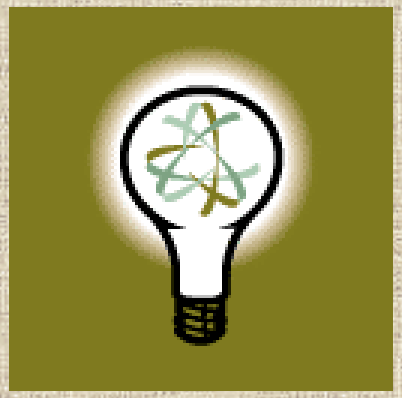
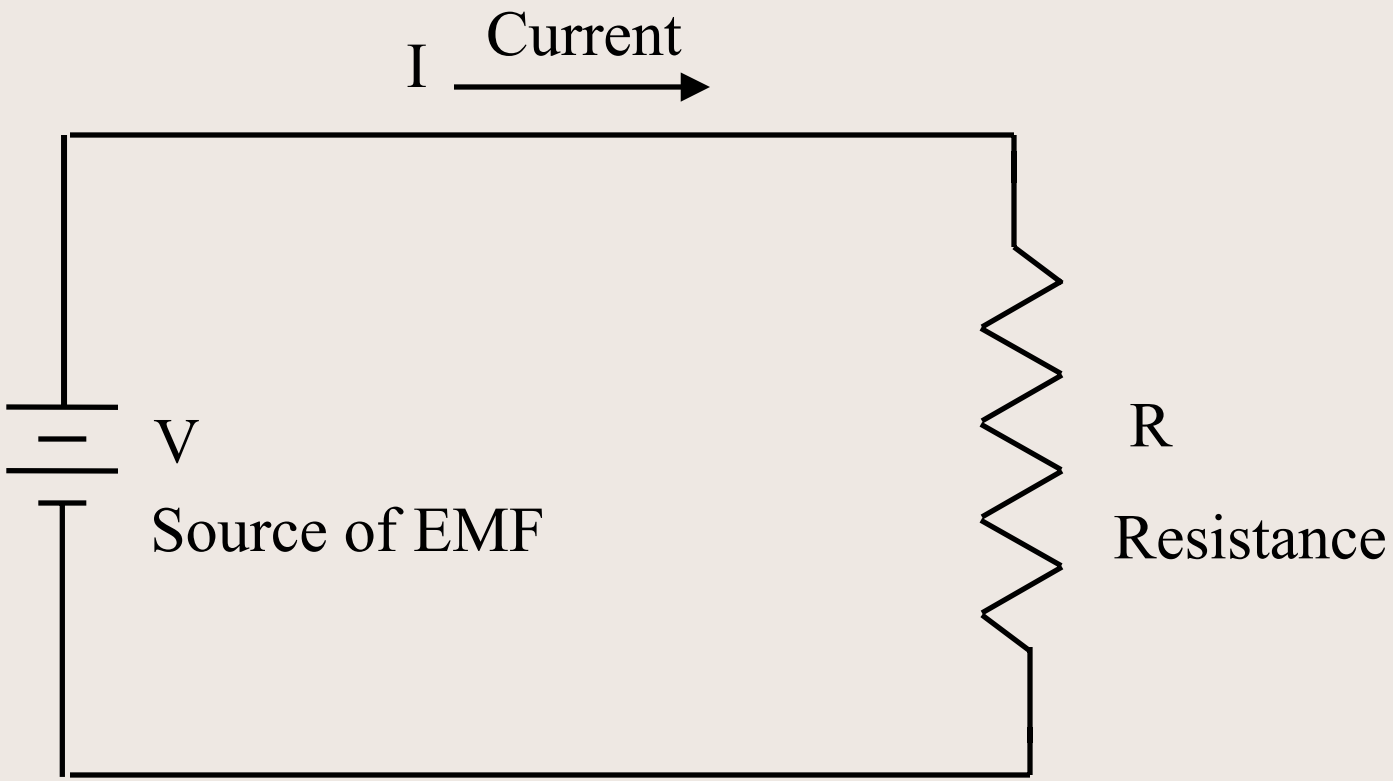


