EXAM III Physics 208 2011

Name.....Section Number.....

USEFUL INFORMATION

For two point particles

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

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

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

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

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

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

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

1.

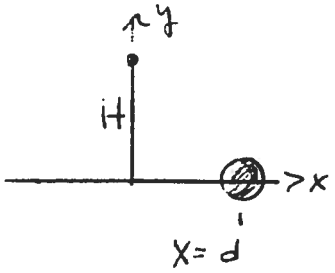
2.

3.

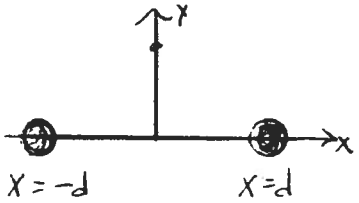
4.

1. (25 points) An infinitely long wire carrying a current i directed into the page $(-\vec{i}_z,)$ has a circular cross section of radius W. The current is uniformly spread over the cross sectional area.

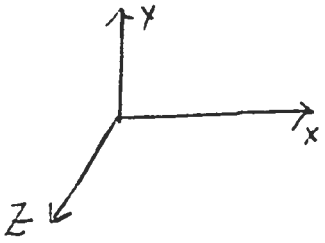
a. If the center of the wire is on the x axis at $x = d$, find the x and y components of the magnetic field at the point with $x = 0$ and $y = H$.



b. If a second, identical wire, also with current i into the page, has its center on the x axis at $x = -d$, find the total magnetic field due to both wires at the point at $y = H$ on the y axis.

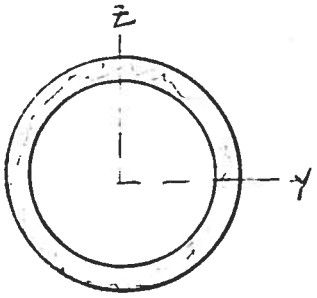


c. If a particle with positive charge q had velocity $\vec{v} = v_0\vec{i}_z$, at the point $x = 0$ and $y = H$ what would be the magnetic force on it?

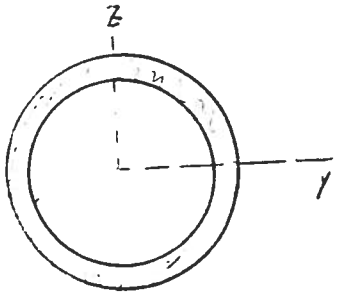


2. (25 points)A circular loop of wire with radius H is made of wire which has resistivity ρ and cross sectional area a. It is in the y, z plane with its center at the origin.

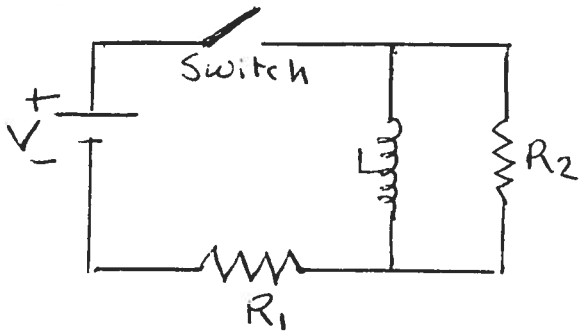
a. If a magnetic field given by $\vec{B} = B_0 \sin \beta t \vec{i}_x$ is present, find the current that will flow in the loop, ignoring the self inductance of the loop. Here B_0 and β are known constants and $\vec{i}_x$ points out of the page.



b. Find the current in the loop if instead the magnetic field was $\vec{B} = B_0(1 - \frac{r}{2H}) \sin \beta t \vec{i}_x$ where r is the distance from the origin.



3. (25 points) In the circuit below all self inductance is assumed to be contained in the coil which has inductance L.

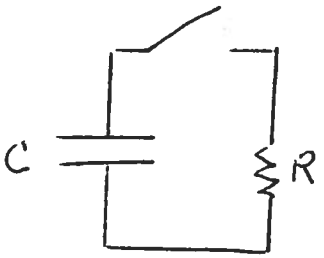


a. If the switch has been closed for a long time so that the steady state has been reached, find the currents in the resistors.

b. If the switched is now opened, at $t = 0$, find the current through the coil as a function of time. Clearly show how you obtain the result.

4. (25 points)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 is closed.

a. Find the charge on the plates and the current through the resistor as functions of time assuming the self inductance of the circuit can be ignored.



b. In the circuit below the capacitor C_2 is initially uncharged and C_1 has charge Q_0. At $t = 0$ the switch is closed. Find the charges on the capacitors as a function of time assuming the self inductance of the circuit can be ignored.