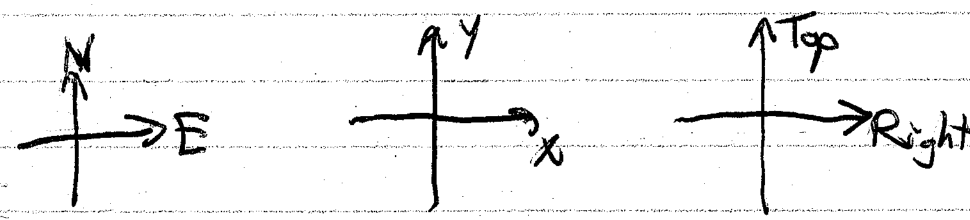
① Phys 2426 2016-10-27 Lec 19

Exam 2 Tue 11/1

Current Flows	North	+y	Top
F_B is	Up	+z	Out



Up = "out" z = "out"

Map	xyz	Page

$$\vec{F} = q\vec{v} \otimes \vec{B}$$

$\vec{B}$ is	West	$-x$	Left

How do we make a magnetic field?

- Magnet $B =$ given
- Straight Wire $B = \mu_0 I/(2\pi r)$
- Coil $B = \mu_0 I N/(2R)$
- Solenoid $B = \mu_0 I N/\ell$

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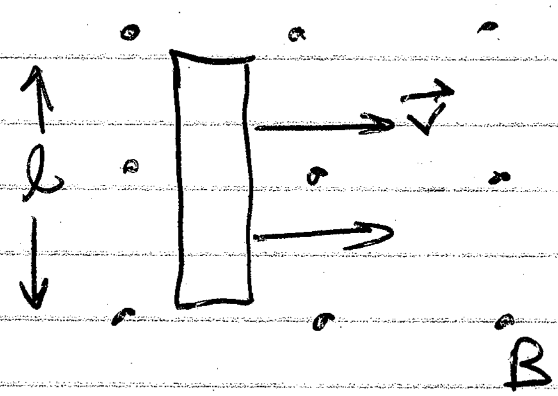
What do Magnetic Fields do?

- Forces on charges
- Forces on wires
- Torques on coils
- Induced EMF

Motional $\mathcal{E} = vB\ell$



Coil in changing Field

$$\mathcal{E} = N\dot{B}A = N\frac{dB}{dt}A$$

$\mathcal{E} = -\frac{d\Phi_B}{dt}$ Rotating Coil

$\Phi_B = NBA\cos\theta$ $\quad\quad \mathcal{E}_{max} = NBA\omega$

↑ rotational speed in rad/s

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Series AC Circuit

$$P = I^2 R$$

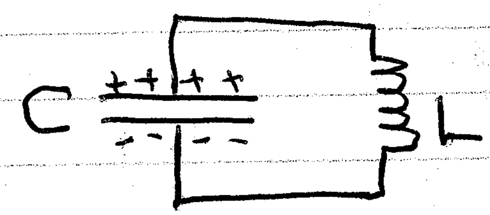
$R = 44\,\Omega$
$Z = 67\,\Omega$
$V_{rms} = 210\text{ V}$

$$I_{rms} = \frac{210}{67} = 3.134\text{ A}$$

$$P = (3.134)^2 (44) = 432\text{ W}$$

LC Oscillator

$L = 0.1\text{ H}$
$C = 1.4\ \mu\text{F}$



$$f = \frac{1}{2\pi\sqrt{LC}} = 425\text{ Hz}$$

Cap: $Q = CV$ Energy $= \frac{1}{2}CV^2$

$V_0 = V_{max} = 12\text{ v}$

$$Q = (1.4\times10^{-6})(12) = 16.8\ \mu C$$

$$\text{Energy} = \tfrac{1}{2}(1.4\times10^{-6})(12)^2 = 101\ \mu J$$

Inductor: Energy $= \frac{1}{2}LI^2$

$$101\times10^{-6} = \tfrac{1}{2}(0.1)I^2$$

$$44.9\text{ mA} = I$$

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Velocity Selector $F_E = F_B$

$qE = qvB$

Practice test #10: $2000 = v(0.005)$

$v = 4\times10^5$ m/s

Direction of E?