Electrical

Module 1

Basic Electrical Circuit



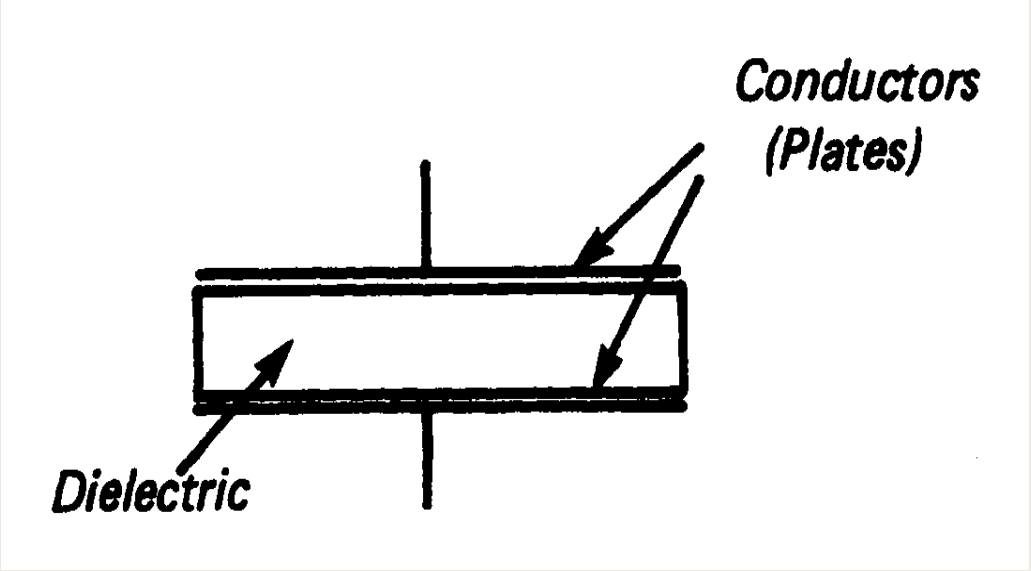
Basic Terms

- Current
- Voltage
- Resistance

Ohm's Law

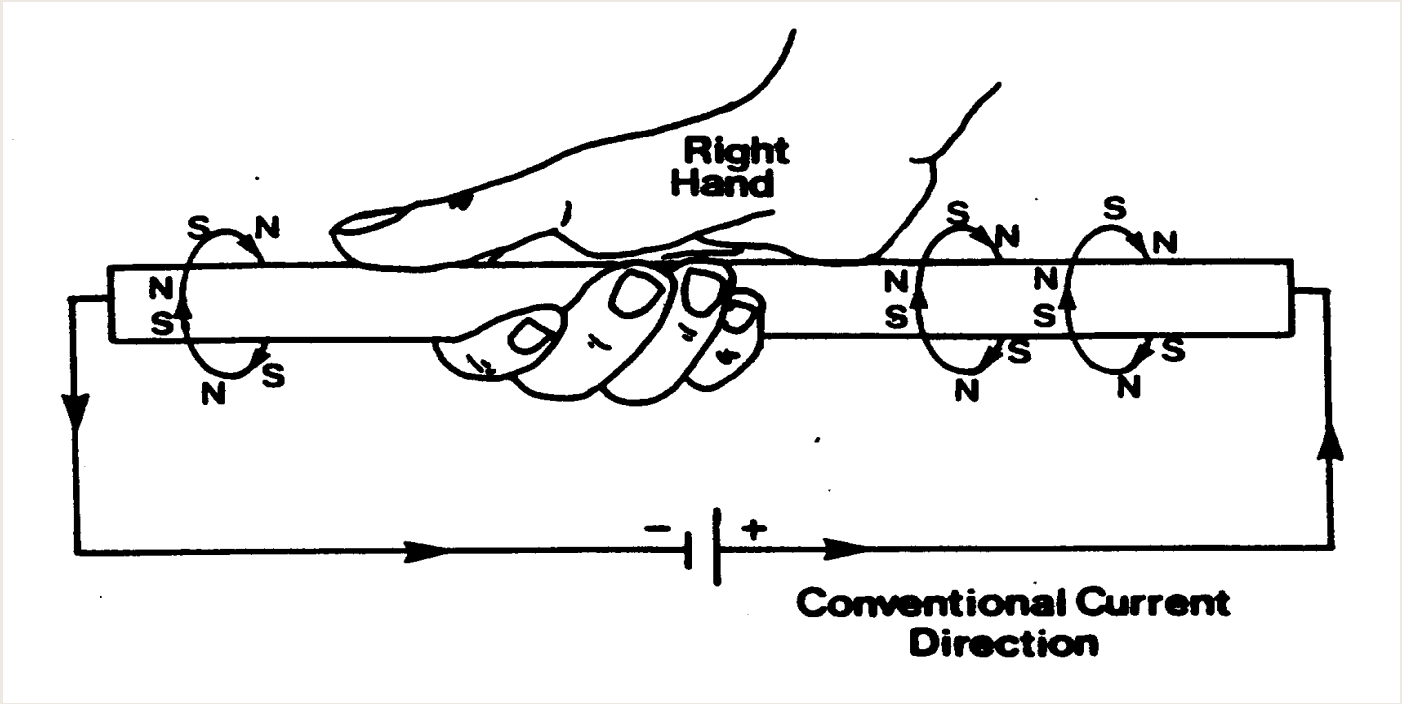
$$I = \frac{V}{R}$$

Capacitors

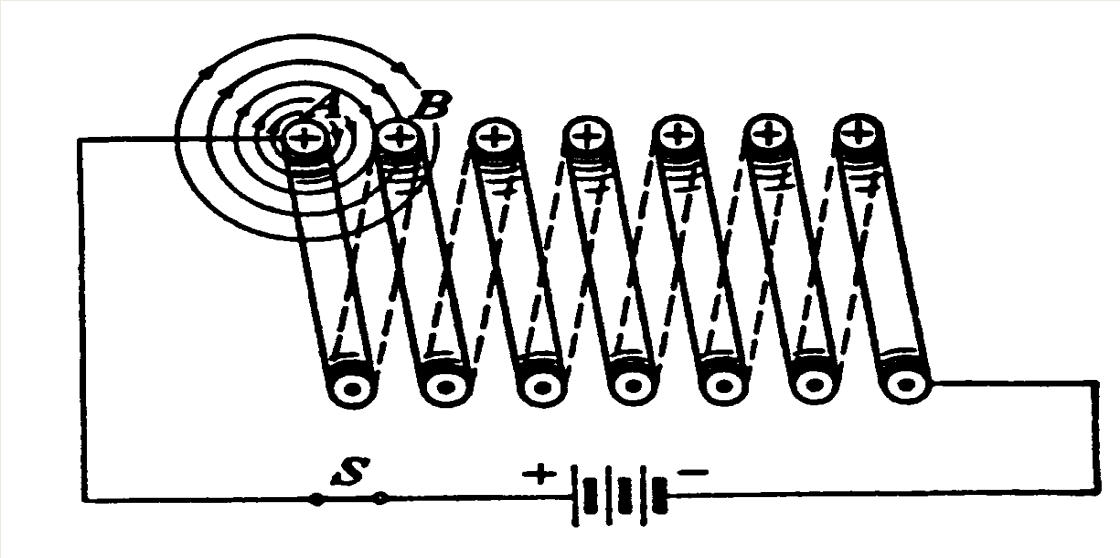


$$C = \varepsilon \frac{A}{d}$$

Magnetic Field



Coil



Inductors, Capacitors & ac

- Ac circuits have continuously changing values of voltage and current
- Inductors and capacitors continuously oppose these changes
- Opposition to current is called reactance
- Measured in ohms

