Exam Final

P208 Fall 2007,
Instructor: Prof. Abanov

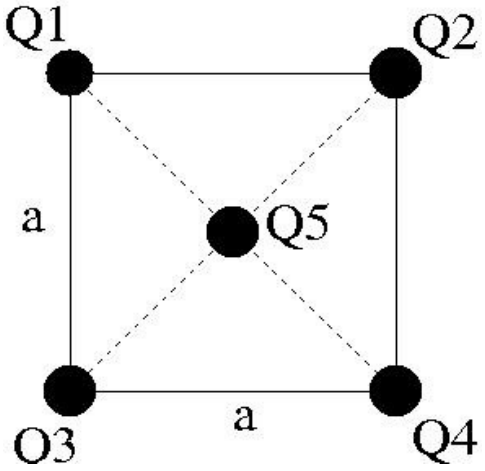
12/10/07

Name_____ Section_____

(print)

Your grade:

Problem 1.



Four charges Q1, Q2, Q3, Q4 and Q5 are positioned in the corners and the center of a square side measures a=0.5m. Q1=+3.0mC, Q4=+ 3.0mC, and Q2= +1.0mC are positive, while Q5=- 3.0mC is negative.

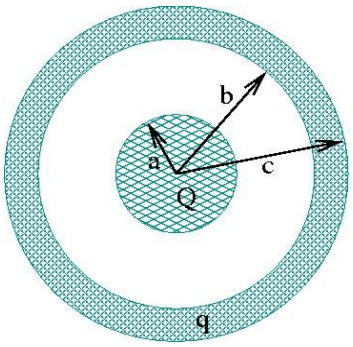
What is the magnitude and direction of the force with which charge Q1 acts on charge Q2?_____ (show direction on the figure)

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.



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?_____

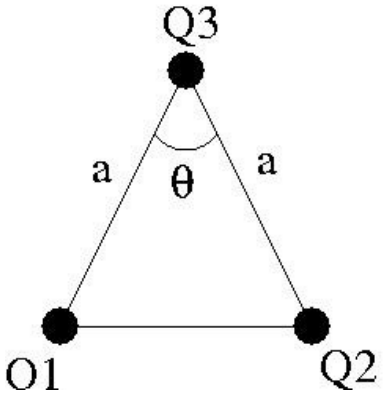
What is the magnitude and direction of the electric field at a distance 14cm from the center?_____

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 3.

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= +2.0mC. 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 4.

The plates of the parallel-plate capacitor are d=20mm 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?_____

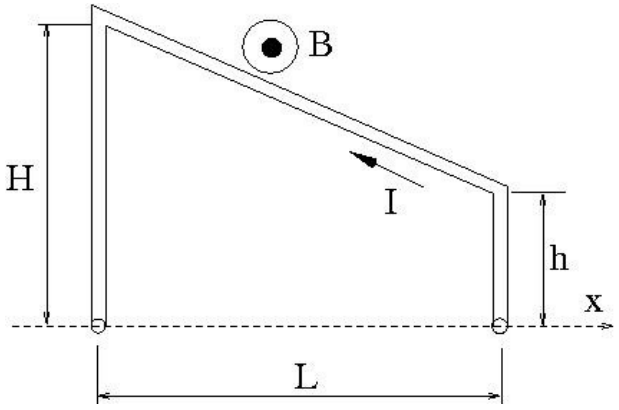
What is the area of each plate?_____

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 5.

A wire with a current $I=2\text{mA}$ has the form shown in the figure with dimensions $L=10\text{cm}$ and H, h unknown. It was placed in the magnetic field $B=0.5\text{T}$ pointing out of the paper.

