PHYSICS 208 Final Exam

Sections 524, 526, 528
Spring, 2007 STEPS

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

Name:_____
Signature:_____
Student ID:_____
E-mail:_____
Section Number: _____

- 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)

A rod of length L has a total charge Q smeared uniformly over it. A test charge q is a distance a away from the rod's midpoint.

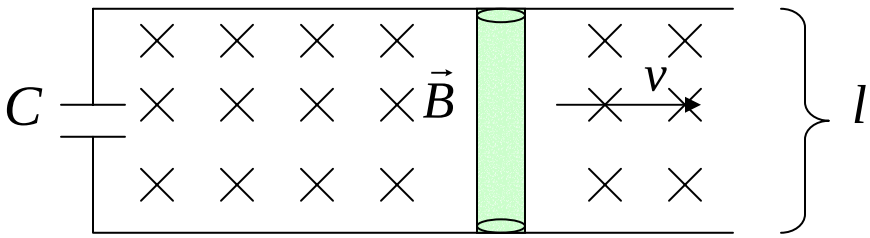
a) What is the force that the rod exerts on the test charge?

$$\int \frac{dx}{(x^2+c)^{\frac{3}{2}}} = \frac{x}{c(x^2+c)^{\frac{1}{2}}} + c \qquad \int \frac{xdx}{(x^2+c)^{\frac{3}{2}}} = \frac{-1}{(x^2+c)^{\frac{1}{2}}} + c$$

b) What is the force at $a >> L$?

Problem 3: (20 points)

a) A rod with resistance R is pushed with a velocity v along the two parallel, horizontal rails that are a distance l apart. The rails have no resistance and are connected by a capacitor C. There is a constant uniform magnetic field as shown. If the capacitor has zero charge at $t=0$, find the charge on the capacitor as a function of time (<u>determine the equation for the charge, do not solve it</u>). Ignore the self-inductance of the circuit.



c) In part a) suppose that the self-inductance is L. Write the equation for the charge on the capacitor's plates.

Problem 4: (20 points)

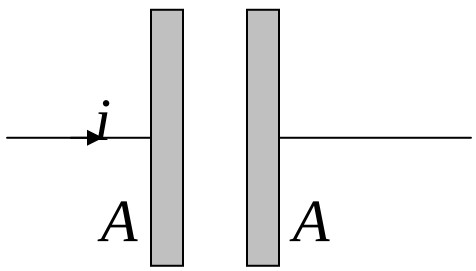
a) An insulating sphere of radius *R* has charge **uniformly** spread through it with a charge density ρ . Find the electric field everywhere.

b) Find the difference in an electric potential between the center and a point *4R.*

c) If ρ is a function of *r*, $\rho = \alpha r$, where *r* is a distance from the center of the sphere, $\alpha = const$, find the electric field everywhere.

Problem 5: (15 points)

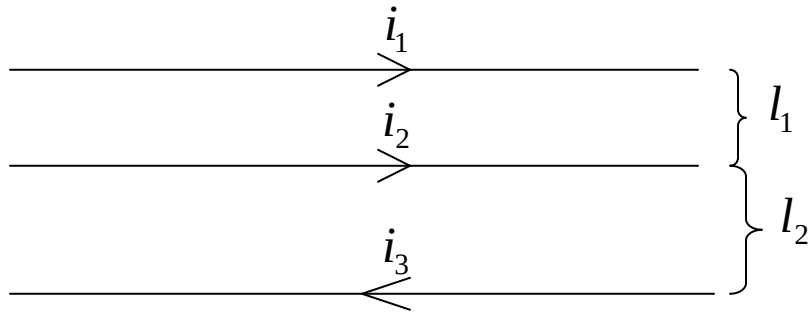
Consider two parallel plates of area A in some circuit:



The electric field is a function of time $E = E_0 \cos \omega t$. Find the current $\boldsymbol{i}$ in the wire and show that it is equal to the displacement current between the plates.

Problem 6: (15 points)

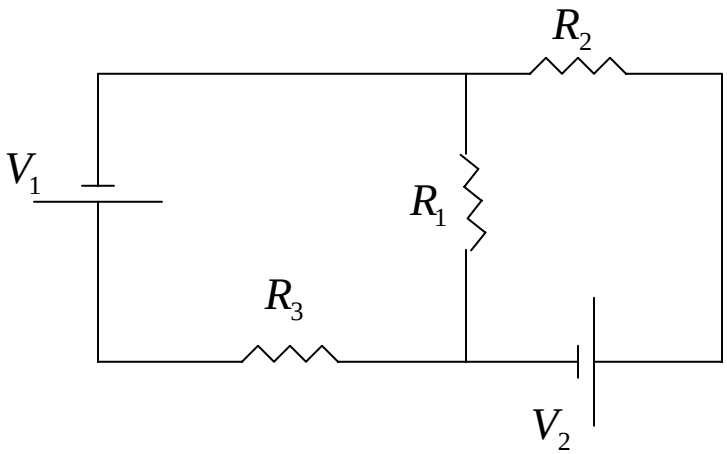
Consider three infinitely long wires in the plane of the paper (i_3 is in the opposite direction with respect to i_1 and i_2).



Find the force exerted on a length *l* of the center wire.

Problem 7: (15 points)

a) Write Kirchhoff's rules for this circuit below.



b) Find the current through resistor R_2 assuming that $R_1 = R_2 = R_3 = R$ and V_1 and V_2 are given.

c) Find the voltage drop across the resistor R_3 assuming that $R_1 = R_2 = R_3 = R$ and V_1 and V_2 are given.