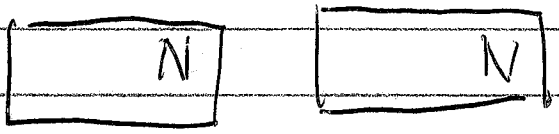
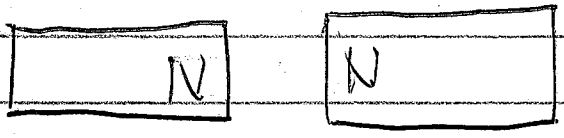
Phys 1402 2017-10-17 Lec 13

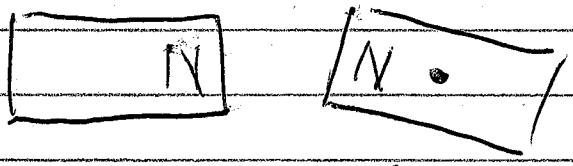
Cool Magnetic Effects



Attracted

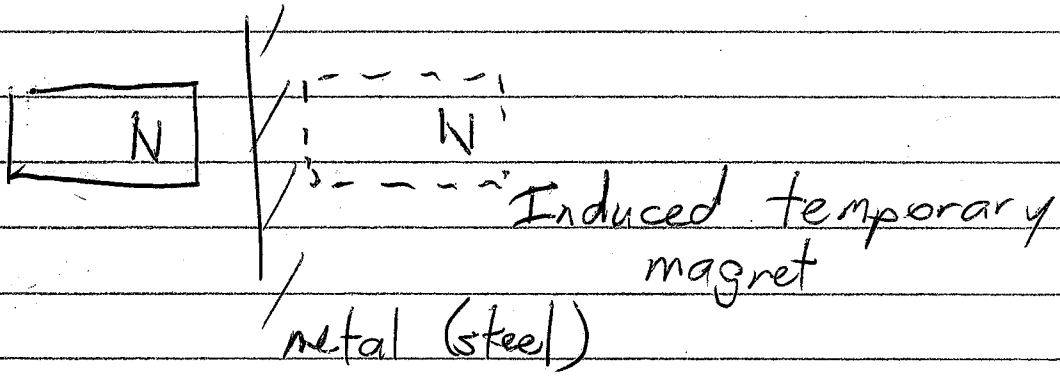


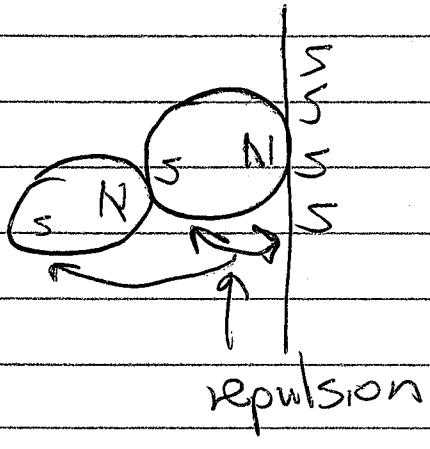
Repelled



Flips then attracted

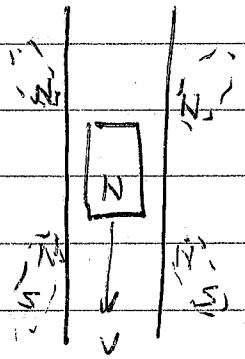
(pivoting)





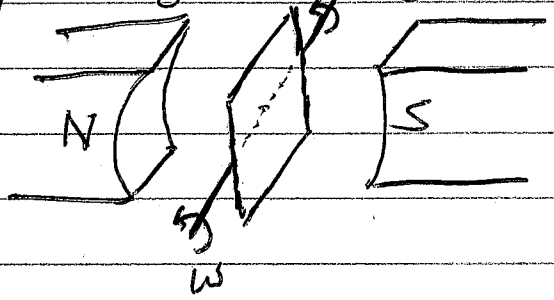
(2)

Magnet falls slowly in a copper tube.



