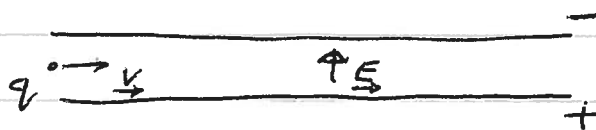


TEST QUESTIONS - EXAM II (2ND INSTALLMENT)

1. Two parallel plates have

a uniform $\vec{E} = E\hat{y}$ between them.

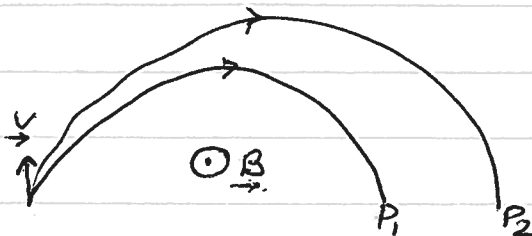


Introduce a particle of charge q , travelling at $\vec{v} = v\hat{x}$. What \vec{B} field would you apply so that the particle goes through the plates undeflected?

2. A proton with a velocity of $100 \text{ km/s } \hat{y}$ is introduced in a region where there is a \vec{B} field of $0.5 \text{ T } \hat{z}$. Show that the proton will move on a circular orbit in the xy -plane. Calculate the radius of the orbit and the angular velocity of the proton. [$q = 1.6 \times 10^{-19} \text{ C}$, $m_p = 1.6 \times 10^{-27} \text{ kg}$].

3. Repeat prob 2 with an electron. [$q = -1.6 \times 10^{-19} \text{ C}$, $m_e = 9 \times 10^{-31} \text{ kg}$].

4. Show on the paths of two particles in a mass spectrometer.



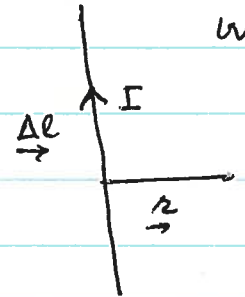
Both have same initial vel. $\vec{v} = v\hat{y}$. For the \vec{B} field shown ($\vec{B} = +B\hat{z}$) what is the sign of the charge on the particles?

i) In case I both particles have same charge

but different masses M_2 and M_1 . Where will the larger mass land, at P_1 or at P_2 ? Why?

(ii) In Case II both have same mass but different charges. Where will the larger charge land? Why?

5. We are told that a current I creates a \vec{B} field at the point \vec{r} given by

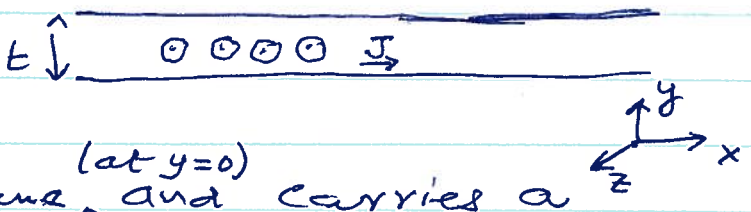


$$\Delta \vec{B} = \frac{\mu_0}{4\pi} \frac{I \Delta \vec{l} \times \vec{r}}{r^3}$$

where $\Delta \vec{l}$ is the length of the conductor. Show that the \vec{B} field circulates around the current.

6. State Ampere's Law in your own words.

7. Shown is a large sheet of conductor

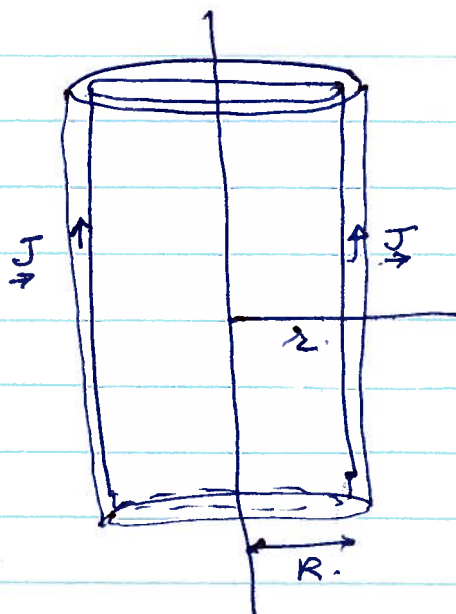


of thickness t . The sheet is in the xz -plane (at $y=0$) and carries a current density $\vec{J} = -J\hat{y}$. Show that if we go from $y < 0$ to $y > 0$, the \vec{B} field changes from $-\frac{\mu_0 J t}{2} \hat{x}$ to $\frac{\mu_0 J t}{2} \hat{x}$.