$$X_L = 2\Pi fL$$

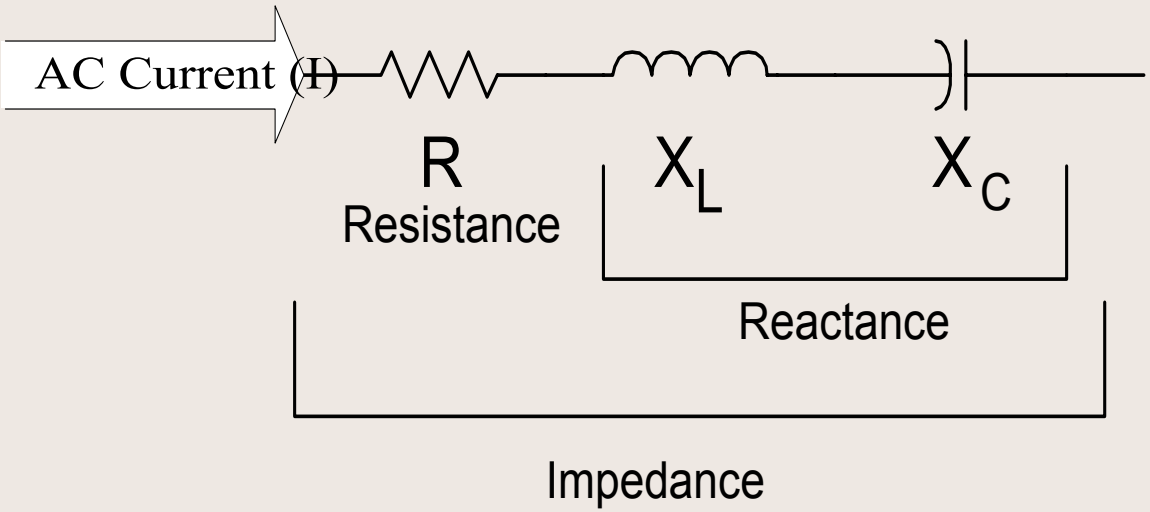
$$X_C = \frac{1}{2\Pi fC}$$

Reactance Voltages & Currents

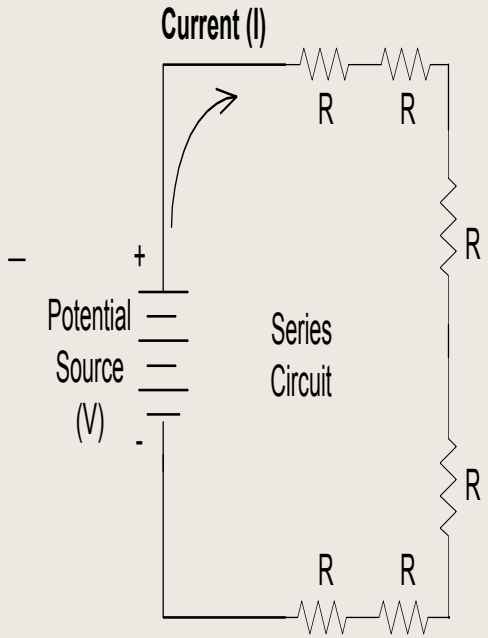
$$V_{X_L} = I_{X_L} \times X_L$$

$$V_{X_C} = I_{X_C} \times X_C$$

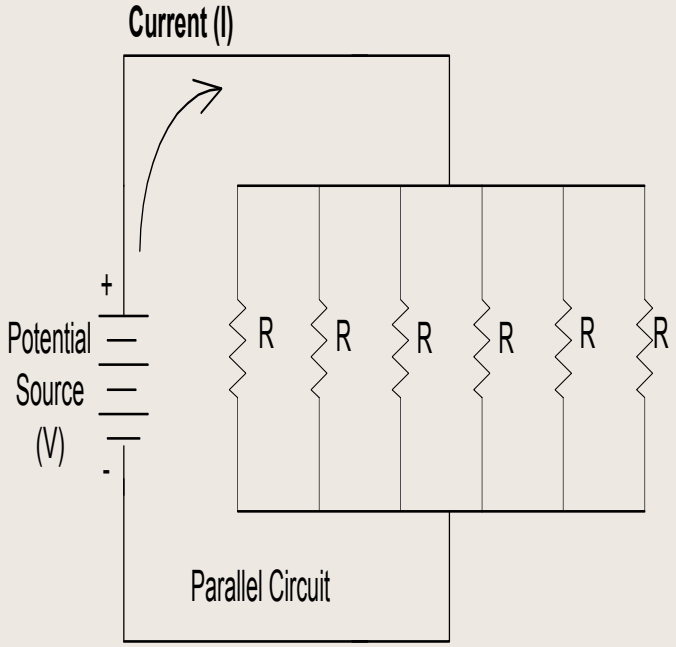
Terminology



Resistors

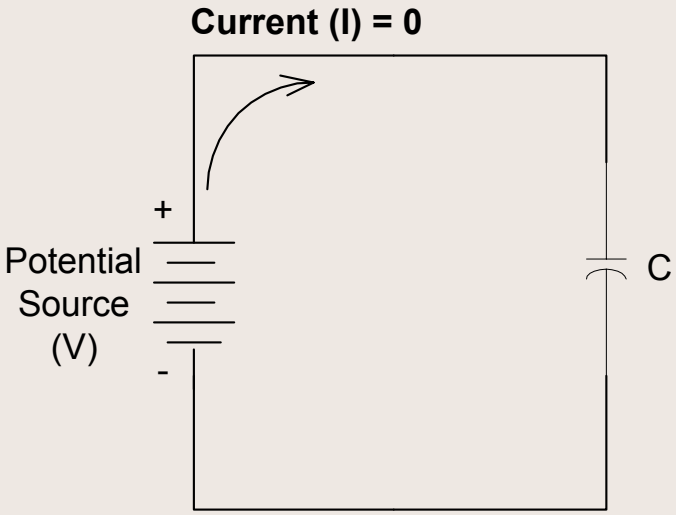


With all 6 Resistances the same value (R)
Current would be 6 times less
that of 1 resistance (R)



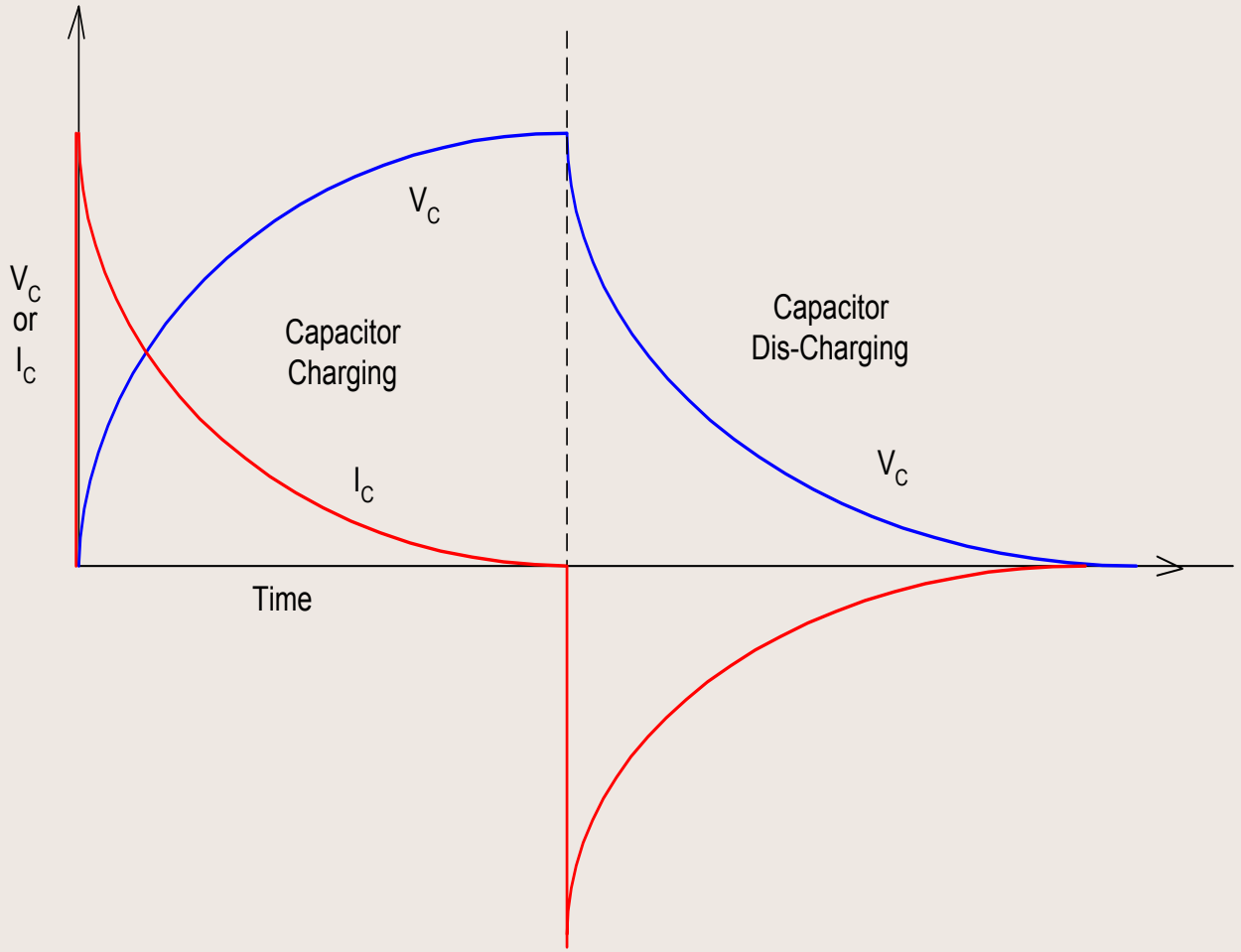
With all 6 Resistances the same value (R)
Current would be 6 times more
that of 1 resistance (R)

