EXAM III Physics 208

Name..Section Number......

USEFUL INFORMATION

For two point particles

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

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

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

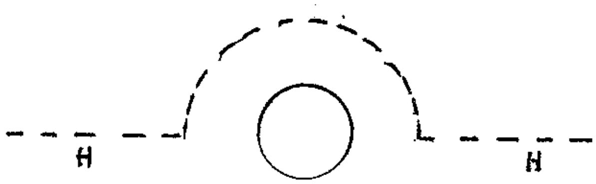
$$\oint \vec{E} \cdot d\vec{r} = -\frac{d}{dt}\int \vec{B} \cdot d\vec{S}$$

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

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

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

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

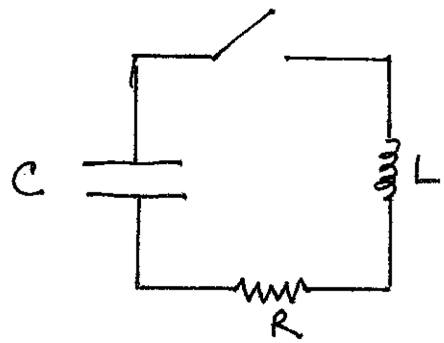


a. Evaluate $\int \vec{B} \cdot d\vec{r}$ for the path shown which consists of a semi-circle of radius $a = 2W$ and two straight segments of length H.

b. Evalaute $\int \vec{B} \cdot d\vec{r}$ for the same path if, instead, $a = \frac{W}{2.}$

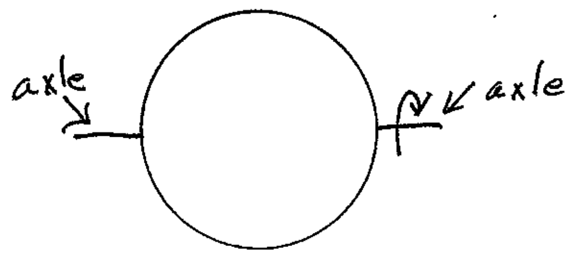
2. (25 points) In the circuit below the capacitor is originally charged with Q_0 on the top plate and $-Q_0$ on the bottom. At $t = 0$ the switch is closed.

a. Find the equation for the charge on the plates as a function of time.



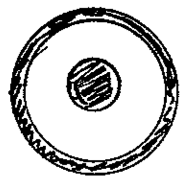
b. Solve the equation for the charge on the plates if the resistance of the circuit can be ignored.

3. (25 points)A constant magnetic field, magnitude B_0, points into the page. A circular loop of very thin wire with resistivity ρ and cross-sectional area W, has radius H. It is initially in the plane of the paper. The loop can be rotated about the axle shown:



If a torque is applied to the axle, starting at $t = 0$, so that the loop has a constant angular acceleration, α, find the current in the loop.

4. (25 points) A coaxial cable has a wire with current i_1 flowing to the right in the center wire and i_2 flowing to the left in the outer, hollow wire. Both wires have circular cross-sections. The inner wire has a radius a_1 and the outer wire a radius a_2 with a thickness T.



What must be the relationship between i_1 and i_2 so that there is no magnetic field at a point x away from the central axis if

a. $x > a_2 + T$

b. $a_1 < x < a_2$

c. $x = a_2 + \frac{T}{2}$