8. Let us bend the sheet into a cylindrical shell of radius R ($\gg t$). ~~Show that~~ and make the axis at $z=0$. [See figure].

Show that as r goes from $r < R$ to $r > R$, the \vec{B} field jumps by $\mu_0 J$.

[When you cross a current sheet \vec{B} field jumps].



9. Show that parallel currents attract and antiparallel currents repel one another.

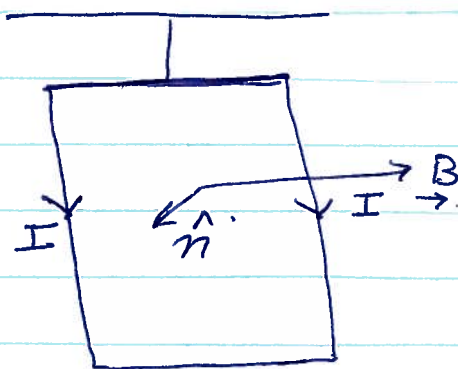
10. A rectangular coil is suspended from the ceiling.

There is a uniform

$$\vec{B} = B\hat{x}.$$

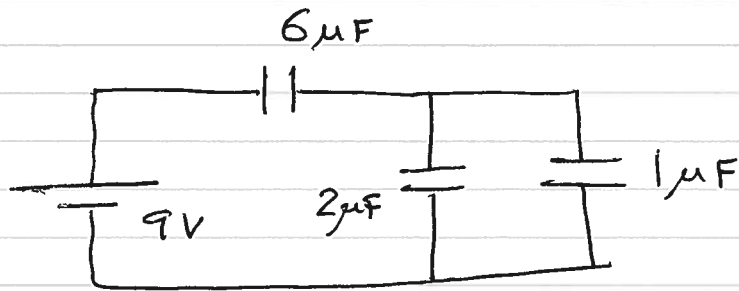
If a current I is driven through the coil

what would you observe? Why?



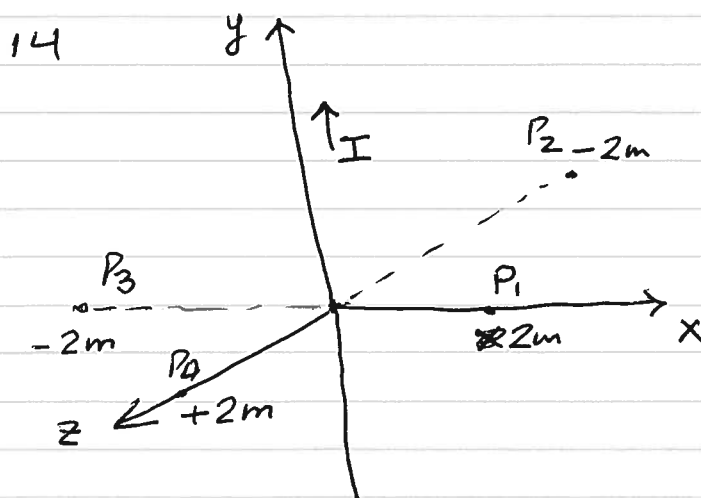
11. Why does Gauss' Law for a \vec{B} -field tell you that the total flux of \vec{B} through any closed surface is zero?

12. In the circuit shown



- which capacitor has the highest potential?
- which capacitor has the least charge?

13. Currents $I_1 = 2 \text{ amp}$ and $I_2 = -5 \text{ amp}$ flow through long straight wires. Which B field will be larger i) at $r = 4 \text{ m}$ away from I_1 , or ii) at $r = 10 \text{ m}$ away from I_2 ? Why?



Write down the B -field at P_1, P_2, P_3, P_4 .