Capacitor in a DC circuit

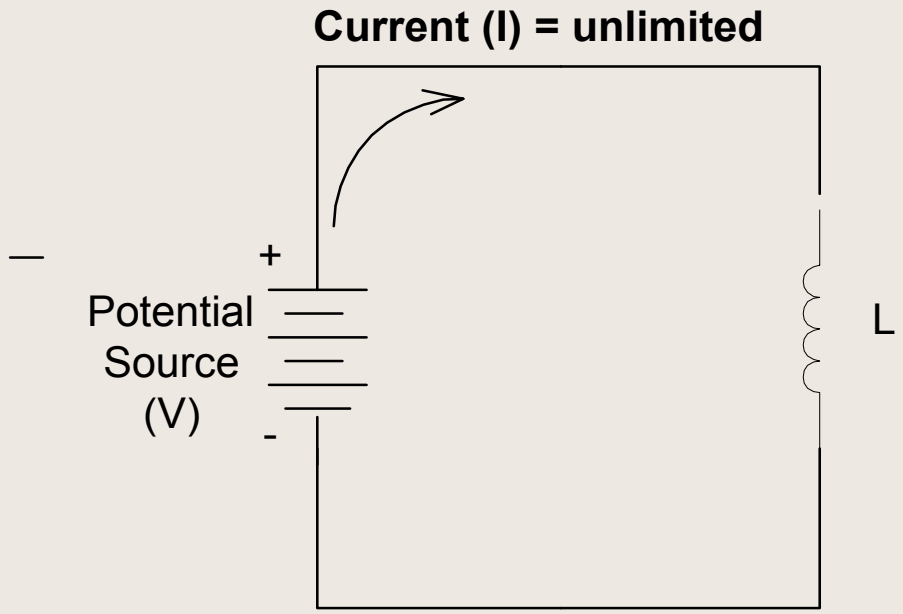


Capacitors will not pass DC Current

Capacitive Transients

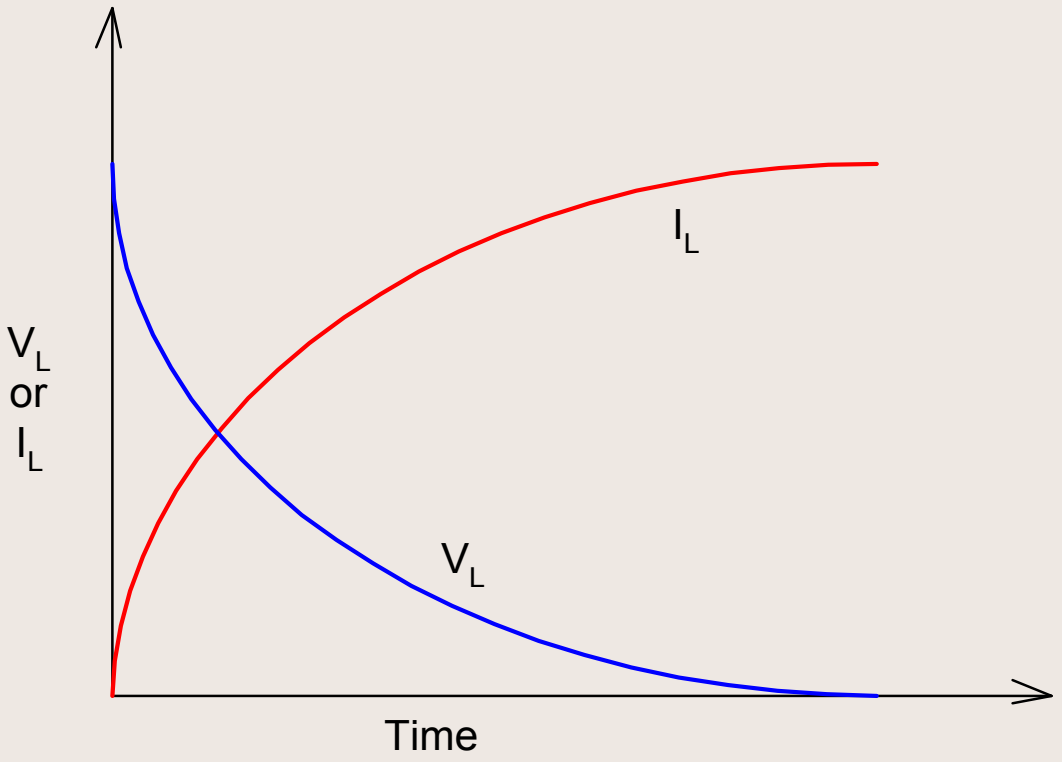


Inductor in a DC circuit

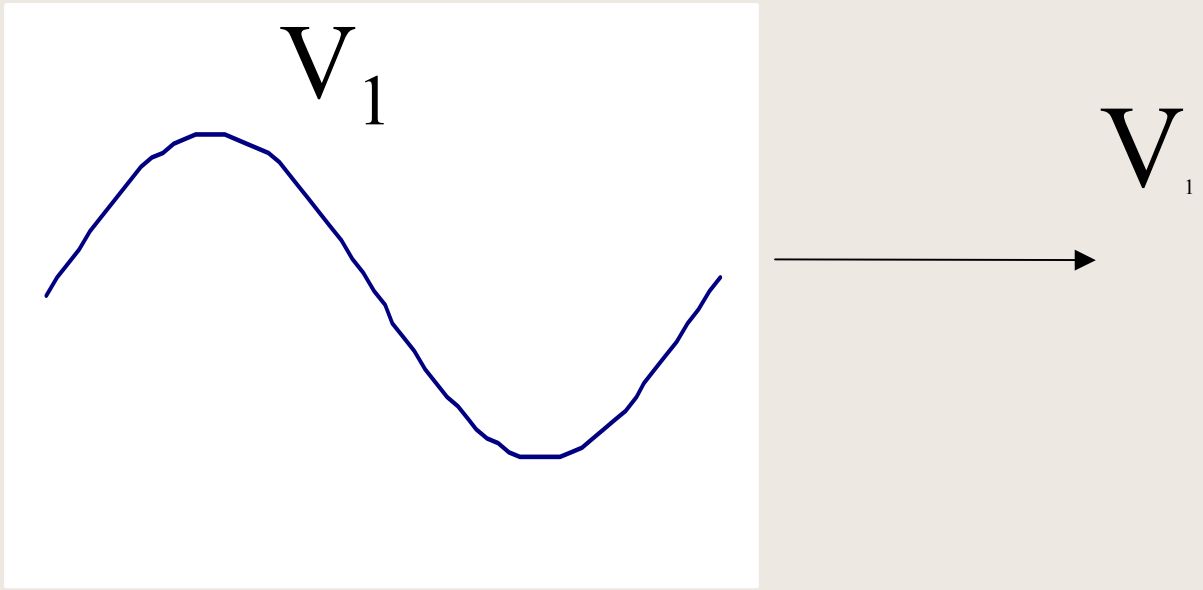


Inductors are a Short circuit to DC Current

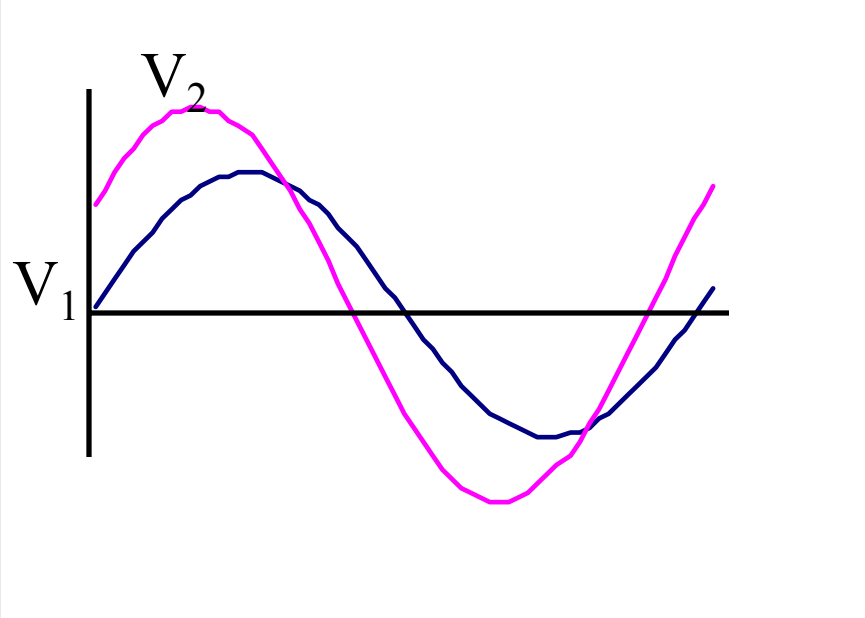
Inductor Transients

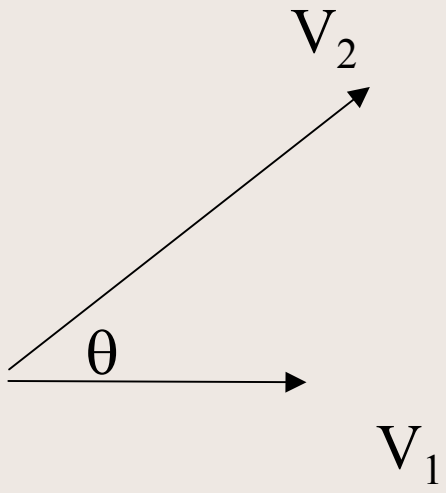


Sine curves and phasors



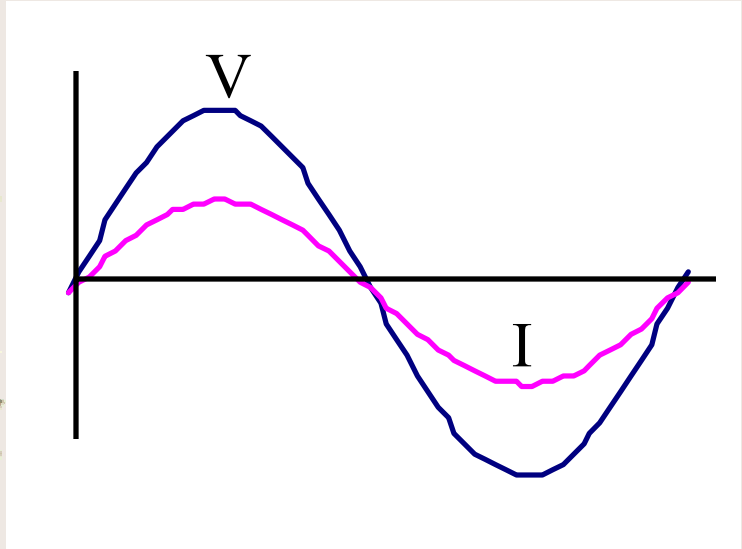
Phasor Diagram

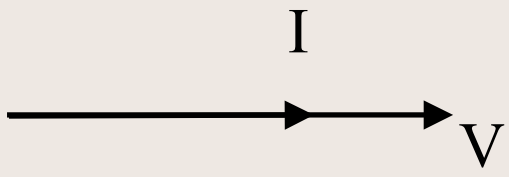




