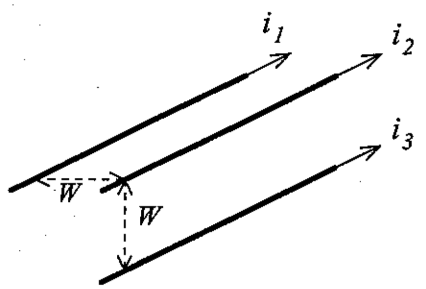
Print your name: ____________________

Physics 208: Electricity and Magnetism, Exam 3

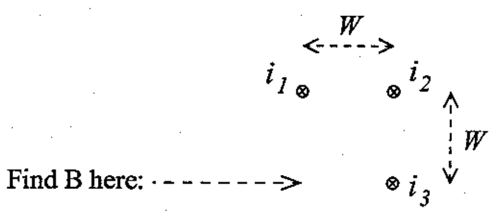
Problem 1. 25 points.

(a) There are three very long, extremely thin, parallel wires. One with current i_1 and one with i_2 and one with i_3. In cross-section, the wires are located at the corners of a square of side W. If all currents flow into the page, find the magnetic field vector at the fourth corner.



perspective

cross–section



(b) What would be the force on a length H of wire if it was parallel to the other wires at the fourth corner and had a current i_4 coming out of the page?

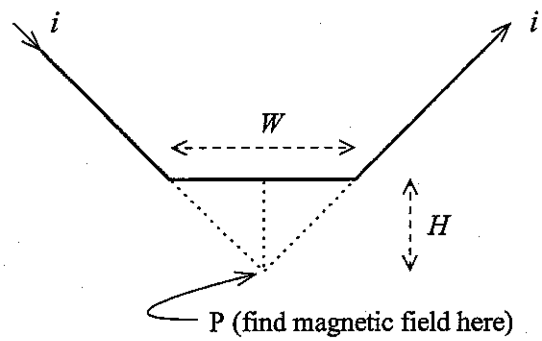
Be **neat**. Neatness helps. Work *neatly*.

Print your name: ______________________________

Physics 208: Electricity and Magnetism, Exam 3

Problem 2. 25 points.

A very long thin wire carries a current i. It has the shape and dimensions shown below.



Find the magnetic field at the point P.

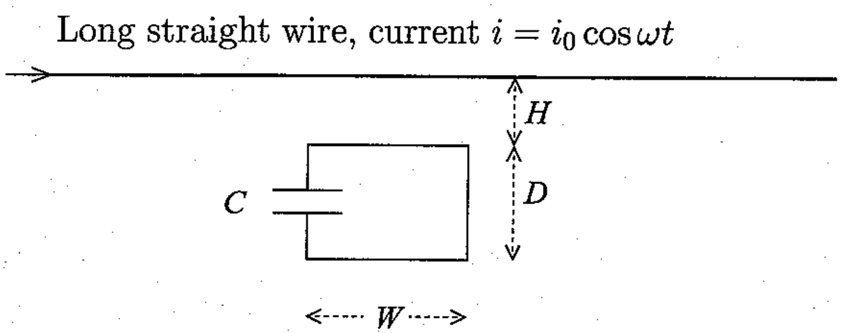
If you work **neatly** I will find more partial credit for you!

Print your name: ______________________________

Physics 208: Electricity and Magnetism, Exam 3

Problem 3. 25 points.

A rectangular circuit containing a capacitor C is located near an infinitely long narrow wire carrying a current $i_0 \cos \omega t$ where i_0 and ω are constants. The circuit has no resistance and its self-inductance can be ignored. Find the charge on the top capacitor plate as a function of time.



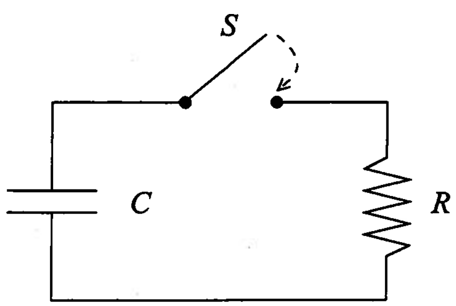
Make sure you are being neat. Working neatly will help you get it right.

Print your name: ____

Physics 208: Electricity and Magnetism, Exam 3

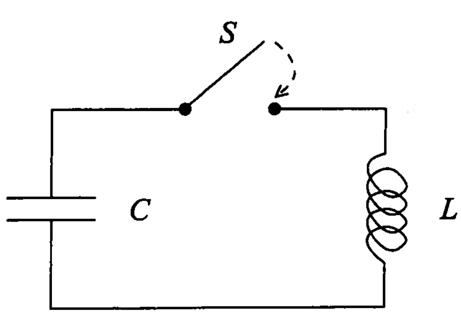
Problem 4. (25 points)

(a) In the circuit below, the capacitor is originally charged with Q_0 on the top plate, and $-Q_0$ on the bottom. At $t = 0$ the switch S is closed. Please note that all wires in this circuit have no resistance.



Derive the equation for the charge on the capacitor as a function of time assuming the self-inductance of the circuit can be ignored. Solve the equation.

(b) In the circuit below, the capacitor is originally charged with Q_0 on the top plate, and $-Q_0$ on the bottom. At $t = 0$ the switch S is closed. Derive the equation for the charge on the plates as a function of time if the self-inductance of the circuit is L and the resistance of the circuit is negligible. Solve the equation.



Work neatly! If you are neat, I can read what you did and maybe find more points for you.

POTENTIALLY USEFUL INFORMATION

You may remove this sheet.

If you do remove this sheet,

DO NOT TURN IT IN!

$$\vec{F} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\hat{r}$$

$$d\vec{B} = \frac{\mu_0 i}{4\pi}\frac{d\vec{s}\times\vec{r}}{r^3}$$

$$\frac{d\vec{r}}{dt} = \frac{dx}{dt}\vec{i}_x + \frac{dy}{dt}\vec{i}_y = \frac{dr}{dt}\vec{i}_r + r\frac{d\theta}{dt}\vec{i}_\theta$$

$$\oint \vec{E}\cdot d\vec{r} = -\frac{d}{dt}\int \vec{B}\cdot d\vec{S}$$

$$C = \frac{Q}{V} \qquad R = \rho\frac{l}{A}$$

For parallel p lates $C = \frac{A\epsilon_0}{d}$

$$\int \vec{B}\cdot d\vec{S} = \pm Li$$

$$\oint \vec{B}\cdot d\vec{r} = \mu_0 i_{enclosed}$$

$$\vec{F} = q(\vec{v}\times\vec{B} + \vec{E}) \qquad d\vec{F} = i(d\vec{s}\times\vec{B})$$

POTENTIALLY USEFUL INTEGRALS

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

DO NOT WASTE TIME ON ARITHMETIC

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