① Phys 2426 2017-07-27 Lec 15

#17 $\Phi_B = \iint \vec{B} \cdot d\vec{A} = NBA$

$= (1000)(3.14 \times 10^{-3})(\pi (0.05)^2)$

$= 0.0247 \ T \cdot m^2$

#23 Accelerator → Mass Spec

$q\Delta V = \frac{1}{2}mv^2$ ↑ Doubles ↓ Increase by $\sqrt{2}$

$r = \frac{mv}{qB}$

∴ r increases by $\sqrt{2}$

$q\Delta V = \frac{1}{2}mv^2$

$\frac{\Delta V}{v^2} = \frac{m}{2q} = \text{const}$

$\frac{\Delta V_1}{v_1^2} = \frac{\Delta V_2}{v_2^2}$

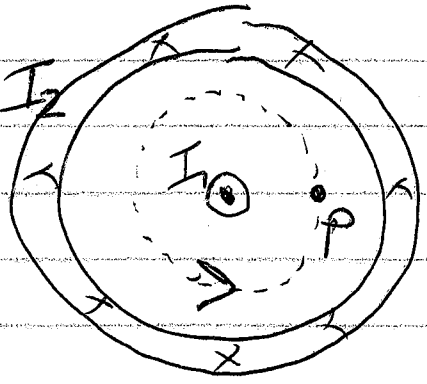
$\frac{\Delta V_2}{\Delta V_1} = \frac{v_2^2}{v_1^2}$

2

$\sqrt{2} = \frac{v_2}{v_1}$

Ampere's Law:

$$\oint_{\text{Edge}} \vec{B} \cdot d\vec{\ell} = \mu_0 \iint_{\text{Surface}} \vec{J} \cdot d\vec{A}$$



$$B\ell = \mu_0 I_{enc}$$

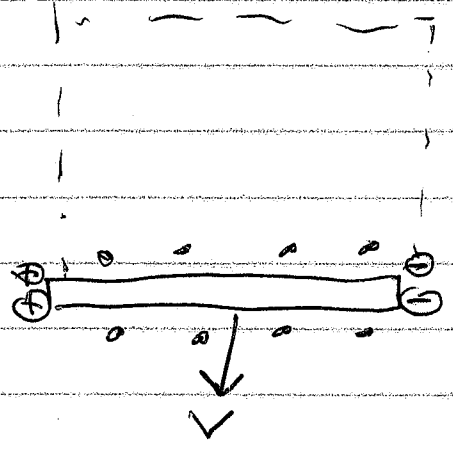
↳ only current "inside" matters

At P, mag field is just due to I_1.

RHR for direction

$$B = \frac{\mu_0 I_1}{2\pi r}$$ for magnitude

(#11) $F_B = qvB$



- ⊕ Forced left
- they move CW to complete circuit

Lenz's Law

- B pointing out
- Flux increasing
- Want induced B to be into page.
- Induced I is CW.

#12 Want B

Know I and speed = const

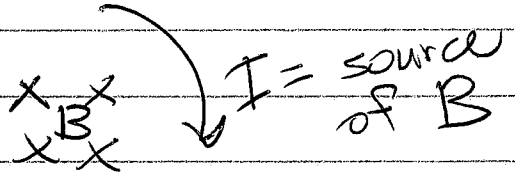
Step 1: $F_g = mg = (0.001\,kg)(9.8\,N/kg)$

$= 0.0098\,N$

Step 2: $F_B = IlB$ (l = width of loop)

$(0.0098\,N) = (0.25\,A)(0.03\,m)(B)$

#13 B = into page



#22

$$r = \frac{mv}{qB} = \frac{(7.64\times10^{-26}\,kg)(3000\,m/s)}{(1.6\times10^{-19}\,C)(0.5\,T)}$$

EM Waves

$\vec{E}$ & $\vec{B}$ both oscillate perpendicular to "ray" they act as sources for each other.

Dir of $\vec{E}$ is "Polarization"

Ex: Reflection from water tends to be horizontally polarized.

Frequency and Wavelength determine type.

Low-Freq = Long Wavelength
- Radio, microwave, IR
- Less than 400 THz
- Low energy when low intensity.
- Damage causes pain.

Visible Light
- 400 - 750 THz in frequency
- 400 - 750 nm in wavelength

High-Freq = Short λ
- UV, X-ray, Gamma
- High energy, even at low intensity

(5)

Standing Waves

$\lambda_1 = 2L$ $\quad f_1 = \frac{v}{\lambda} = \frac{v}{2L}$

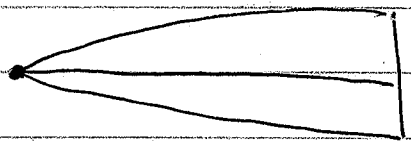
$\lambda_2 = L$ $\quad f_2 = \frac{v}{L} = 2f_1$

$\lambda_3 = \frac{2L}{3}$ $\quad f_3 = 3f_1$

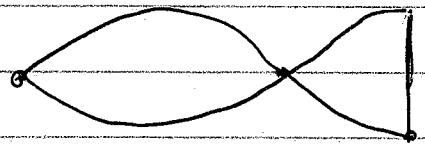
General: $\lambda_m = \frac{2L}{m}$ $\quad f_m = mf_1$

m = any integer = harmonic

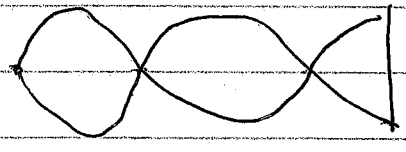
What if one side is "open"?



$\lambda_1 = 4L$ $\quad f_1 = \frac{v}{4L}$



$\lambda_3 = \frac{4L}{3}$ $\quad f_3 = 3f_1$



$\lambda_5 = \frac{4L}{5}$ $\quad f_5 = 5f_1$

$\lambda_m = \frac{4L}{m}$ $\quad f_m = mf_1$

m = odd harmonics only

(6)

Flux $\Phi = LI$

$V = I X_L = I 2\pi f L$

$\Phi = L \frac{V}{2\pi f L}$

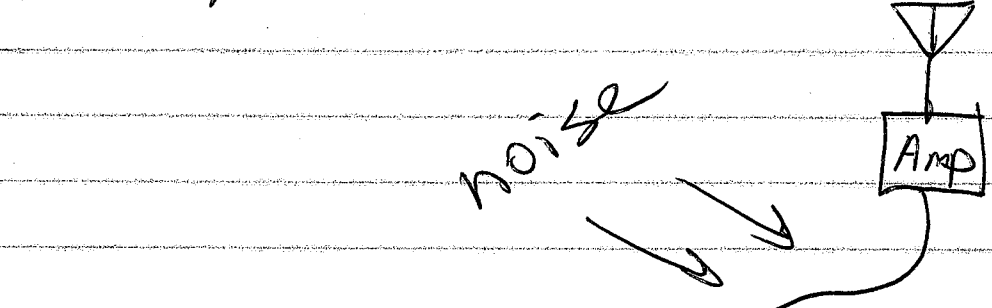
$\Phi \uparrow$ as V_L and V_C cancel.

$X_C = \frac{1}{2\pi f C}$

High f $\Rightarrow$ Low X_C

Capacitor passes high-f

LNB - Low-noise Block
Amplifier placed @ antenna.



In rcvr: