Final Exam

P208 Fall 2009,
Instructor: Prof. Abanov

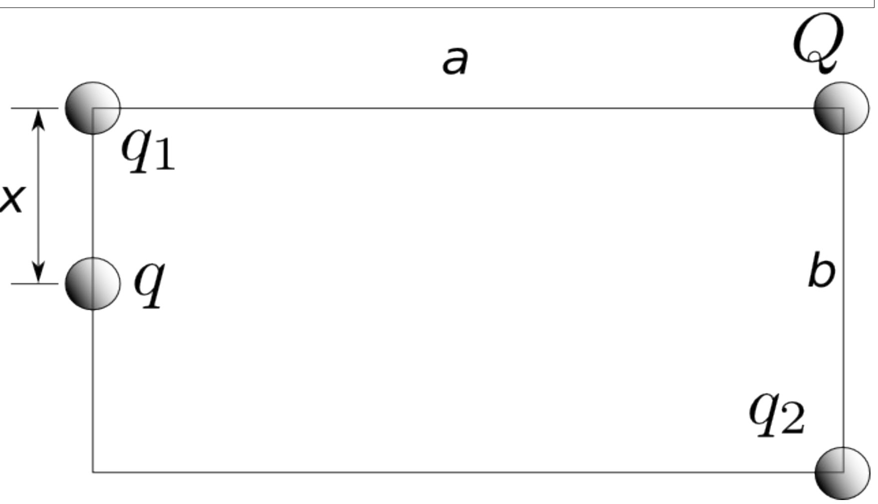
December 2009

Name______________ Section___________
(print)

501 Fuller, Melissa	Tues, 2:20-5:10	516 Li, Feng	Thurs, 8:00-10:50
502 Mahony, James	Tues, 3:55-6:45	517 Amin, Vivek	Thurs, 9:35-12:25
503 Chen, Jason	Tues, 4:55-7:45	518 Chen, Jason	Thurs, 11:10-2:00
504 Ferguson, Jim	Tues, 5:55-8:45	519 Russell, Charles	Thurs, 12:45-3:35
505 Zhang,Xiwen	Tues, 6:55-9:55	520 Zhang,Xiwen	Thurs, 2:20-5:10

Your grade:

Problem 1.



Three charges $Q = 4.0\text{mC}$, $q_1 = 16.0\text{mC}$, $q_2 = 1.0\text{mC}$, are positioned in the corners of a rectangle with sides a=1.0m, and b=0.5m.

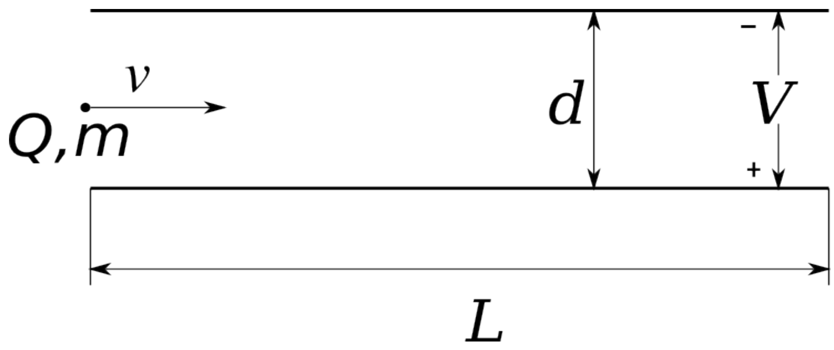
What is the magnitude and direction of the force with which charge q_1 acts on charge Q ?_______ (show direction on the figure)

What is the magnitude and direction of the force with which charge q_2 acts on charge Q ?_______ (show direction on the figure)

What must the distance x be (see figure) where a charge q can be placed in order for the total force acting on Q to be zero?

What must the charge q be?________

Problem 2.



A parallel plate capacitor with length L=10cm is set up horizontally and has a distance between plates d=1cm and the potential difference between the plates V=500Volts. 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.

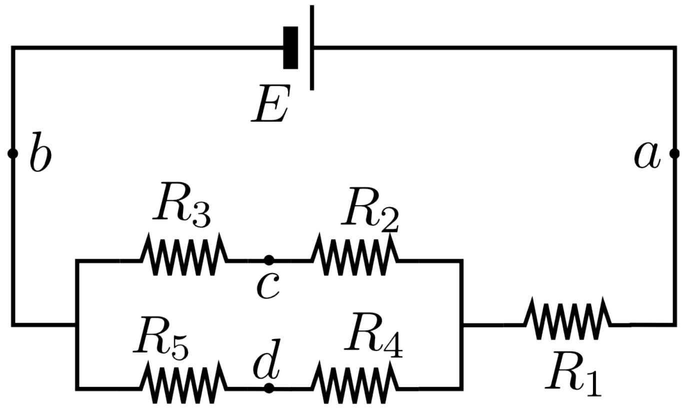
What is the magnitude and the direction of the electric field between the plates?
____

What is the magnitude and direction of the force acting on the object due to the electric field?_________

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 3.



