Phys 1402 2016-10-27 Lec 19

Exam 2 Tuesday

HW 46-10 Series AC Circuit

Given $L = 3.0\ H$ Want Power

$C = 3.2\ \mu F$

$R = 25\ \Omega$ $P = I^2R$

$V_{rms} = 120\ V$

At resonance: $X = 0$

$Z = \sqrt{R^2 + X^2} = R$

$$I = \frac{V}{Z} = \frac{120}{25} = 4.8\ A$$

$$P = I^2R = (4.8^2)(25) = 576\ W$$

At half-resonance:

$$f_R = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{(3)3.2\times10^{-6}}} = 51.37\ Hz$$

$f = 25.68\ Hz$

$$X_L = 2\pi f L = 2\pi\left(\frac{51.37}{2}\right)(3) = \boxed{484\ \Omega}$$

Note: at resonance $X_L = 2 \cdot 484 = 968\ \Omega$

$X_C = 968\ \Omega$ @ f_R

$$X_C = \frac{1}{2\pi f C} = 968 \cdot 2 = \boxed{1936\ \Omega}$$

$X = X_L - X_C = 1452\ \Omega$

1452 $Z = \sqrt{R^2 + X^2} = 1452\ \Omega$

$I = \frac{120}{1452} = 0.0826$ $P = I^2R < 0.171\ W$

②

	f_R	$f_R/2$	$2f_R$	$4f_R$
$2\pi fL = X_L$	968	484	1936	3872
$1/(2\pi fC) = X_C$	968	1936	484	242
R	25	25	25	25
X	0	-1452	+1452	3630
Z	25	1452	1452	3630

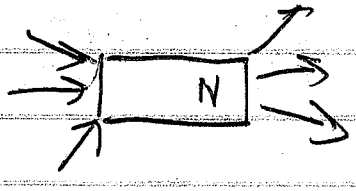
$120/Z = I$

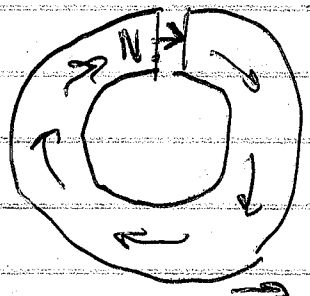
$I^2R = P$

Note: $\sqrt{25^2 + 3630^2} = 3630.08 \approx 3630$

How do we create magnetic Fields?

Permanent Magnet $\vec{B}$ = (given) (Away from N)





In the gap, $\vec{B} = B_0 \hat{x}$

In the ring, $\vec{B} = B_0$ (CW)

Wire (straight)

r = our dist from wire

$$B = \frac{\mu_0 I}{2\pi r}$$

Coil

R = coil radius

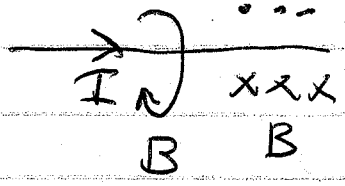
$$B = \frac{\mu_0 I N}{2R}$$

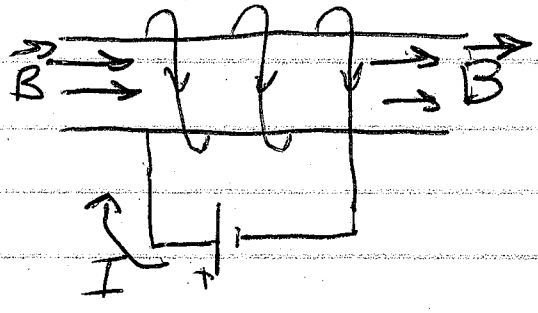
Solenoid

ℓ = solenoid length

$$B = \frac{\mu_0 I N}{\ell}$$

RHR For direction





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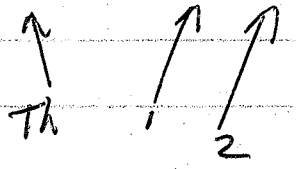
What do mag fields do?

Force on charge $F = qv_\perp B$

Force on current $F = I_\perp \ell B$

RHR 

Ex: I flows North $\hat{y}$ Top
Force is West $-\hat{x}$ Left
B is ?(Down) $-\hat{z}$ Into

Map (xyz) ~~Page~~

Torque on coil $\tau_{max} = NBAI$
(Tries to orient with mag field.)

EMF in coil (voltage) $\mathcal{E} = N\frac{\Delta B}{\Delta t}A$ varying B

$\mathcal{E} = NBA\omega$ rotating coil

Applications Mass Spec $r = \frac{mv_\perp}{qB}$

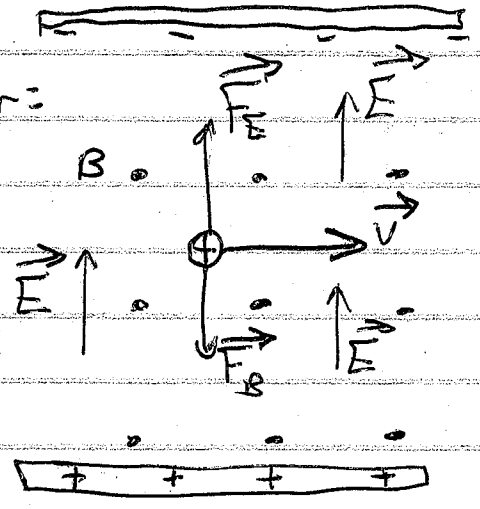
Velocity Selector $qE = qvB$

(3)

$\vec{B} = 3.0\ T\ \hat{z}$

$\vec{v} = 2000\ m/s\ \hat{x}$

What $\vec{E}$ selects this velocity?



① $\vec{F_B}$ is $-\hat{y}$

② $\vec{F_E}$ is $+\hat{y}$

③ $\vec{E}$ is $+\hat{y}$

Magnitude: $qE = qvB$

$= (2000)(3)$

$E = 6000\ N/C$

$= 6000\ V/m$

$\vec{E} = 6000\ V/m\ \hat{y}$