EXAM III Physics 208 2015

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

USEFUL INFORMATION

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

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

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

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

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

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

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

$$\frac{d\ln U}{dx} = \frac{dU}{dx}\frac{1}{U}$$

Please mark all charges and currents on the appropriate figure so that your symbols are defined.

1.

2.

3

4.

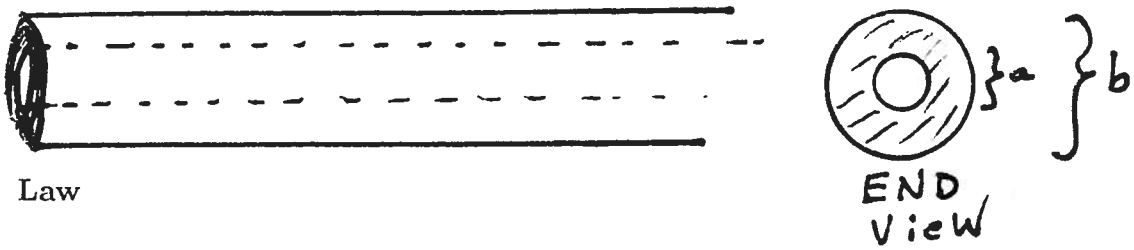
1. (25 points) A very thin wire lies in the x, y plane. It has the shape shown below consisting of two circular segments, centered at the origin, connected by segments along radii. There is a current i in the wire as shown. Find the magnetic field at the origin.

Law

Application

Result

2. (20 points) Consider an infinitely long, hollow cylindrical wire. The wire has outer radius b and the cylindrical hole at its center has radius a.
Find the magnetic field everywhere if a known current i flows from left to right and the current is uniformly spread over the region between a and b.
(5 points) Find the force that this wire would exert on a thin, straight length of wire W located a distance $2b$ from the axis of the cylinder if that thin wire had a current $3i$ flowing from left to right.

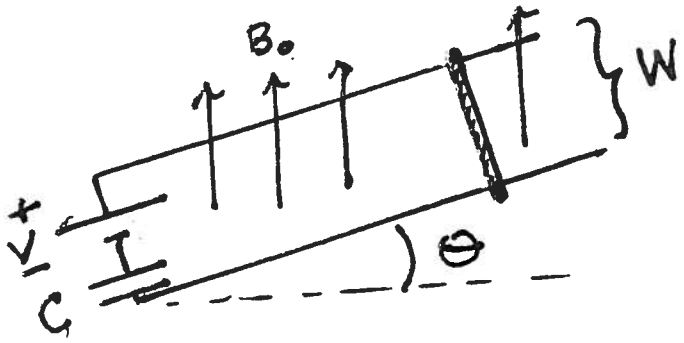


Law

Application

Result

3. (25 points) A rod can slide on two frictionless, resistance free rails. The rails are connected by a battery and a capacitor as shown. There is a constant, vertical magnetic field with magnitude B_0. The rails are at an angle θ with the horizontal plane. The rod is somehow moved up the rails by some external force so that its velocity along the rails has constant magnitude v_0 and the charge on the capacitor is zero at $t = 0$. If the rod has resistance R and self inductance can be ignored, find the charges on the plates of the capacitor as a function of time for $t > 0$.



Law

Application

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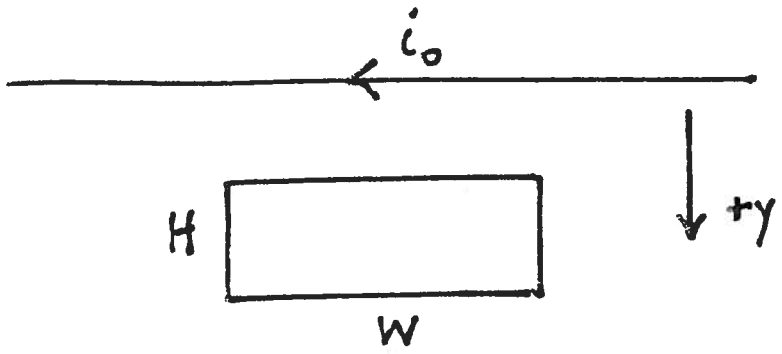
4. (25 points) An infinitely long wire carries a constant current as shown. Nearby is a rectangular loop of wire with resistivity ρ which has cross sectional area A and dimensions W and H as shown. The loop is originally a distance P from the wire. At $t = 0$ the loop begins to move at a constant velocity v_0 in the $+y$ direction. Ignoring self inductance find the current that will flow in the loop.



Law

Application

Result