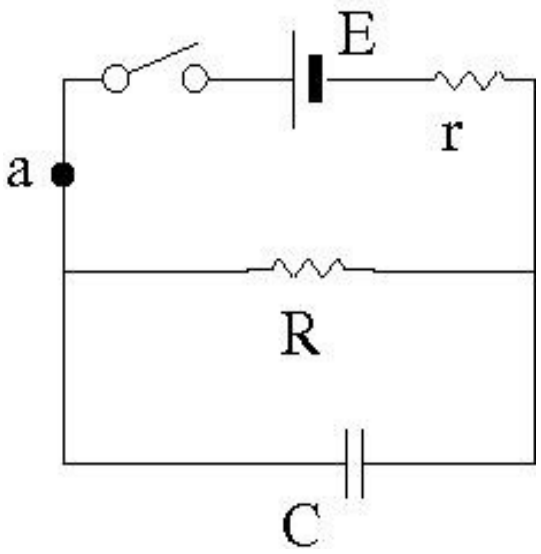


What is x component of the force acting on the wire?___

What is y component of the force acting on the wire?_____

Problem 6.

In the circuit shown in the figure $E=10\text{V}$, $r=6\text{k}\Omega$, $R=4\text{k}\Omega$, and $C=4\,\mu F$. Initially the capacitor is uncharged. At the moment t_0 the switch is closed.



What is the current in point a immediately after t_0 ?_____

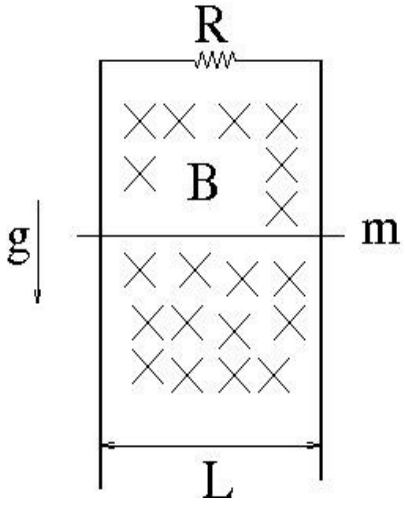
What is the current in point a after a very long time?

_____

What is the charge on the capacitor C long time after t_0 ?_____

Problem 7.

A metal bar of mass $m = 10\text{kg}$ can move along two vertical straight rails which are $L = 1\text{m}$ apart from one another. The total friction force between the bar and the rails is $F_f = 50\text{N}$. The resistor $R = 2\,\Omega$ connects the rails. Magnetic field is $B = 0.5\text{T}$ After a long time the bar falls with constant velocity.



What is the direction of electric current induced by the motion?(show on the figure)

What is the direction of the magnetic force acting on the bar?(show on the figure)

What is the velocity of the bar?_____

What will be the velocity if we double the magnetic field?_____

Problem 8.

A light passes through two slits separated by 0.460mm. In the resulting interference pattern on a screen 2.20m away, adjacent bright fringes are separated by 2.82mm.

What is the wavelength of the light?

What will be the separation between the fringes if we double the frequency of the light?

Problem 9.

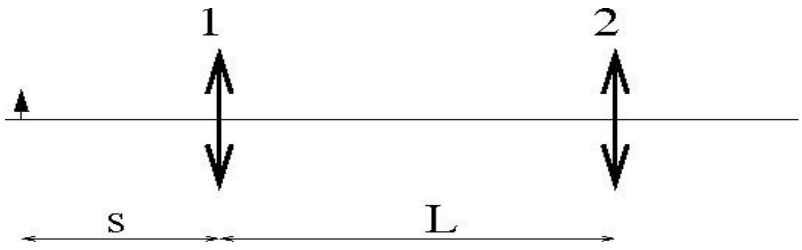
Light of 600.0 nm is incident on a single slit of width 6.5 μm. The resulting diffraction pattern is observed on a nearby screen and has a central maximum of width 3.5 m.

What is the distance between the screen and the slit?

What will be the width of the central maximum if the light of $\lambda = 400\text{nm}$ is used?

Problem 10.

The object is s=30cm from the first lens. The distance between lenses is L=50cm. The focal length of the first lens is $f_1 = 10\text{cm}$ and of the second lens it is $f_2 = 20\text{cm}$.



What is the distance between the first lens and the first image?_____

What is the distance between the second lens and the final image?_____

What is the magnification of the first length?_____

What is the magnification of the second lens?_____

What is the final magnification?_____

Is the final image virtual?_____

Is the final image inverted?_____