

PHYSICS 208 Final Exam

Spring, 2008 STEPS

*Do not fill out the information
below until instructed to do so!*

Name: _____

Signature: _____

Student ID: _____

E-mail: _____

Section Number: _____

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- No calculators are allowed in the test.
 - Be sure to put a box around your final answers and clearly indicate your work to your grader.
 - **All work must be shown to get credit for the answer marked. If the answer marked does not obviously follow from the shown work, even if the answer is correct, you will not get credit for the answer.**
 - Clearly erase any unwanted marks. No credit will be given if we can't figure out which answer you are choosing, or which answer you want us to consider.
 - Partial credit can be given only if your work is clearly explained and labeled. Partial credit will be given if you explain which law you use for solving the problem.

Put your initials here after reading the above instructions:

For grader use only:

Problem 1 (5) _____

Problem 2 (15) _____

Problem 3 (20) _____

Problem 4 (20) _____

Problem 5 (15) _____

Problem 6 (15) _____

Problem 7 (15) _____

Total (105) _____

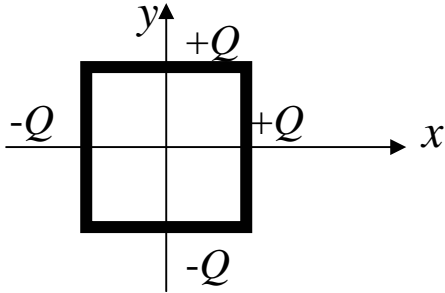
Problem 1: (5 points)

Write Maxwell's equations in the integral form.

Problem 2: (15 points)

Electric charge is distributed uniformly along each side of a square with length a . Two adjacent sides have positive charge with total charge $+Q$ on each.

a) If the other two sides have negative charge with total charge $-Q$ on each (see the figure below), what is the net electric field at the center of the square?



b) Find the electric field in the center of the square if all four sides have positive charge $+Q$.

Problem 3: (20 points)

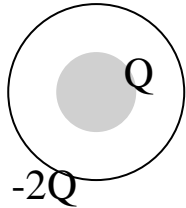
- a) A non-uniform, but spherically symmetric, distribution of charge has a charge density $\rho(r)$ given as follows:

$$\rho(r) = \rho_0 \left(1 - \frac{r}{R}\right) \quad \text{for } r \leq R$$

$$\rho(r) = 0 \quad \text{for } r \geq R$$

Find the electric field everywhere.

- b) A solid conducting sphere with radius R , that carries positive charge Q , is concentric with a very thin conducting shell of radius $2R$ that carries charge $-2Q$. Find the electric field (magnitude and direction) in each of the regions $0 < r < R$, $R < r < 2R$, and $r > 2R$. Draw schematically the electric field lines.

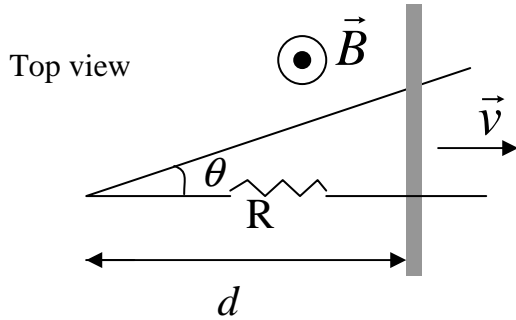


- c) For part b) find a difference in electric potential between points $r = 0$ and $r = \infty$

Problem 4: (20 points)

Two horizontal conducting rails form an angle θ where their ends are joined. A conducting rod slides on the rails without friction with constant velocity v as shown in the figure. At $t=0$ it starts from $x=d$ from rest. There is a resistor R in one of the rails. There is a uniform magnetic field in the direction shown.

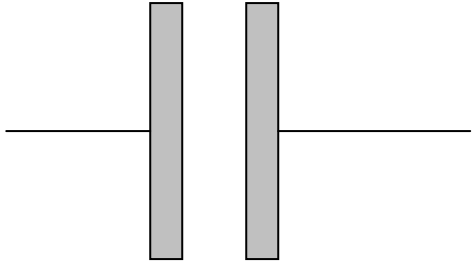
(a) Find the current as a function of time. Ignore self-inductance.



b) Find the force that needs to be applied to move the rod with constant velocity.

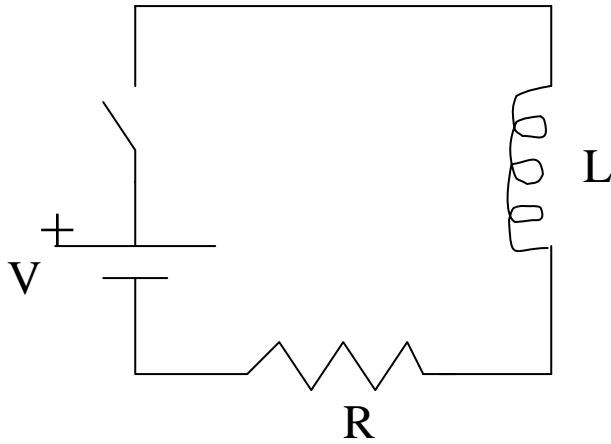
Problem 5: (15 points)

Show that the displacement current between the plates of a parallel plate capacitor is given by $C \frac{dV}{dt}$, where C is capacitance and V is the potential difference between the plates.



Problem 6: (15 points)

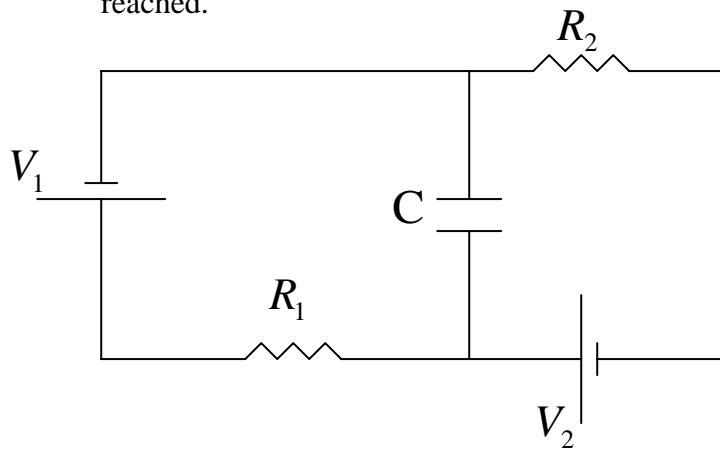
In the circuit below the switch is closed at $t=0$.



Find the current as a function of time and plot it schematically

Problem 7: (15 points)

The circuit below was put together a long time ago so that the steady state has been reached.



Find all currents and the charge on the capacitor.