EXAM III Physics 208 2016

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

USEFUL INFORMATION

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

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

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

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

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

$$\int \vec{B}\cdot d\vec{S} = LI$$

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

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

Please mark all charges and currents on the appropriate figure so that your symbols are defined. Do not waste time on non-trivial integrals.

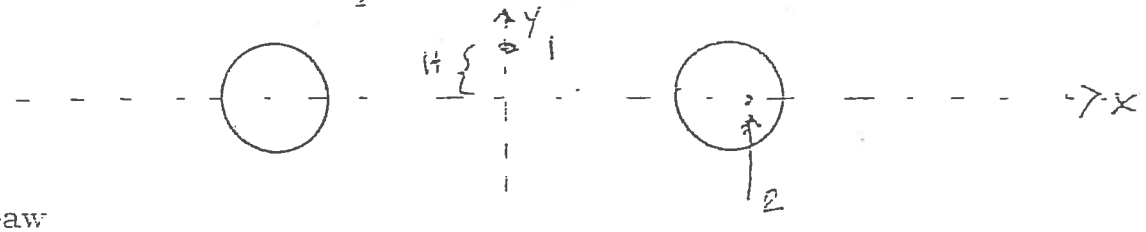
1.

2.

3.

4.

1. (25 points) Consider two infinitely long, cylindrical wires with radii D at the positions shown. Their centers are a distance S from the origin. The wire on the left has a current i_1 uniformly spread over its cross section, flowing out of the page. The wire on the right has a current i_2 uniformly spread over its cross section, flowing into of the page.
Find the magnetic field at the point 1 and the magnetic field at the point 2 which is inside the wire a distance $\frac{D}{2}$ from the center.

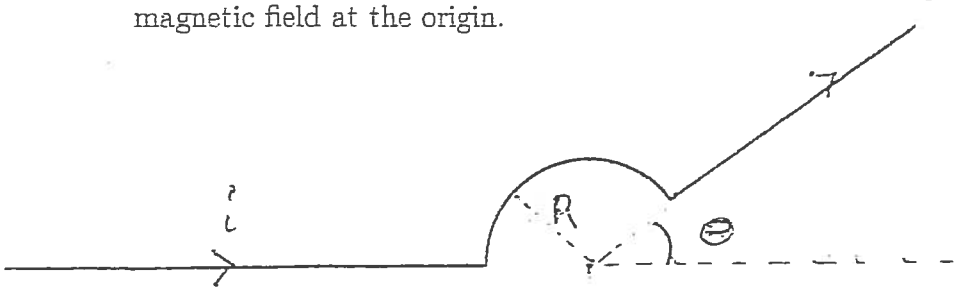


Law

Application

Result

2. (25 points) A very thin wire lies in the x, y plane. It has the shape shown below consisting of two straight segments and a circular part centered at the origin There is a current i in the wire as shown. The radius R and the angle θ are known. Find the magnetic field at the origin.

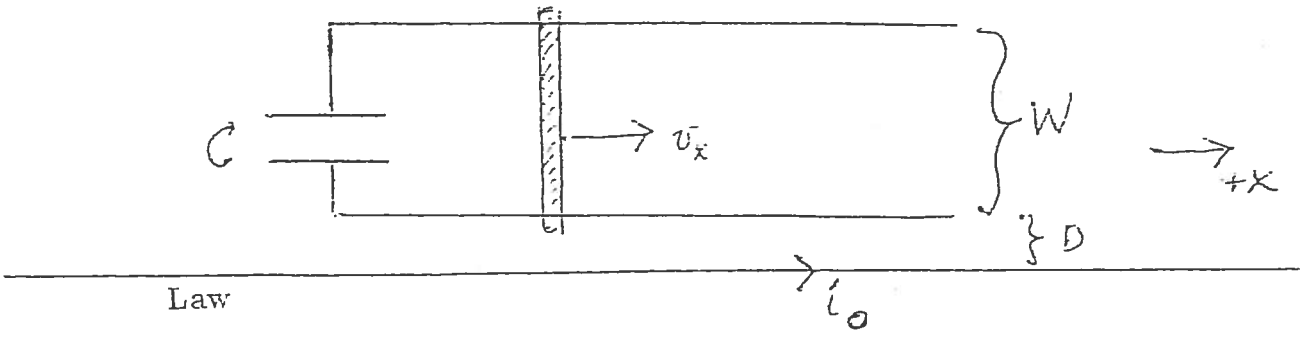


Law

Application

Result

3. (25 points) A rod with no resistance can slide on two frictionless, resistance free rails. The rails are connected by a capacitor, capacitance C, as shown. There is an infinitely long wire carrying a constant current i_0 as shown. The rod is moved by some external force so that its velocity along the rails is given by $v_x = at$ where a is a known constant. Ignoring self inductance find the charge on the capacitor plates as a function of time. What is the direction of the magnetic force exerted on the rod?

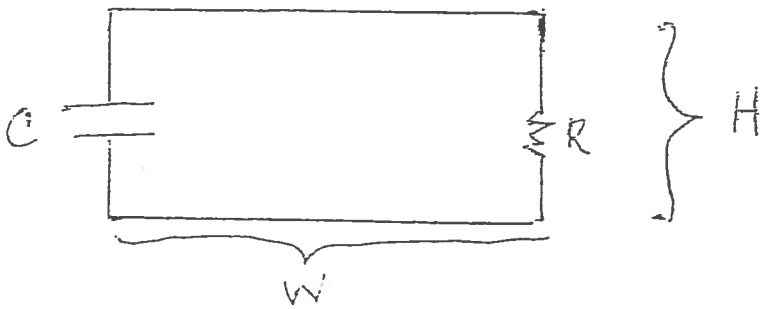


Law

Application

Result

4. (25 points) A circuit consists of a capacitor, C, and a resistor, R, as shown. There is a uniform magnetic field directed perpendicular to the plane of the circuit, pointing into the page. The magnitude of the magnetic field is given by $|\vec{B}| = B_0(1 + \beta t)$ where β and B_0 are known constants. Ignoring self inductance find the charge on the capacitor plates as a function of time, assuming it was uncharged at $t = 0$.



Law

Application

Result