In the circuit shown in the picture
$E = 24\text{V}$, $R_1 = 2\text{k}\,\Omega$, $R_2 = 1\text{k}\,\Omega$,
$R_3 = 2\text{k}\,\Omega$, $R_4 = 2\text{k}\,\Omega$, $R_5 = 4\text{k}\,\Omega$.

What is the potential difference between points a **and** b **?**____________

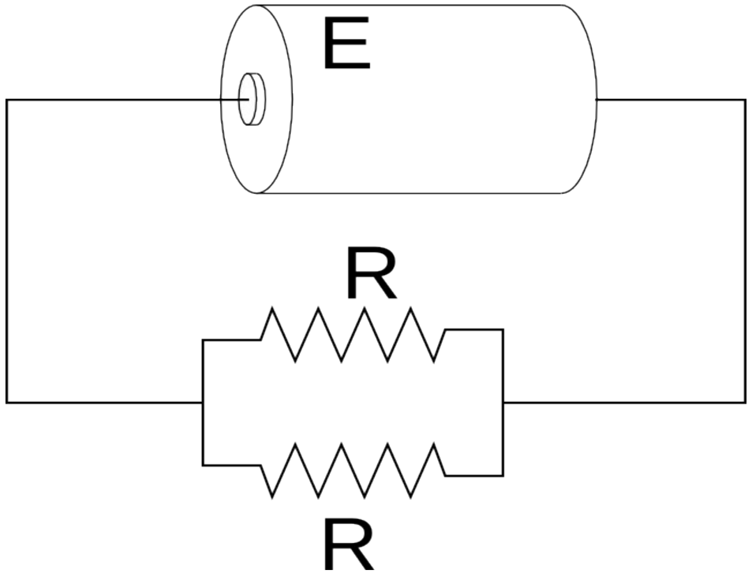
What is the current at point a **of the circuit?**________

What is the the current at point c **?**_________

What is the the current at point d **?**_________

What is the potential difference between points c **and** d **?**___________

Problem 4.



A battery with $E = 20\mathrm{V}$ and internal resistance $r = 1\mathrm{k}\Omega$ is connected to a simple circuit shown in the schematics with $R = 18\mathrm{k}\Omega$.

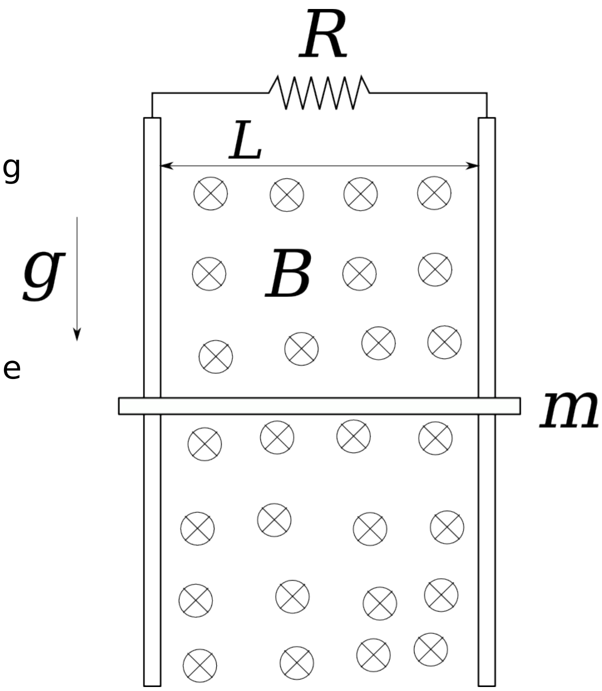
What is the current through the battery?______

What is the potential difference between the battery's terminals?_____

How much power does the battery supply to the simple circuit?______

How much power dissipates inside the battery?________

Problem 5.



A metal bar of mass $m = 10\text{kg}$ can move along two vertical straight rails which are $L = 2\text{m}$ apart from one another. The total friction force between the bar and the rails is proportional to the velocity $F_f = kv$, where $k = 4\text{Ns}/m$. The resistor $R = 2\,\Omega$ connects the rails. Magnetic field is $B = 1.41\text{T}$. After a long time the bar falls with constant velocity.