AC Electricity

- Varying voltage causes varying I.
- Varying I causes varying B.
- Varying B generates voltage.
- Easy to generate.



Voltage Generated $\mathcal{E} = NBA\,\omega \sin(\omega t)$

ω = rotation speed in rad/s

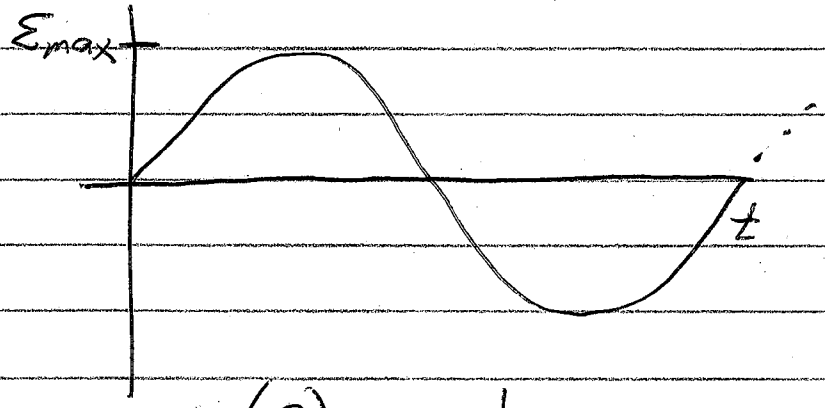
f = rotation frequency in rot/s = rev/s = Hz

$\omega = 2\pi f$

$\mathcal{E} = NBA\,2\pi f \sin(2\pi f t)$

$= \mathcal{E}_{max} \sin(2\pi f t)$

Amplitude



$\sin(\theta)$ repeats every $2\pi = \theta$

$\sin(2\pi ft)$ repeats when $2\pi = 2\pi ft$

$1 = ft$

$\frac{1}{f} = t$ $\quad$ $1/t = f$

This special time is called the period symbolized by T.

$$f = \frac{1}{T}$$

Resistors and AC

Mostly same as DC.

$$I(t) = \frac{V(t)}{R} = \frac{V_{max}}{R}\sin(2\pi ft)$$

$$= I_{max}\sin(2\pi ft)$$

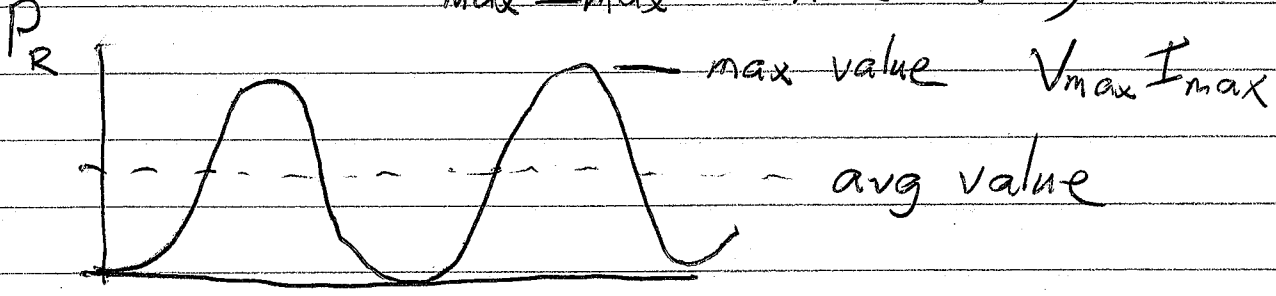
Amplitudes obey Ohm's Law: $V_{max} = I_{max}R$

Power:

