EXAM III Physics 207 2019

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

USEFUL INFORMATION

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

$$\vec{F} = q(\vec{v} \times \vec{B}) \qquad d\vec{F} = i(d\vec{s} \times \vec{B})$$

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

$$\frac{d\vec{r}}{dt} = \frac{dx}{dt}\vec{i}_x + \frac{dy}{dt}\vec{i}_y = \frac{dr}{dt}\vec{i}_r + r\frac{d\theta}{dt}\vec{i}_\theta \qquad 1.$$

$$\oint \vec{E} \cdot d\vec{r} = -\frac{d}{dt}\int \vec{B} \cdot d\vec{S} \qquad 2.$$

$$C = \frac{Q}{V} = \frac{A\epsilon_0}{d} \qquad R = \rho\frac{l}{A} \qquad 3.$$

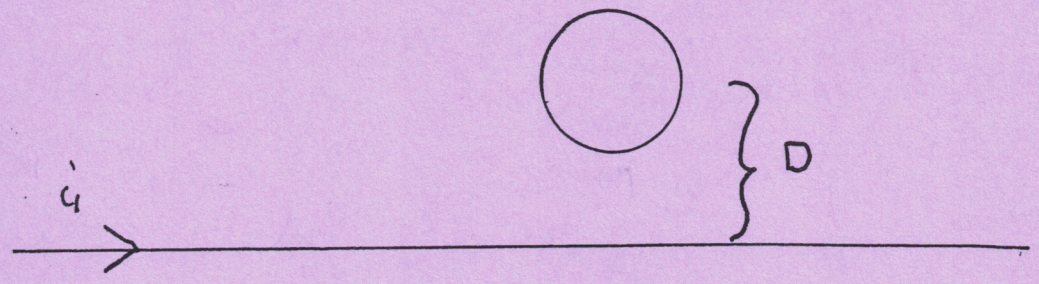
$$\int \vec{B} \cdot d\vec{S} = \pm Li \qquad 4.$$

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

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

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

1. (25 points)A very thin, very long wire has a current flowing from left to right of magnitude i_1. A circular loop of thin wire has radius R and its center is a distance D from the straight wire. What current would have to flow in the circular loop in order to have zero magnetic field at its center?

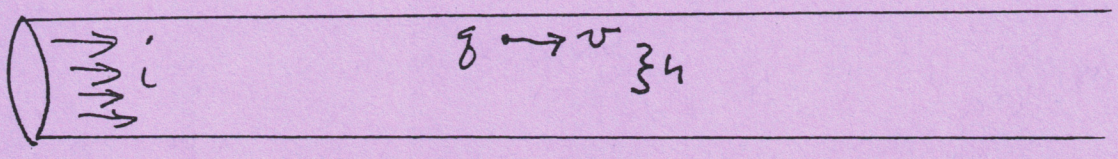


Law

Application

Result

2. (25 points) An infinitely long wire has a circular cross section of radius A. A current i flows uniformly through the wire as shown. Find the magnetic force that would be exerted on a positively charged particle with charge q if it were travelling with a velocity v parallel to the axis of the cylinder, a distance h from the axis.



Law

Application

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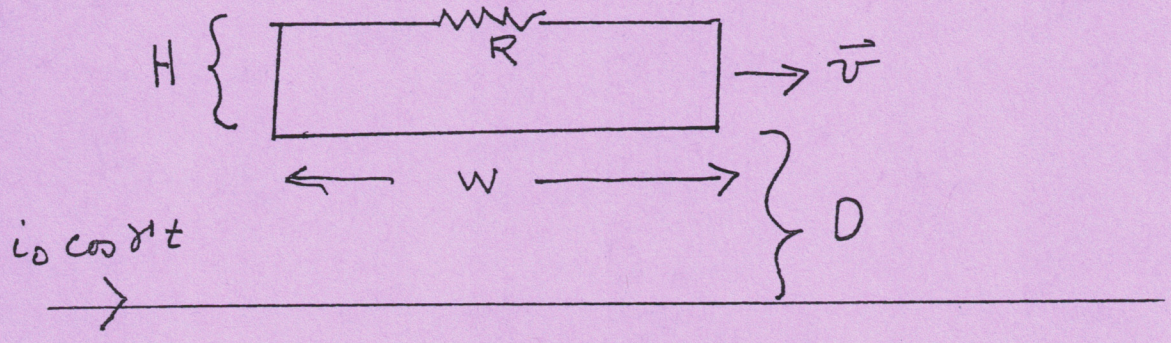
3. (25 points) A very long wire carries a current $i_0 \cos \gamma t$ where i_0 and γ are known. A loop of wire with the known dimensions H and W is a distance D from the wire. At $t = 0$ it is being pulled so that it moves with a constant velocity of magnitude v to the right, parallel to the wire. If the loop contains a resistor of known resistance R, find the current in the loop ignoring self inductance.



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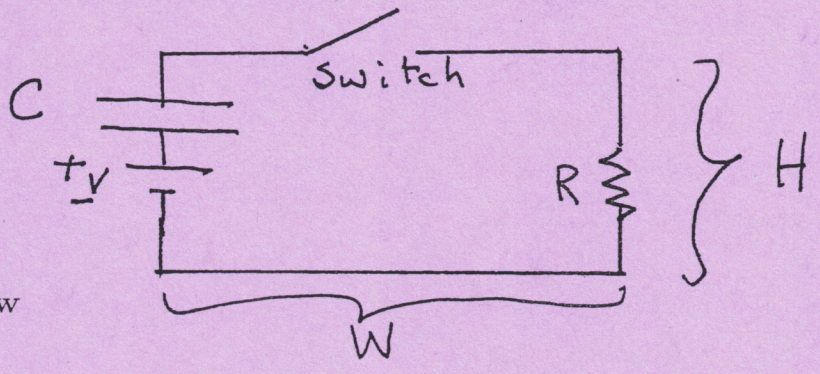
4. (25 points) A circuit consists of a capacitor, C, a battery, V, and a resistor, R, and has the dimensions as shown. At $t = 0$ the switch is closed. At that time a uniform magnetic field is directed perpendicular to the plane of the circuit, pointing into the page. The magnitude of the magnetic field is given by $|\vec{B}| = B_0 \alpha t$ where α 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

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