Exam 1

P208 Fall 2007,

Instructor: Prof. Abanov

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Name_____   Section_____
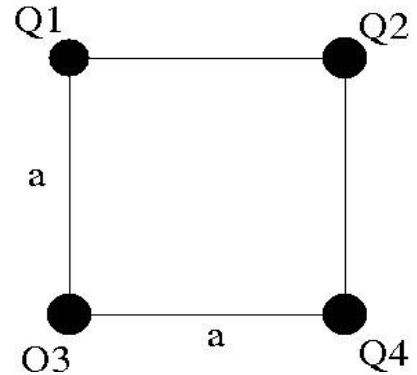
Problem 1.

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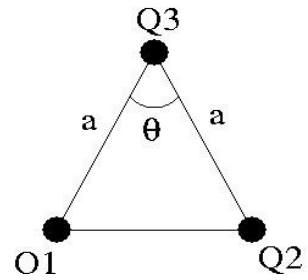
What is the magnitude and direction of the force with which charge Q4 acts on charge Q2?_____ (show direction on the figure)

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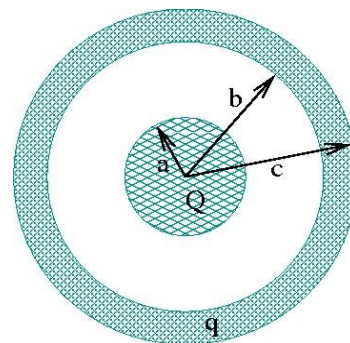
What is the magnitude and direction of the force with which charge Q2 acts on charge Q3?_____ (show direction on the figure)

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?_____

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

Problem 4.

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

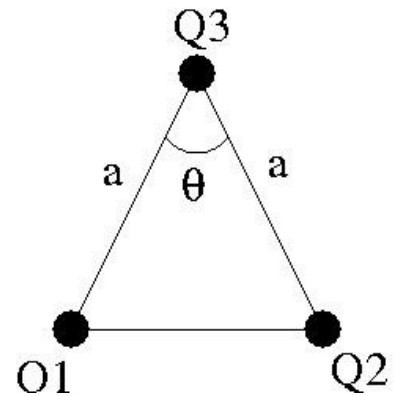**What is the maximum speed they will reach?_____**

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?_____

**How the electric field will change if we double the distance between the
plates?_____**

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

Problem 7.

A spherically symmetric charge distribution has a charge density $\rho(r)=\rho_0\left(1-5r^2/3R^2\right)$ for $r<R$ and $\rho=0$ for $r>R$.

What is the total charge inside a sphere of radius 1 and center in the origin?_____

What is the electric field magnitude for points $r>R$?_____

What is the electric field magnitude for points $r<R$?_____

At what distance r_0 the magnitude of the electric field is the largest?_____

Problem 8.

For the distribution of charge given in Problem 7.

What is the electric field potential for points $r>R$?_____

What is the electric field potential for points $r<R$?_____

At what distance r_1 the potential is the largest?_____

Problem 9.

A uniformly charged ring of radius R has a total charge Q .

What is the magnitude and direction of the electric field along the axis of the ring?_____

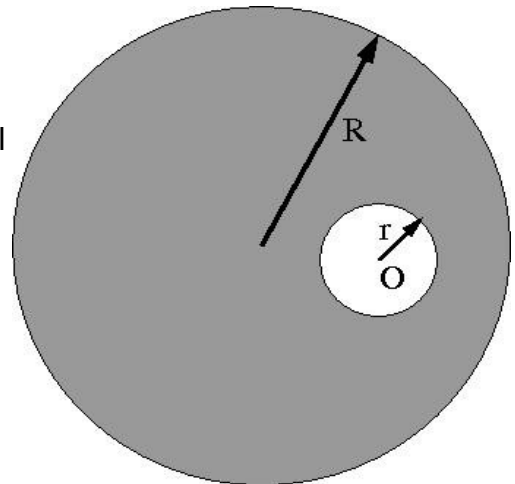What is electric field potential along the axis of the ring?_____

What is the electric field at the center of the ring?_____

What is the electric potential at the center of the ring?_____

Problem 10.

A uniformly charged sphere of radius R has a spherical cavity of radius r and center O as shown on the picture.

What is the electric field at the point O ?_____

What would be the electric field at the point O if we double the radius r , but still entire cavity is inside the big sphere?_____