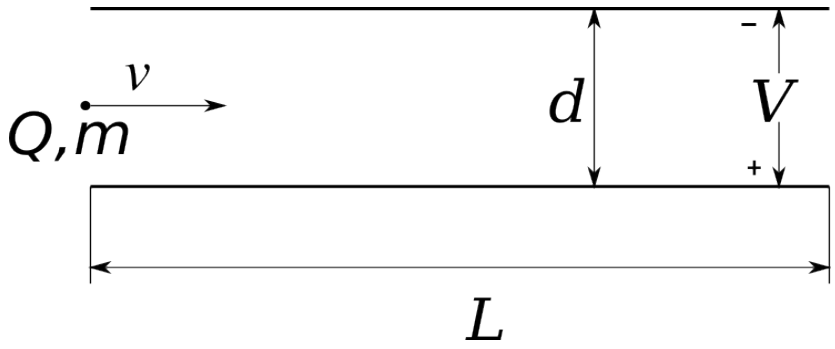


What is the potential difference between the solid and the hollow spheres?_____

What is the capacitance of this system of conductors?_____

How the capacitance changes if we double the radius c?_____

Problem 9.



A parallel plate capacitor with the length of the plates L=10cm is set up horizontally and has a distance between plates d=1cm and the potential difference between the plates V=1000Volts. A small object of charge $Q=2\mu C$ and mass m=1g enters the capacitor with horizontal velocity v=20m/s. Neglect the gravitational force.

What is the magnitude and the direction of the electric field in between the plates?
_____

What electrostatic force is is acting on the object?_____

What is the magnitude of the object's velocity when it leaves the capacitor?_____

What is the direction of the object's velocity when it leaves the capacitor?_____

Problem 10.

An insulating sphere of radius R is uniformly charged throughout its volume. The total charge of the sphere is Q. Find the electric field at distance r from the center of the sphere. (Volume of a sphere of radius a is $\frac{4}{3}\pi a^3$)

If r>R _____

if r<R _____