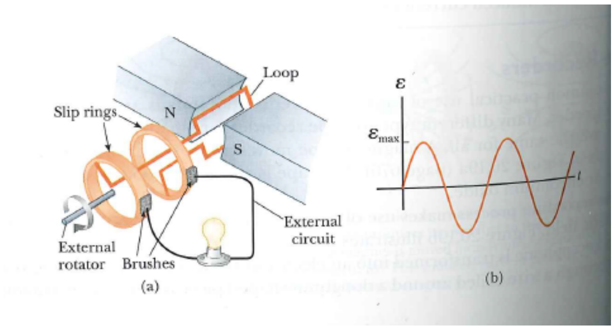
20.5 Generators

Alternating-Current Generator - device that converts mechanical energy to electrical energy



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Direct-Current Generator - Contacts to the rotating loop are made by a split ring, otherwise the same as AC Generator

ACTIVE FIGURE 20.22
(a) A schematic diagram of a DC generator. (b) The emf fluctuates in magnitude, but always has the same polarity.

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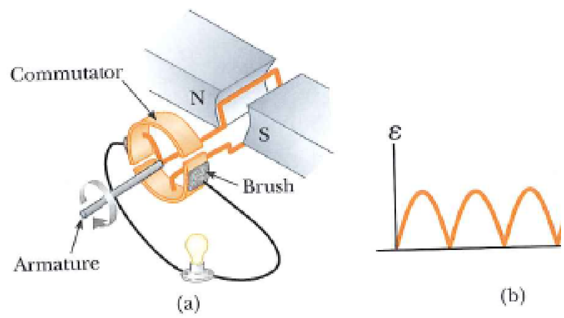


Generator Formulas:

$$\mathcal{E} = NBA\omega \sin \omega t$$

$$\mathcal{E}_{max} = NBA\omega$$

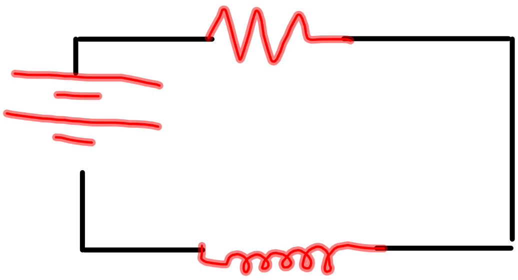
E = emf
N = number of turns on the coil
B = Strength of the Magnetic Field generated
A = Area of the loop (length x area for cylinder)
ω = 2*pi*f where f is the frequency in hz (US = 60hz, Europe = 50 Hz)

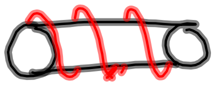
20.7 RL Circuits

Inductor: a circuit element that has a large inductance, such as a closely wrapped coil of many turns

Inductors get charged up when the circuit is running and when the power supply is shut off, it reverses current and continues to power the circuit for some time

Circuit example





Time Constant: the time required for the current in the circuit to reach 63.2% of its final value E/R

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

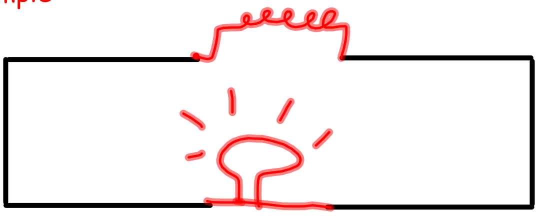
The current in the system when charging is then defined by:

$$I = \frac{\varepsilon}{R}(1 - e^{-t/\tau})$$

Decaying LR Circuit

Once the inductor is charged, you can remove the power supply and the inductor powers the circuit. This is called a decaying LR Circuit.

Circuit Example



The current in the system is defined by:

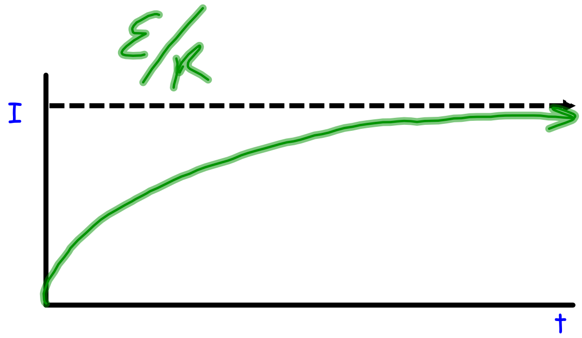
$$I_f = I_i e^{-t/\tau}$$

Looking at current as a function of time for both charging and decaying...

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

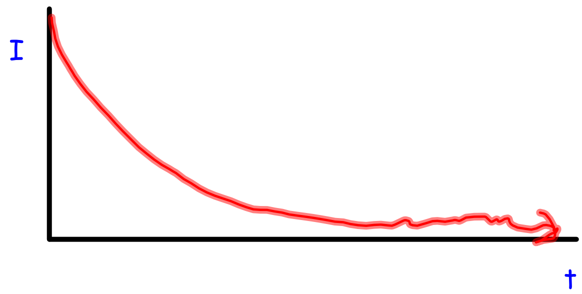
Charging:

$$I = \frac{\varepsilon}{R}\left(1 - e^{-t/\tau}\right)$$



Decaying:

$$I_f = I_i e^{-t/\tau}$$



Energy stored in an inductor

$$\mathcal{E}_{inductor} = \frac{1}{2}LI^2 = PE$$

energy, not emf

With the conservation of energy, you get all the energy back when you allow the system to decay

Homework due Friday:

Chapter 20: 6, 9, 19, 22, 25, 33, 37, 45, 49

We will have some work time on Thursday