Resistor Power

$$P = VI = V_{max} \sin(2\pi f t)\, I_{max} \sin(2\pi f t)$$

$$= V_{max} I_{max} \sin^2(2\pi f t)$$



$$P_{max} = V_{max} I_{max} = I_{max}^2 R$$

$$\frac{\Delta Energy}{\Delta t} = P_{avg} = \frac{1}{2} P_{max}$$

$$I_{RMS}^2 R = \frac{1}{2} I_{max}^2 R$$

$$I_{RMS} = \frac{1}{\sqrt{2}} I_{max}$$

I_{RMS} is just another way to describe the amount of current.
It works in Ohm's Law

$$V_{RMS} = I_{RMS} R \qquad V_{RMS} = \frac{V_{max}}{\sqrt{2}}$$

In the US: $V_{RMS} = 120\ V$

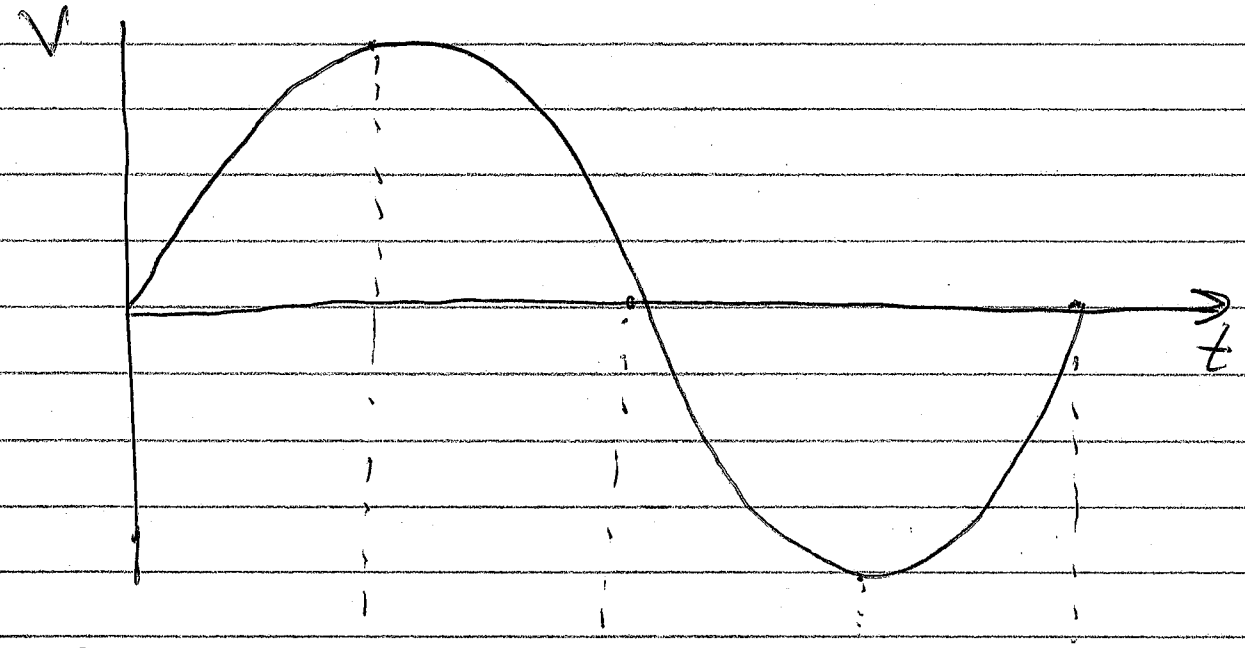
$f = 60\ Hz$

$$V(t) = (120\,v)\sqrt{2} \sin\left(2\pi (60\,Hz)\, t\right)$$

$$= (170\ V) \sin(377\ t)$$

Capacitors in AC

$Q = CV$



$Q=0$ $Q=+Q_{max}$ $Q=0$ $Q=-Q_{max}$ $Q=0$

Q increasing
$I=+I_{max}$

Q decreasing
$I=-I_{max}$

Q increasing
$I=+I_{max}$

$I=0$

$Q = CV$

Capacitor $I_{max} = 2\pi f C V_{max}$