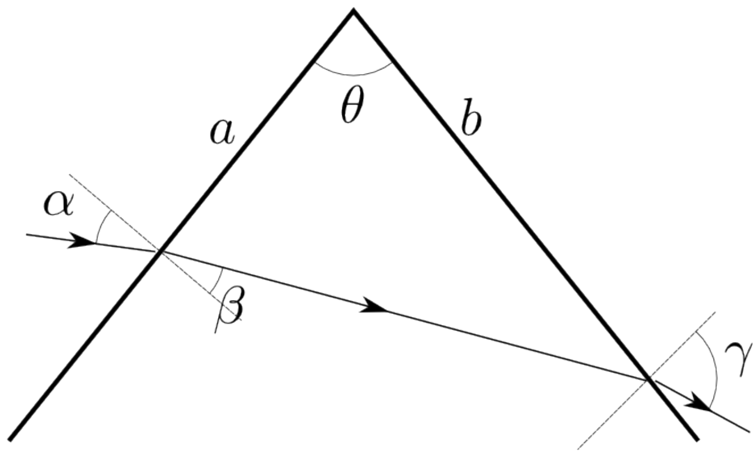
What is the direction of electric current induced by the motion?(show on the figure)

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

What is the velocity of the bar after a long time?______

What will be the velocity if the magnetic field is zero?_______

Problem 6.



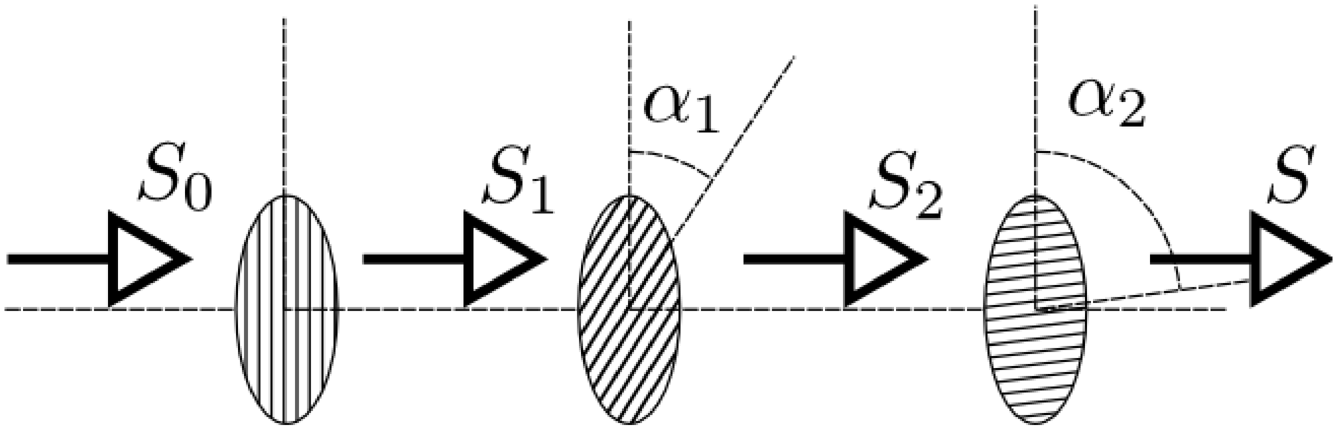
A ray of light enters a prism ($\theta=60°$) with $n_g=1.33$ from the side **a** at the angle $\alpha=41.68°$

What is angle β ?_________

What is the angle γ *?*_______

What must α be in order for the ray not to be able to go through the side b?

Problem 7.



An unpolarized beam of light is incident upon a group of three polarizing sheets which are arranged so that the transmission axis of the sheets are rotated by $\alpha_1=30°$ and $\alpha_2=90°$ with respect to the vertical

What fraction of the incident intensity S_0 passes through the first polarizer?_______

What fraction of the incident intensity S_0 passes through the second polarizer?_______

What fraction of the incident intensity S_0 is transmitted? __________

Problem 8.

A light passes through three slits separated by 0.50mm. In the resulting interference pattern on a screen 3.0m away, adjacent bright fringes are separated by 3.0mm.

What is the wavelength of the light?________________

How will the answer change if it is four slits?_____________

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

Problem 9.

A diver is under water ($n=1.33$) on a sunny day. He looks up and sees a diving board which appears to be 3m above the water.

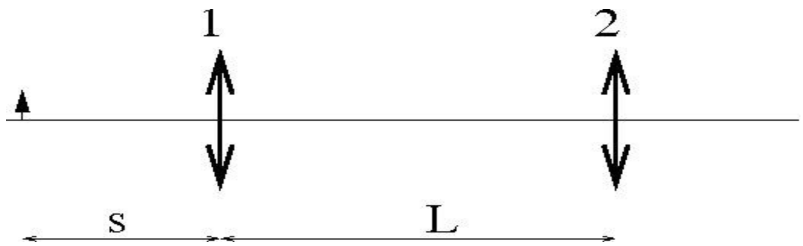
What is the real height of the diving board above the water?

What is the angle of internal reflection?______

If the diver is 2m under water what is the radius of the bright circle he sees when he looks up?______

Problem 10.

An object is s=5cm from the first lens. The distance between lenses is L=10cm. The focal length of the first lens is f_1=4cm and of the second lens it is f_2=5cm .



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 lens?________

What is the magnification of the second lens?________

What is the final magnification?_________

Is the final image virtual?_______

Is the final image inverted?_________