MIDTERM 2

Physics 9C-03 **NAME:**

Feb. 22, 2001 **Student ID #:**

General Instructions: This examination is closed book. Only a calculator is allowed. Please show all your work and box your answers. Credit will only be given for *complete* solutions. Answers must have correct units. There are seven problems on four pages. Note that not all the problems are worth the same number of points.

[**15 points**] **1.** Derive the formula for the capacitance of a parallel plate capacitor.

[**10 points**] **2.** In the circuit shown the capacitor holds a charge Q_0 at time $t = 0$ when the switch is closed. Sketch $Q(t)$. Label your time axis with appropriate numbers.

[15 points] 3. Two long parallel wires are 0.3 meters apart. One carries a 6 Ampere current and the other a 5 Ampere current, in the directions indicated. Compute the magnetic field at the two points A and B. Give both magnitude and direction.

[10 points] 4. In the figure at the left is a positive point charge Q. Draw the direction of the electric field at points A, B, and C. How much smaller is the electric field at C than at A and B if C is twice as far from the charge as A and B?

In the figure at the right a wire carrying a current I coming out of the paper is shown. Draw the direction of the magnetic field at points A, B, and C. How much smaller is the magnetic field at C than at A and B if C is twice as far from the wire as A and B?

[20 points] 5. Consider the circuit shown. The charge on the capacitor is zero initially. Carefully explaining your reasoning, compute:

The currents in the resistors right after the switch is closed;

The currents in the resistors after a long time passes;

The charge on the capacitor after a long time passes.

[10 points] 6. Ask someone about magnetism, and they'll probably talk about magnets. The connection between magnets and $\vec{B}$ field producing currents isn't an obvious one. Try to find it. Where is the 'current' in a magnet?

[20 points] 7. A wire of radius R carries a current I. The current density in the wire is uniform. Compute the magnetic field both inside and outside the wire using Ampere's law. For full credit, make **sure** you write a clear explanation of all the terms you use in your equations. Make a plot of $|\vec{B}|$ as a function of distance from the center of the wire.