

Exam 1

**P202 Spring 2008,
Instructor: Prof. Abanov**

01/31/08

Name_____

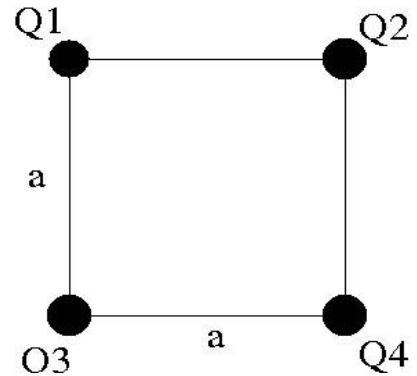
(print)

Section_____

Your grade:

Problem 1.

Four charges Q_1 , Q_2 , Q_3 , and Q_4 are positioned in the corners of a square whose side measures $a=0.5\text{m}$. $Q_1=+3.0\text{mC}$, $Q_4=+3.0\text{mC}$, and $Q_2=+1.0\text{mC}$ is positive.



What is the magnitude and direction of the force with which charge Q_1 acts on charge Q_2 ? _____ (show direction on the figure)

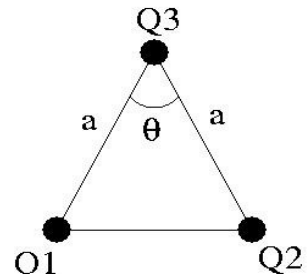
What is the magnitude and direction of the force with which charge Q_4 acts on charge Q_2 ? _____ (show direction on the figure)

What does Q_3 have to be so that the total force on Q_2 to be zero? _____

What will be the total force acting on Q_2 if we double Q_3 ? _____

Problem 2.

Three charges Q_1 , Q_2 , and Q_3 are positioned in the corners of a triangle whose side measures $a=0.5\text{m}$ and angle $\theta=60^\circ$. $Q_1=Q_2=+3.0\text{mC}$ 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)

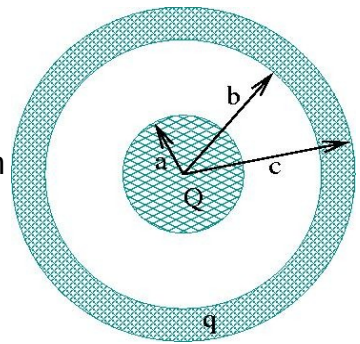
What is the magnitude and direction of the force with which charge Q_2 acts on charge Q_3 ? _____ (show direction on the figure)

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 $Q_2=-3.0\text{mC}$? _____ (show direction on the figure)

Problem 3.

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



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? _____

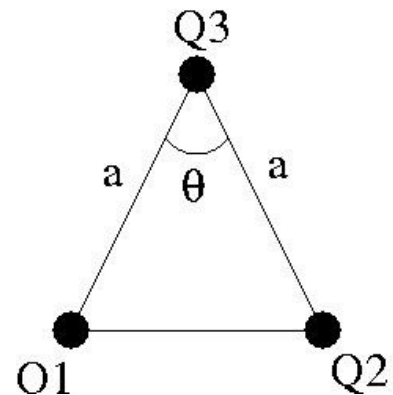
When (at what distance) does this speed occur? _____

What is the maximum acceleration they will achieve? _____

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

Problem 5.

Three charges Q_1 , Q_2 , and Q_3 are positioned in the corners of a triangle whose side measures $a=0.5\text{m}$ and angle $\theta=60^\circ$
 $Q_1=Q_2=+3.0\text{mC}$ 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 6.

The plates of the parallel-plate capacitor are $d=10\text{mm}$ apart, and each carries a charge of magnitude $Q=8.0\mu\text{C}$. The electric field between the plates has a magnitude of

$$E=4.0\times 10^6 \text{ V/m}$$

What is the potential difference between the plates? _____

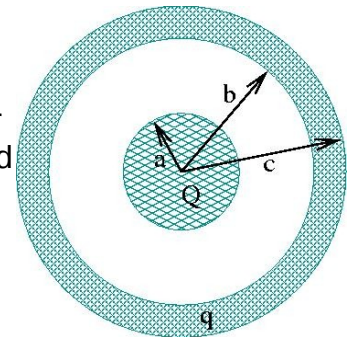
What is the area of each plate? _____

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 $a=3.5\text{cm}$ is located at the center of a hollow, conducting sphere with an inner radius of $b=10.0\text{cm}$ and an outer radius of $c=12.0\text{cm}$ as shown. The charge of the solid sphere is $Q=-8\mu\text{C}$. The hollow sphere carries a total excess charge of $q=+8\mu\text{C}$.



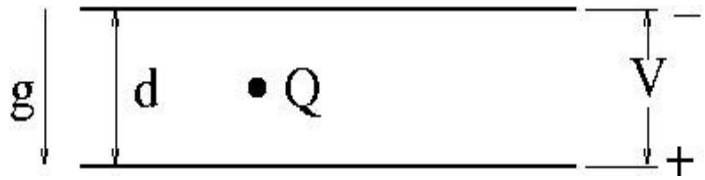
What is the potential difference between the solid and the hollow spheres? _____

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 $d=1\text{cm}$ and the potential difference between the plates $V=100\text{Volts}$. A small object

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



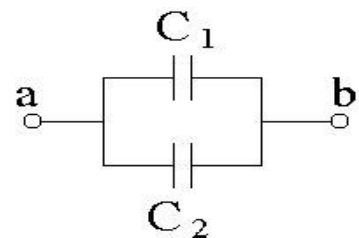
What is the magnitude and the direction of the electric field in between the plates?

What electrostatic force 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, $C_1=2\mu\text{F}$,
 $C_2=3\mu\text{F}$. Potential difference between points a and b is $V=10\text{Volts}$.



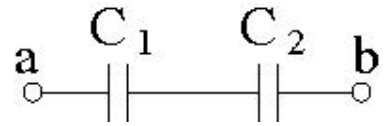
What is the charge Q_1 on capacitor C_1 ? _____

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
 $V=10\text{Volts}$.



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 ?_____