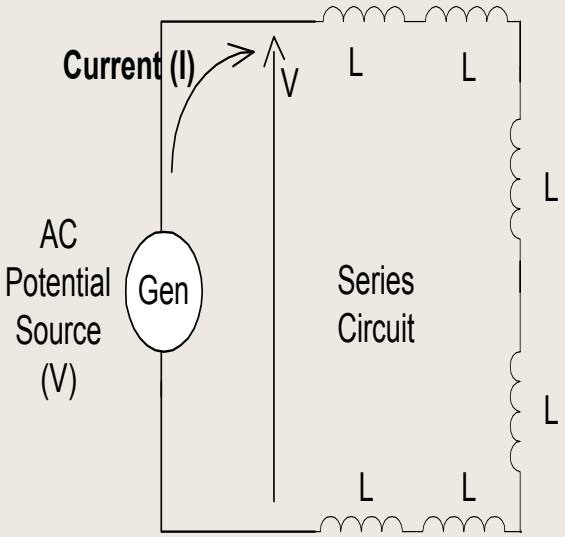
V2 Leads V1 by θ

Resistive Circuit

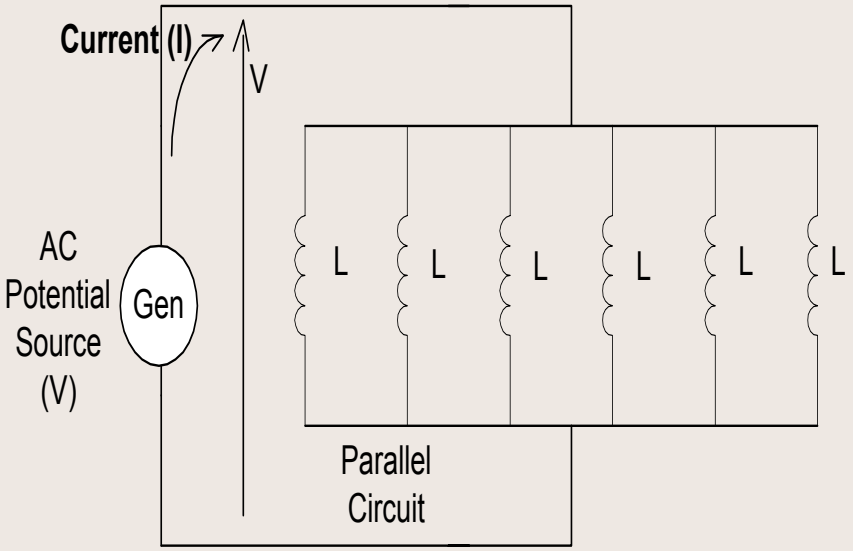




Series & Parallel Inductors



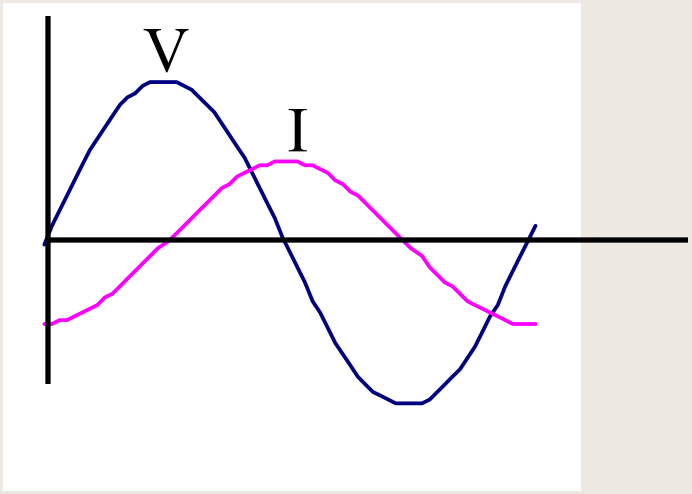
With all 6 Inductances the same value (L)
Current would be 6 times less
that of 1 Inductance (L)

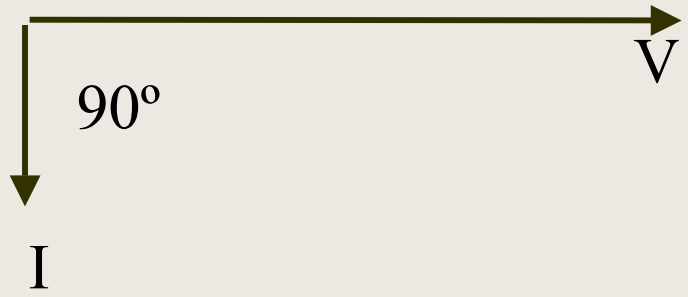


With all 6 Inductances the same value (L)
Current would be 6 times more
that of 1 Inductance (L)

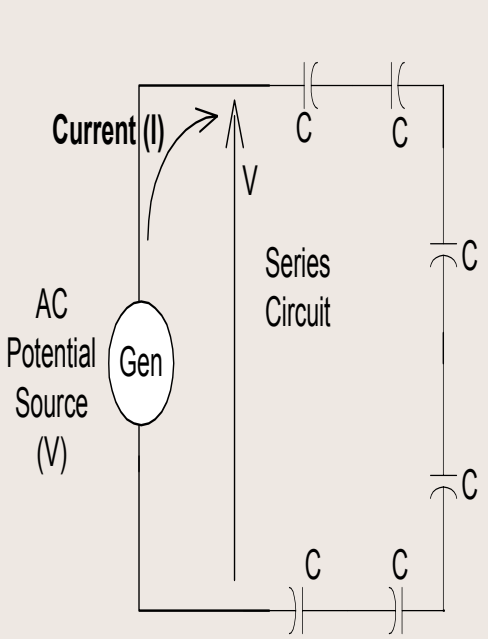
In both circuits the Current will lag the Voltage by 1/4 cycle