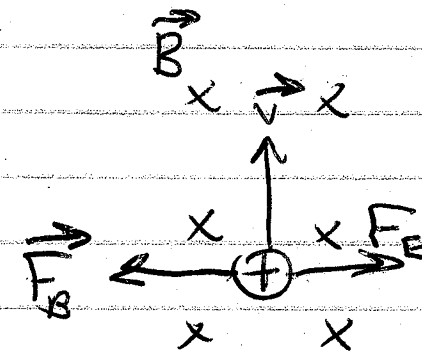
$B = -\hat{z}$

$v = +\hat{y}$

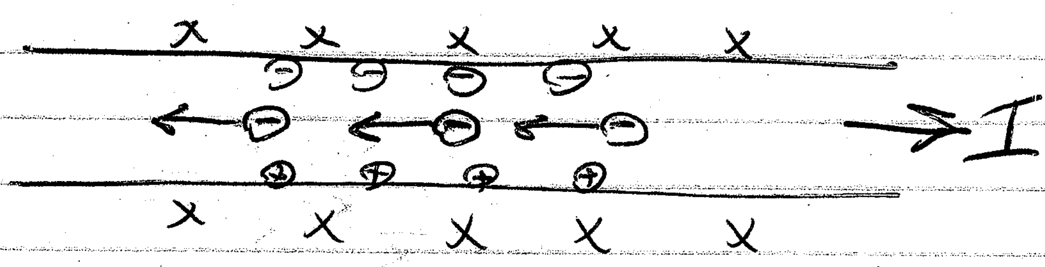
$F_B = -\hat{x}$

$F_E = +\hat{x}$

$E = +\hat{x}$



Hall Effect - Drifting charges generate motional EMF / Velocity Selector



B = (in)

$F_B = +\hat{y}$ makes ⊖ gather at top of wire

Allows us to tell that $I = I_0(+\hat{x})$ is caused by $q = ⊖$ with $v = v_0(-\hat{x})$

③

Resonance

$$f_R = \frac{1}{2\pi\sqrt{LC}}$$

$$X_L = X_C$$

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

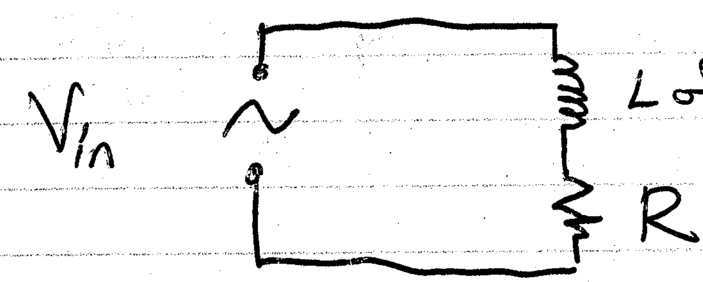
$L = 1.16\ \mu H$
$f = 6.36\ MHz$ } $C = 5.4 \times 10^{-10}\ F$
$= 540\ pF$

540 is 2 orders bigger

10^{-12} is 2 orders smaller

Back EMF of a motor

Schematic :



$\mathcal{E} = NBA\omega$

opposes current
reduces I

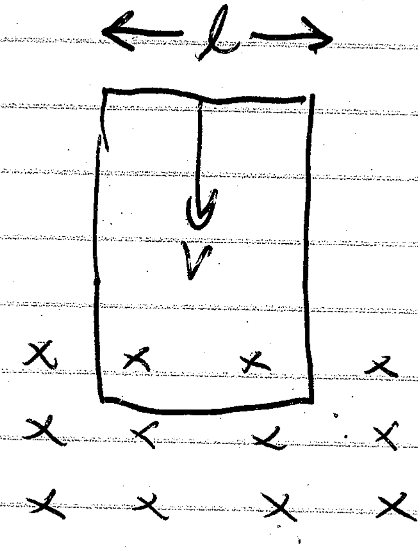
$$P = I^2 R$$

$$V_{in} - \mathcal{E}_{back} = IR$$

Use the motor and it slows.
I increases.
P increases.

(6)

Drop a vertical loop into a B Field



$\mathcal{E} = vBl$

$\mathcal{E} = v(6.0)(2.0\ m)$

$\Sigma F = F_g + F_B = 0$

$mg = IlB$

$(0.6)(9.8) = I(2.0)(6.0)$

$\mathcal{E} = I(40\Omega)$

Watt Balance - will define kilogram