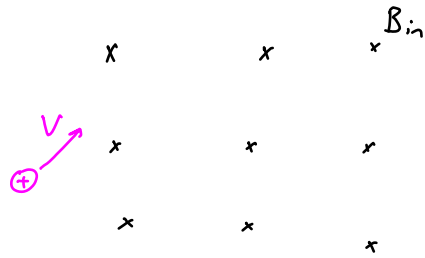


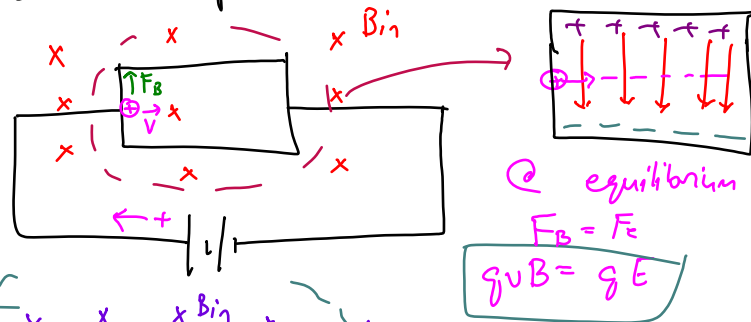
I. Magnetism

(A) Force on charge

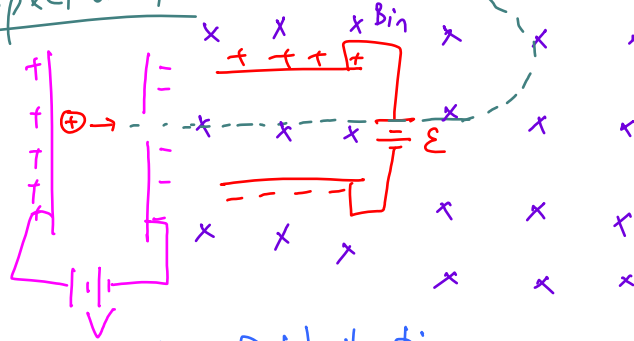
1. $F = qv \times B$
2. $F = I l \times B$
3. RHR (+ charge)



4. Hall Effect: Separation of Charge



Mass Spectrometer



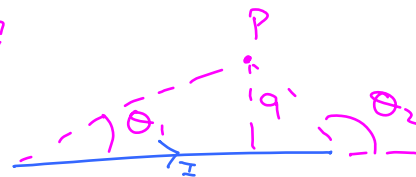
B. Current Distribution

1. Biot Savart:
$$B = \frac{\mu_0 I}{4\pi} \int \frac{d\vec{s} \times \hat{r}}{r^2}$$

(a) Finite Wire:

$$B = \frac{\mu_0 I}{4\pi R} (\cos \theta_1 - \cos \theta_2)$$

Ex] $B_p = ?$



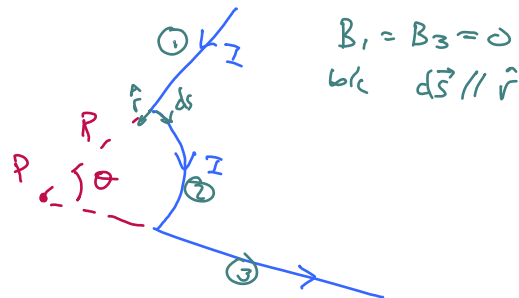
(b) Arc Length

$B_p = ?$

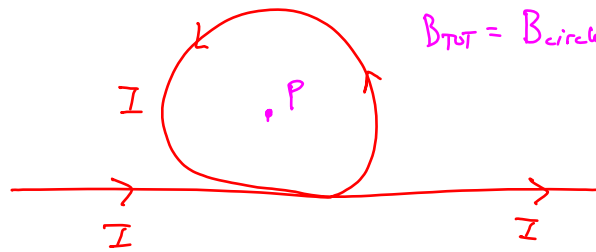
$$B = \frac{\mu_0 I}{4\pi R^2} \int d\vec{s}$$

$$B = \frac{\mu_0 I}{4\pi R^2} s$$

$$B = \frac{\mu_0 I \theta}{4\pi R}$$



Ex)



$$B_{TOT} = B_{circle} + B_{straight\ wire}$$

(c) Ampere's Law

1. Flux: $\Phi_B = \int \mathbf{B} \cdot d\mathbf{A} = \mathbf{B} \cdot \mathbf{A}$

2. Ampere's Law: $\oint_{\text{closed path}} \mathbf{B} \cdot d\mathbf{l} = \mu_0 I + \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$

(a) wire/coaxial cable: $\oint dl = 2\pi r$

(b) Solenoid: $\oint dl = l$

(c) toroid: $\oint dl = 2\pi r$

(D) Faraday's Law

1. Faraday's Law: $\mathcal{E} = -N \frac{d\Phi_B}{dt} = -\oint \mathbf{E} \cdot d\mathbf{s}$

2. Lenz's Law: \mathcal{E} induced opposes the change in Φ_B .

3. Example

(a) Bar on rails

(b) coil in \mathbf{B} -field



iii. calculate \mathcal{E} , I , F and/or \mathbf{E} -field

(E) Inductors - Circuits

1. $\mathcal{E}_L = -L \frac{dI}{dt}$

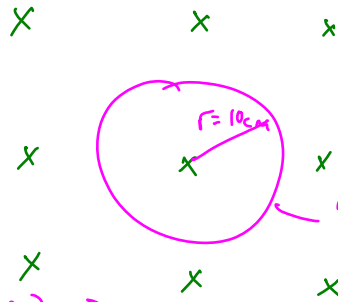
2. $\tau = \frac{L}{R}$

3. $\omega = \frac{1}{\sqrt{LC}}$

4. $U_L = \frac{1}{2} L I^2$

5. @ $t=0$, opposing battery
 @ $t=\infty$, wire

Faraday Ex



$$\frac{dB}{dt} = 8t$$

$$\& B = 0 @ t = 0$$

(a) $\mathcal{E}(t) = ?$

(b) i. $I = ?$ & ii. direction

(c) $E = ?$

$$(a) \mathcal{E} = -N \frac{d\Phi_B}{dt} = \frac{d}{dt} (\pi r^2 \cdot B)$$

$$\mathcal{E} = \pi (0.1)^2 \frac{dB}{dt} = \boxed{\pi (0.1)^2 8t}$$

$$(b) i. I = \frac{\mathcal{E}}{R} = \frac{\pi (0.1)^2 8t}{6}$$

ii. ccw

(c) $\oint E \cdot dl = \mathcal{E}$

$$E \cdot (2\pi r) = \pi (0.1)^2 8t$$

$$E = \frac{(0.1)^2 8t}{2(0.1)} = \frac{8(0.1)t}{2} = \boxed{4t}$$