Inductive Phasors

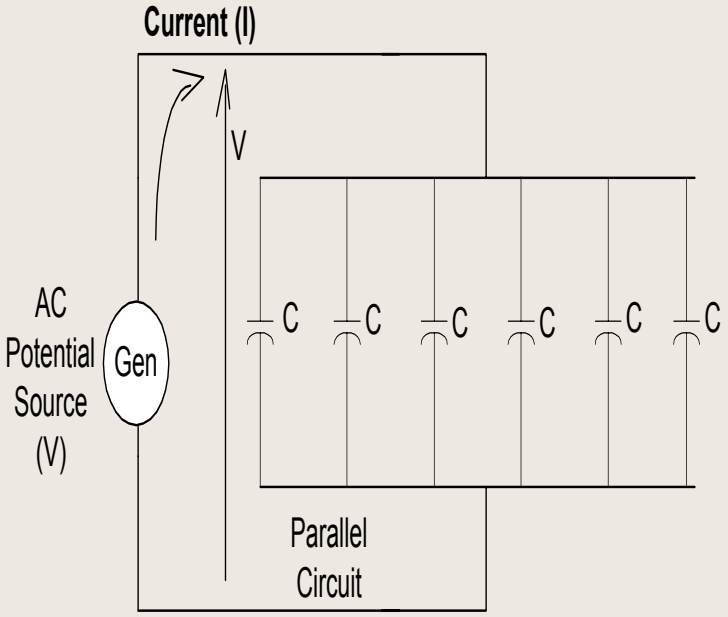




Series & Parallel Capacitors



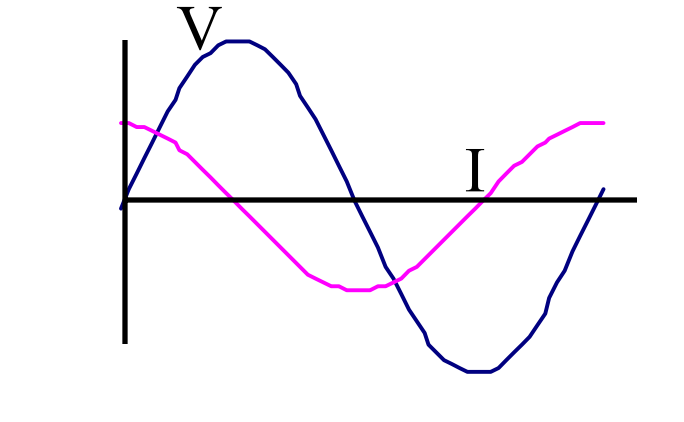
With all 6 Capacitances (C) the same value
Current would be 6 times less
that of 1 Capacitance



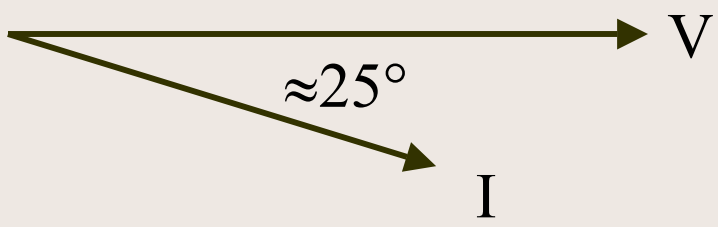
With all 6 Capacitances (C) the same value
Current would be 6 times more
that of 1 Capacitance

In both circuits the Current will lead the Voltage by 1/4 cycle

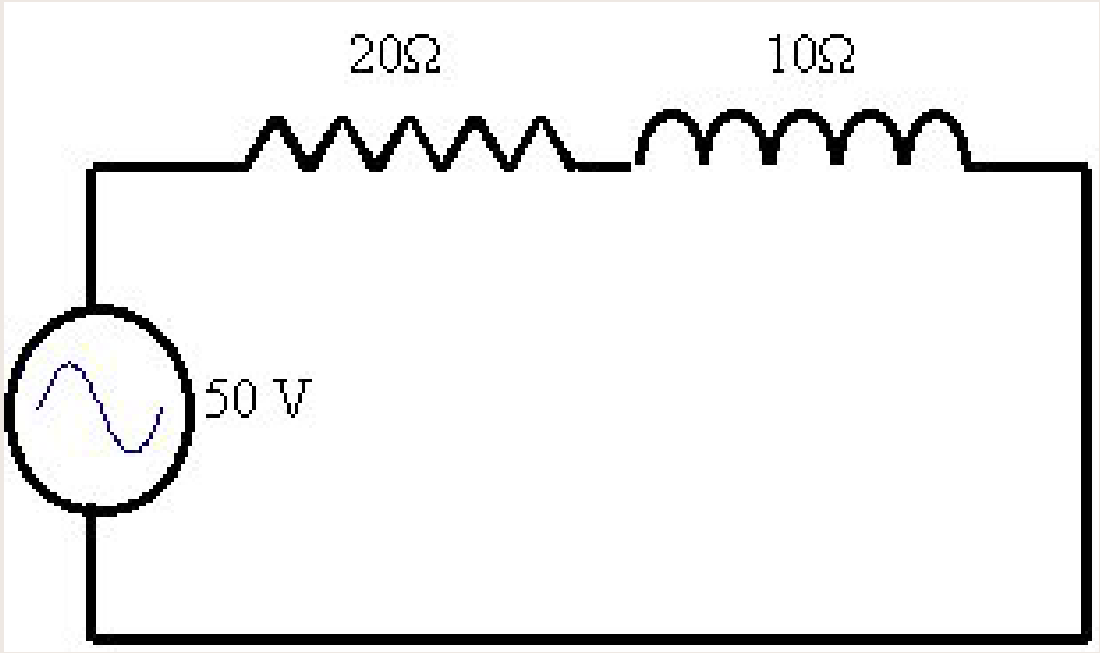
Capacitive Phasors



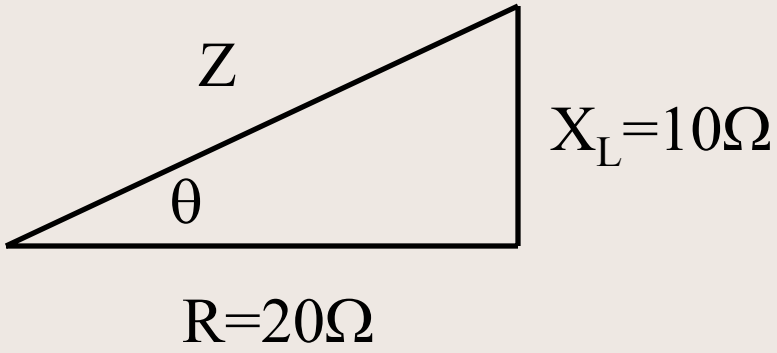
Phasors for a typical circuit



Resistor and Inductor in Series



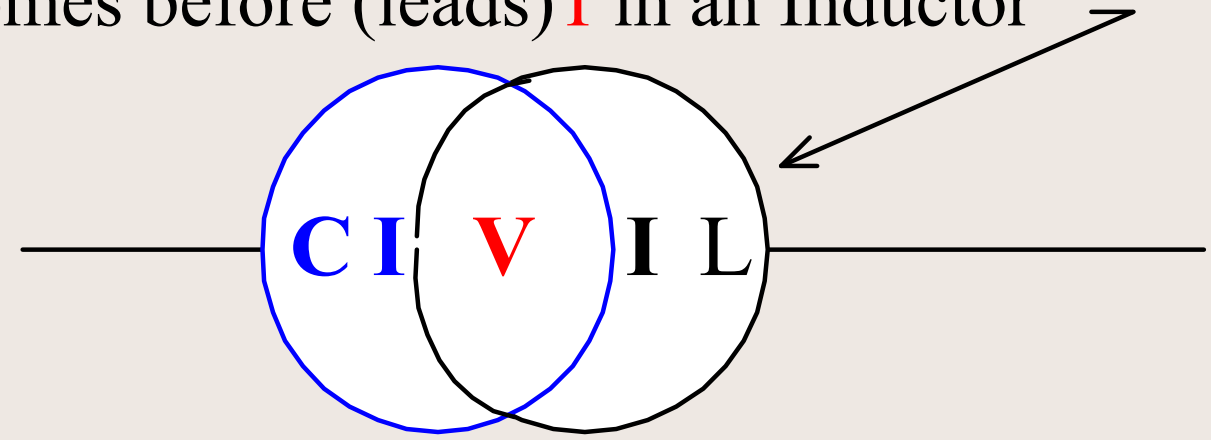
Impedance Triangle



What is the impedance of the circuit?
What is the phase angle?

