

# EXAM III Physics 208

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

## USEFUL INFORMATION

For two point particles

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

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

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

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

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

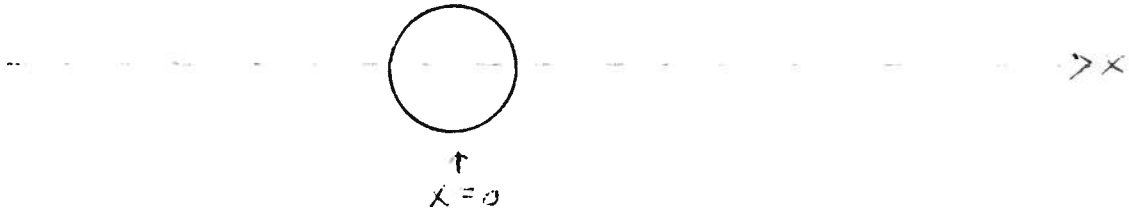
$$\int \vec{B} \cdot d\vec{S} = \pm Li$$

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

1  
2  
3  
4  
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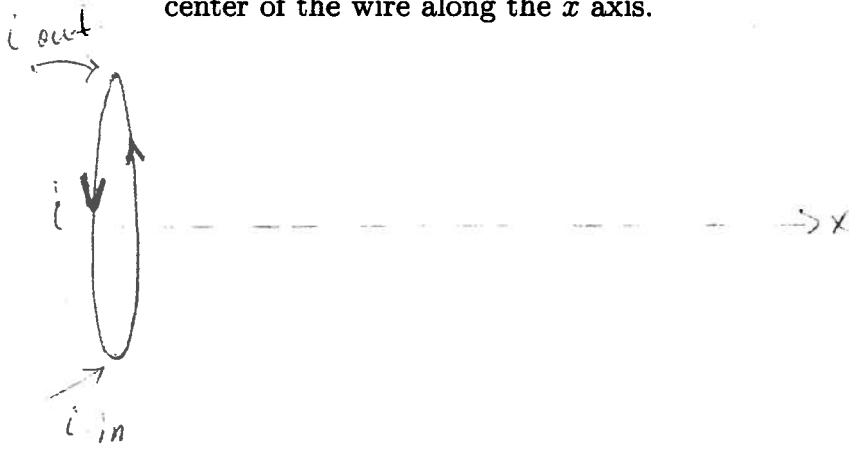
1. (25 points) An infinitely long wire carrying a current  $i$  has a circular cross section of radius  $W$ . The current is uniformly spread over the cross sectional area. If the center of the wire is at the origin, find the points on the  $x$  axis where the magnetic field has one half the magnitude of the magnetic field at the surface of the wire.

$i$  (into page)

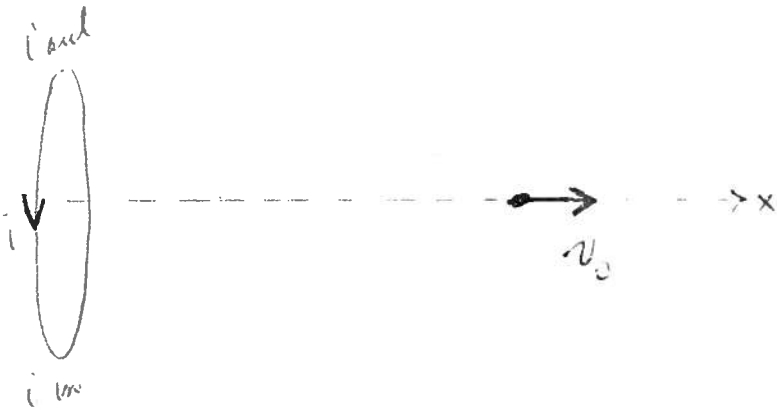


2. (25 points) A circular loop of very thin wire has radius  $R$  and carries a current  $i$ . It is in the  $y, z$  plane with its center at the origin.

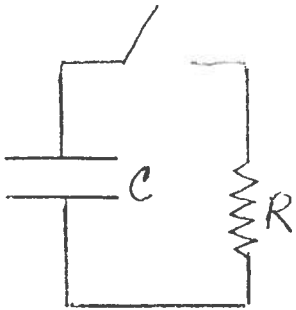
a. Find the magnetic field produced by this wire at a point a distance  $x$  away from the center of the wire along the  $x$  axis.



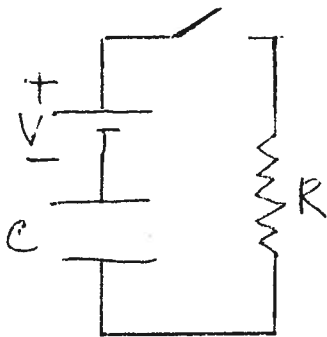
b. Find the force that would be exerted by this current carrying wire on a particle with charge  $q$  and mass  $m$  travelling with velocity  $v_0$  at the point a distance  $x$  from the center.



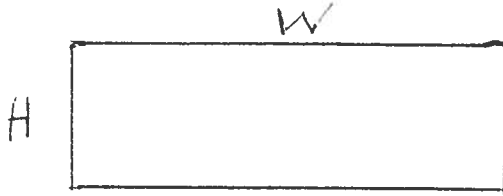
3. (25 points) In the circuit below the capacitor is originally charged with  $Q_0$  on the top plate and  $-Q_0$  on the bottom. At  $t = 0$  the switch is closed.
- a. Find the charge on the plates as a function of time assuming the self inductance of the circuit can be ignored. Please note that all wires in this circuit have no resistance.



- b. In the circuit below the capacitor is initially uncharged. At  $t = 0$  the switch is closed. Find the charges on the capacitor plates as a function of time assuming the self inductance of the circuit can be ignored.



4. (25 points) A rectangular loop is made of wire having resistivity  $\rho$  and cross sectional area  $A$ . It has the dimensions shown below.



If there were a magnetic field that varied with time according to

$$B = 6t^4 + 7t + 11$$

and was directed perpendicular to the loop, pointing into the page, find the current that would flow in the loop, ignoring self inductance.