EXAM III Physics 208 2013

Last Name....................................First Name ....Section Number......

USEFUL INFORMATION

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

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

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

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

$$C = \frac{Q}{V} = \frac{A\epsilon_0}{d} \qquad R = \rho\frac{l}{A}$$

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

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

You do not need to evaluate complicated integrals in order to get a good grade. However, if you have time for integration you might find helpful:

$$\int \frac{du}{(b+u^2)^{\frac{3}{2}}} = \frac{u}{b(b+u^2)^{\frac{1}{2}}} + Constant$$

$$\int \frac{du}{(b-u^2)^{\frac{3}{2}}} = \frac{u}{b(b-u^2)^{\frac{1}{2}}} + Constant$$

$$\int \frac{du}{(b+u^2)^{\frac{1}{2}}} = ln[u + (b+u^2)^{\frac{1}{2}}] + Constant$$

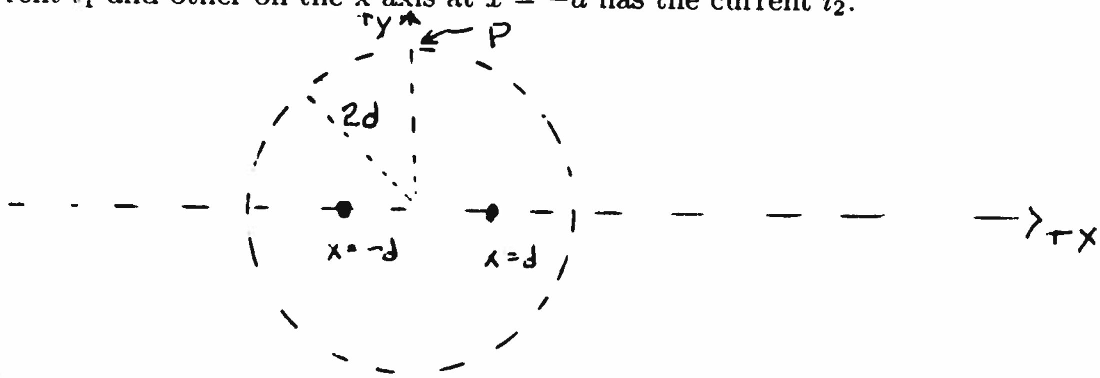
1.

2.

3.

4.

1. (25 points) a. Two infinitely long, extremely thin, straight wires, each carry a current directed into the page, the $(-\vec{i}_z)$ direction. The one on the x axis at $x = d$ has the current i_1 and other on the x axis at $x = -d$ has the current i_2.

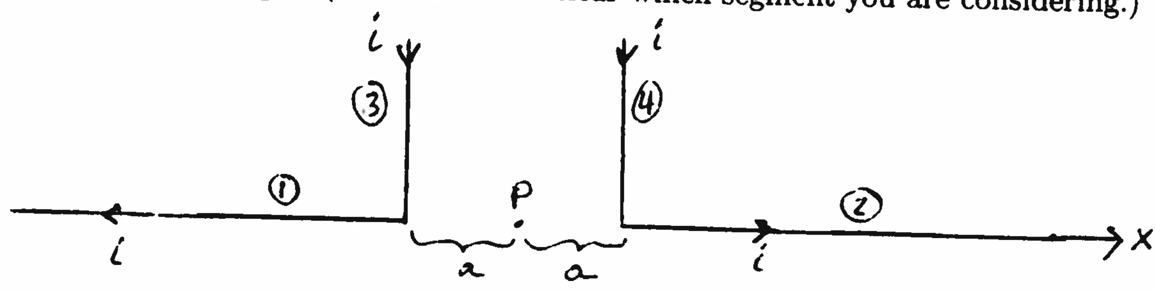


a. Evaluate $\oint \vec{B} \cdot d\vec{r}$ for a circle in the x,y plane, centered at the origin with radius $2d$.

b. Find the magnetic field at the point marked P if $i_2 = 0$.

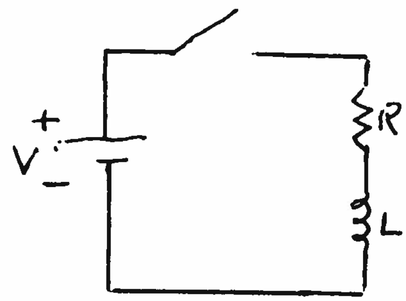
c. What is the direction of the magnetic field at the point marked P if i_2 is not equal zero and $i_1 = i_2$.

2. (25 points)Two infinitely long wires, each carrying a current i, have one segment along the x axis and another perpendicular to the x axis as shown. The segments are numbered 1 through 4. Find the magnetic field produced by each segment at the point P which is at the origin. (Make sure it is clear which segment you are considering.)



Find the total magnetic field at P.

3. (25 points) In the circuit below all self inductance is assumed to be contained in the coil which has inductance L. The switch is closed at $t = 0$.

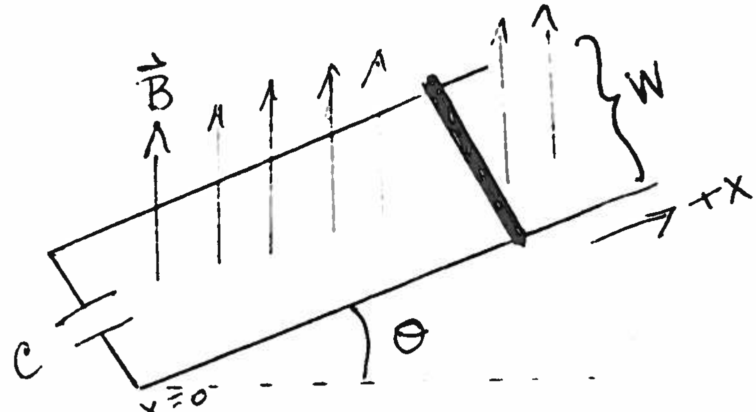


a. Find the current in the resistor as a function of time if the inductance is ignored.

b. Start with a law and find the equation that could be solved for the current in the resistor if inductance is not ignored.

c. Solve the equation for the current in the resistor without ignoring inductance. You must clearly show your work to receive full credit.

4. (25 points)Two resistance free rails are connected by a capacitor, C. A rod of mass m and resistance R is placed at rest on the rails, which make an angle θ with the horizontal. There is a uniform magnetic field, vertically up, with magniture B_0. The coordinate system is defined in the figure below. Ignore self inductance for this entire problem.



a. Find the equation that could be solved for the charge on the capacitor as a function of the velocity of the rod along the rails, $v_x = \frac{dx}{dt}$.

b. Find the charge on the capacitor as a function of the velocity of the rod along the rails, v_x, if the resistance R is ignored.

c. Find the magnetic force on the rod in terms of v_x and a_x, ignoring R.

d. Bonus: Ignoring the resistance, find the current in the rail, assuming no friction.