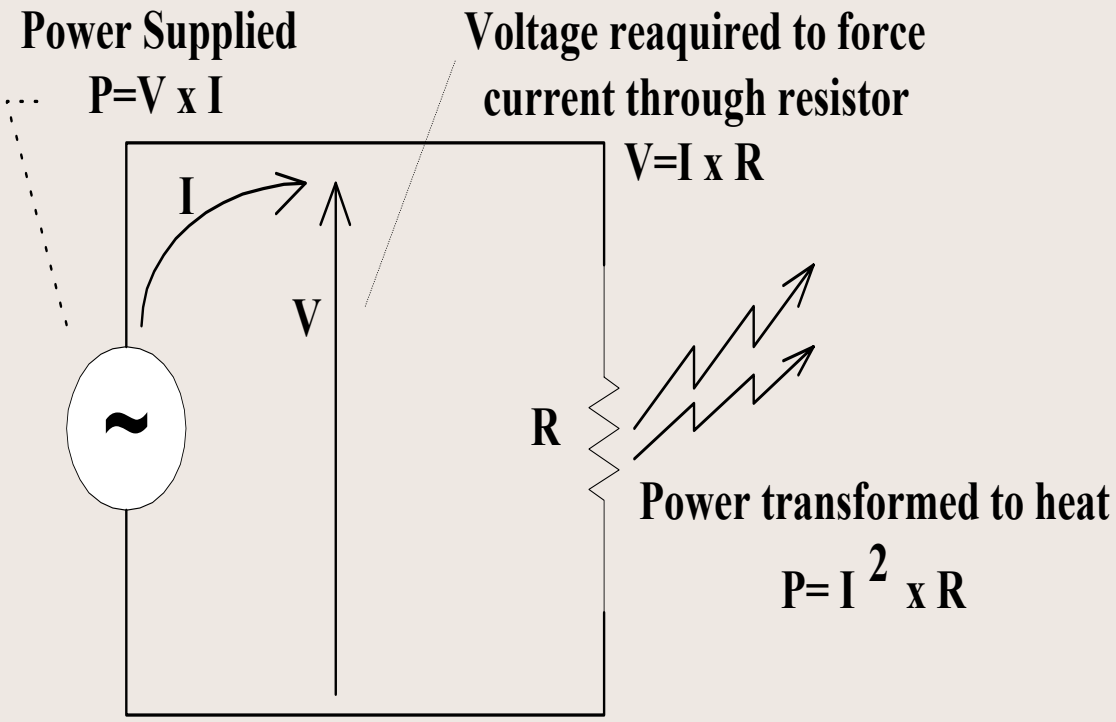
Acrostic

V comes before (leads) I in an Inductor

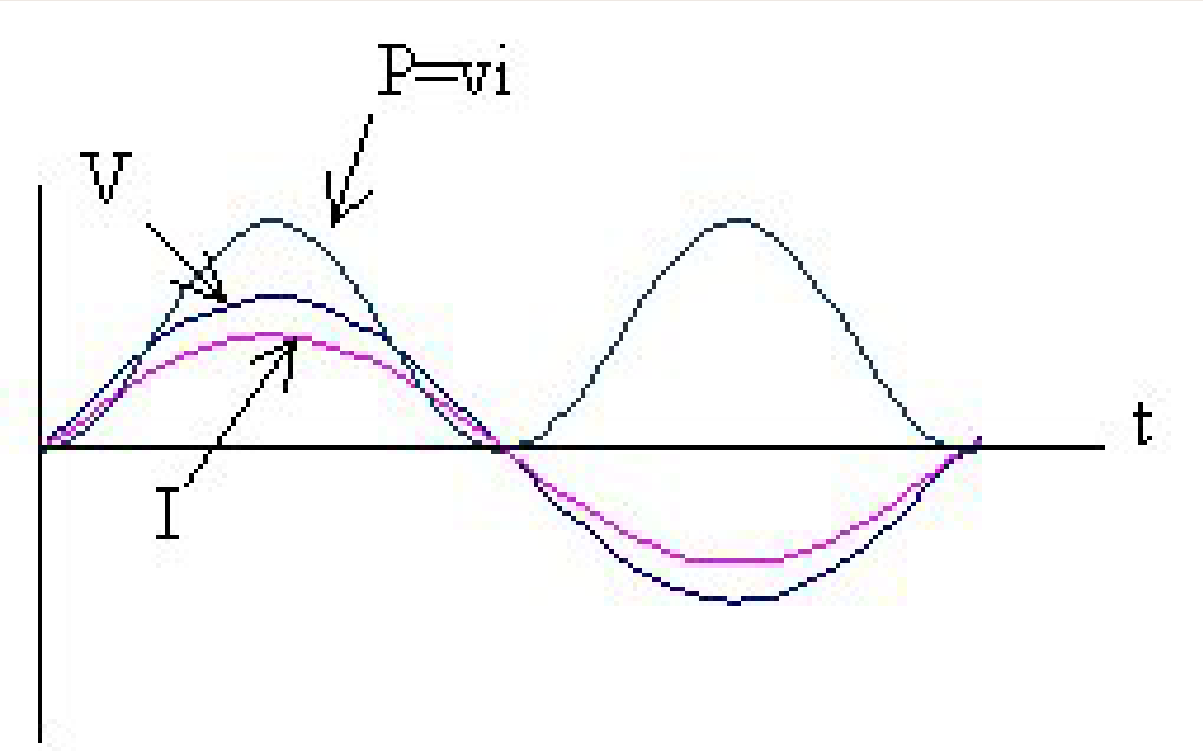


I comes before (leads) V in a Capacitor

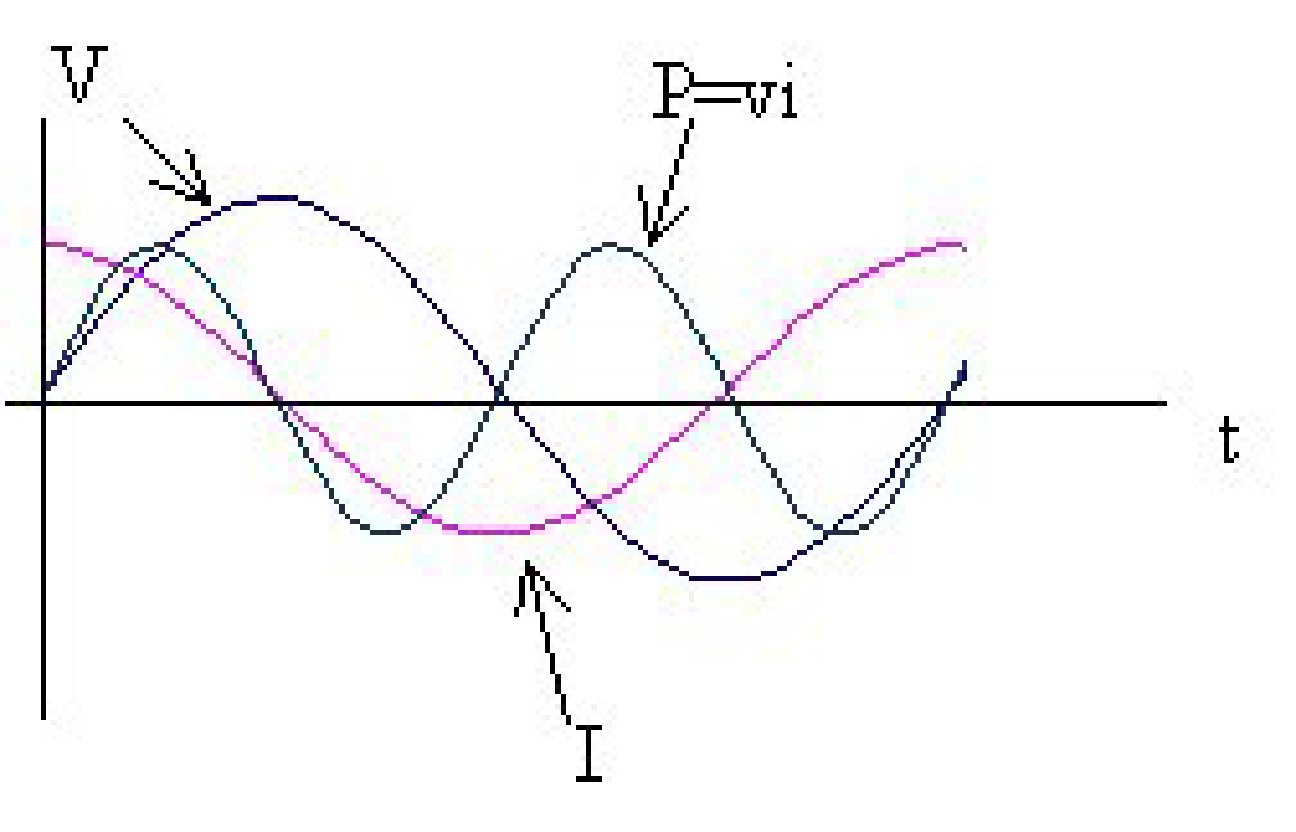
Power


Power Supplied
P=V x I
Voltage reaquired to force
current through resistor
V=I x R
I
V
R
Power transformed to heat
P= I 2 x R

