Exam 1

P202 Spring 2007,
Instructor: Prof. Abanov

02/01/07

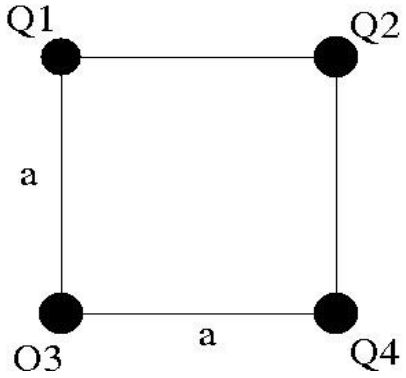
Name_____ Section_____

(print)

Your grade:

Problem 1.

Four charges Q1, Q2, Q3, and Q4 are positioned in the corners of a square whose side measures a=0.5m. Q1=+3.0mC, Q4=+ 3.0mC, 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)

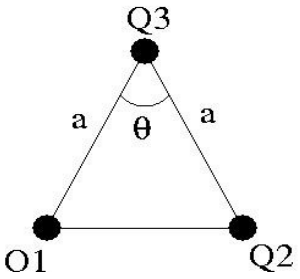
What is the magnitude and direction of the force with which charge Q4 acts on charge Q2?_____ (show direction on the figure)

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 2.

Three charges Q1, Q2, and Q3 are positioned in the corners of a triangle whose side measures a=0.5m and angle $\theta = 60°$ Q1=Q2=+3.0mC and Q3= +1.0mC.



What is the magnitude and direction of the force with which charge Q1 acts on charge Q3?_____ (show direction on the figure)

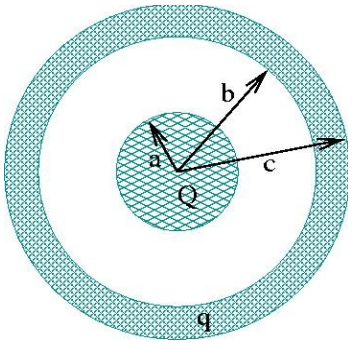
What is the magnitude and direction of the force with which charge Q2 acts on charge Q3?_____ (show direction on the figure)

What is the magnitude and direction of the total force which acts on charge Q3?_____ (show direction on the figure)

What would be the magnitude and direction of the total force which acted on charge Q3, if charge Q2=-3.0mC?_____ (show direction on the figure)

Problem 3.

A solid, conducting sphere of radius *a* =3.5cm carries an excess charge of Q=+6.0μC. This sphere 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 hollow sphere also carries a total excess charge of q=+6.0μC.



What is the magnitude and direction of the electric field at a distance 2cm 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 11cm 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 4.

Two protons are released from the rest when they are 0.8nm apart.

What is the maximum speed they will reach?_____

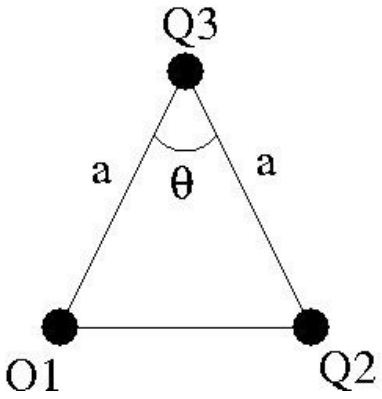
When does this speed occur?_____

What is the maximum acceleration they will achieve?_____

When does this acceleration occur?_____

Problem 5.

Three charges Q1, Q2, and Q3 are positioned in the corners of a triangle whose side measures a=0.5m and angle $\theta = 60°$ Q1=Q2=+3.0mC and Q3= +1.0mC. The mass of charge Q3 is M=10g. At initial time the charge Q3 is released.



What is initial acceleration of the charge Q3?_____

What is the velocity of the charge Q3 at infinity?_____

What would the velocity at infinity be if charge Q3 started from midpoint between charges Q1 and Q2?_____

Problem 6.

The plates of the parallel-plate capacitor are d=10mm apart, and each carries a charge of magnitude Q=8.0μC. The electric field between the plates has a magnitude of $E = 4.0\text{x}10^6 V/m$

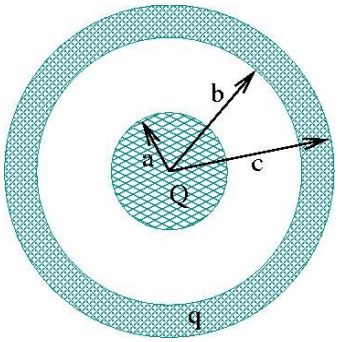
What is the potential difference between the plates?_____

What is the area of each plate?_____

What is the capacitance?_____

How will the capacitance and the potential difference change if we double the distance between the plates?_____

Problem 7. (spherical capacitor)



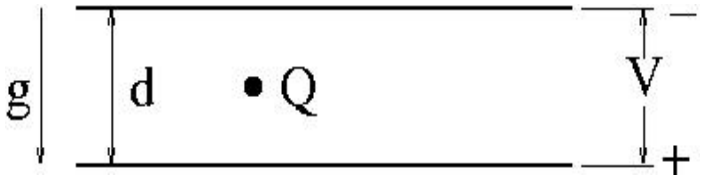
A solid, conducting sphere of radius *a* =3.5cm is located at the center of a hollow, conducting sphere with an inner radius of *b* = 10.0cm and an outer radius of *c* = 12.0cm as shown. The charge of the solid sphere is Q=-6.0μC. The hollow sphere also carries a total excess charge of q=+6.0μC.

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

What is the capacitance of this system of conductors?_____

Problem 8.

A parallel plate capacitor is set up horizontally and has a distance between plates d=1cm and the potential difference between the plates V=100Volts. A small object



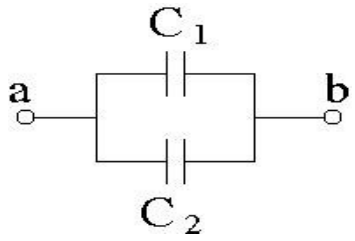
in between the plates has a small charge $Q = 1\,\mu C$.

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

What electrostatic force is is acting on the object?_____

What should be the mass of the object in order for the object to be at rest?($g = 9.8\text{m}/s^2$)**_____**

Problem 9.



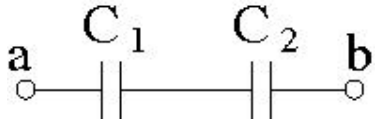
A system of capacitors is shown on the figure, $C_1 = 2\mu F$, $C_2 = 3\mu F$. Potential difference between points a and b is V=10Volts.

What is the charge Q_1 on capacitor C_1 ?_____

What is the charge Q_2 on capacitor C_2 ?_____

What is the total capacitance of the system?_____

Problem 10.



A system of capacitors is shown on the figure, $C_1 = 2\mu F$, $C_2 = 3\mu F$. Potential difference between points a and b is V=10Volts.

What is the total capacitance of the system?_____

What is the charge Q_1 on capacitor C_1 ?_____

What is the charge Q_2 on capacitor C_2 ?_____

What is the voltage difference V_1 across the capacitor C_1 ?_____

What is the voltage difference V_2 across the capacitor C_2 ?_____