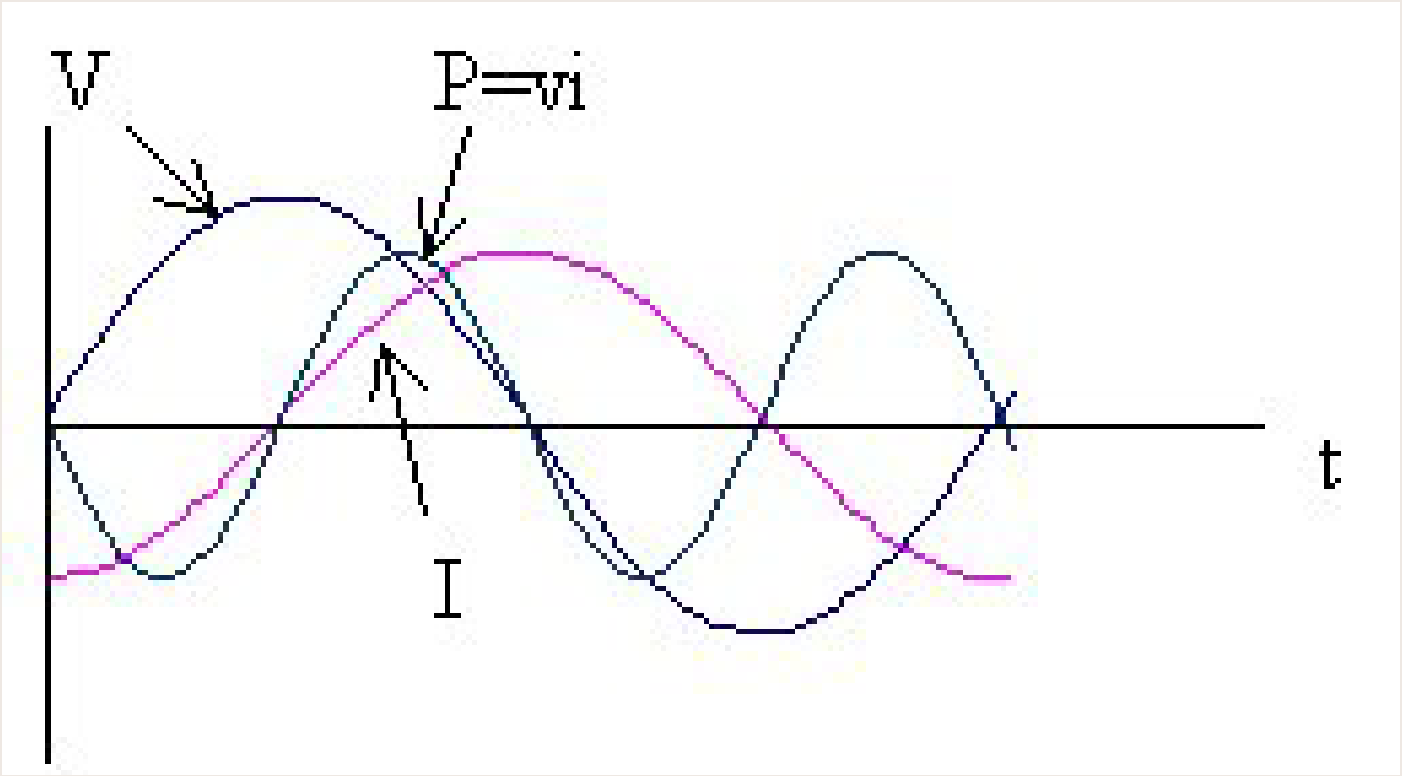
Power wave in a resistive circuit



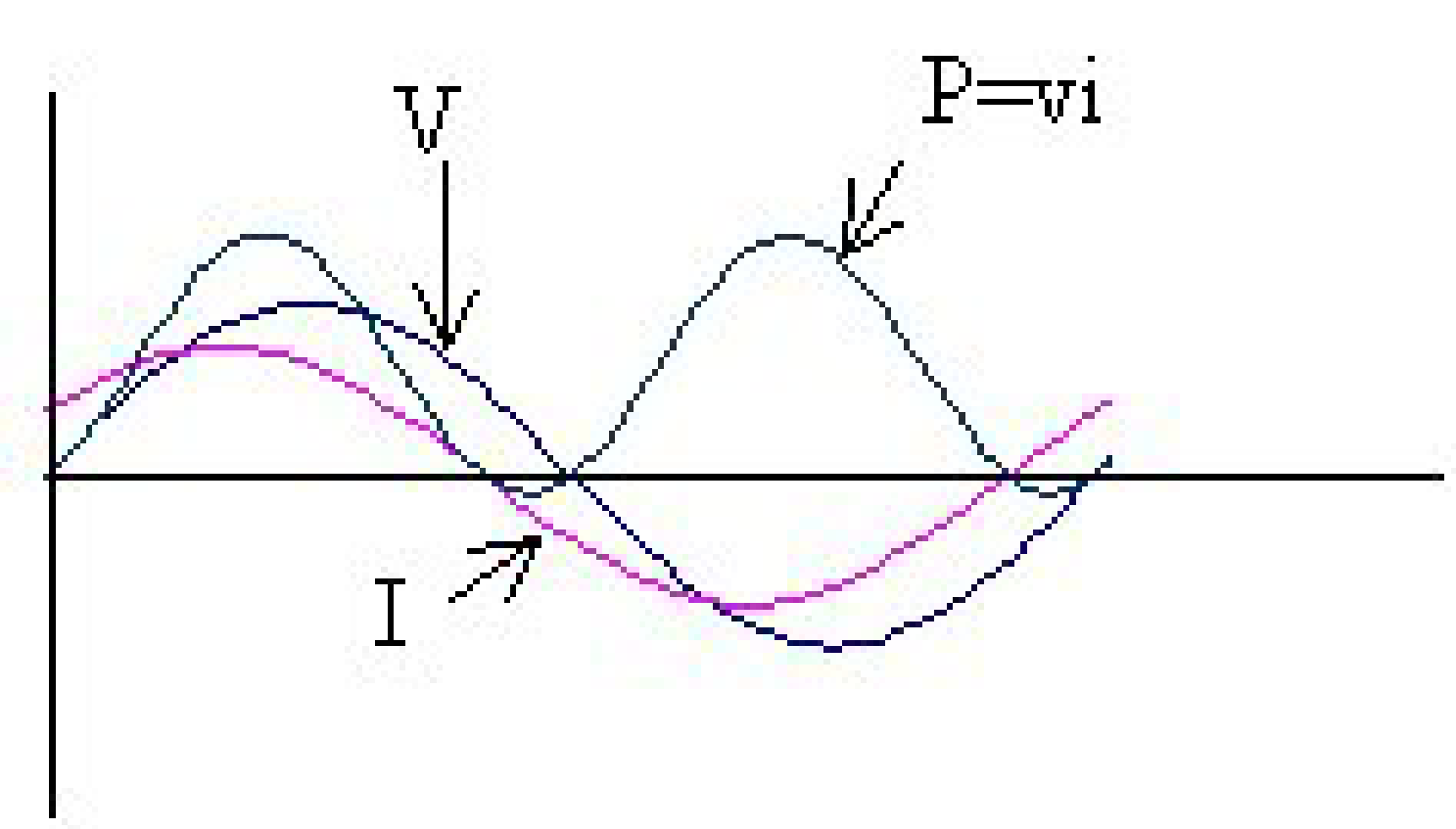
Power in a capacitive circuit



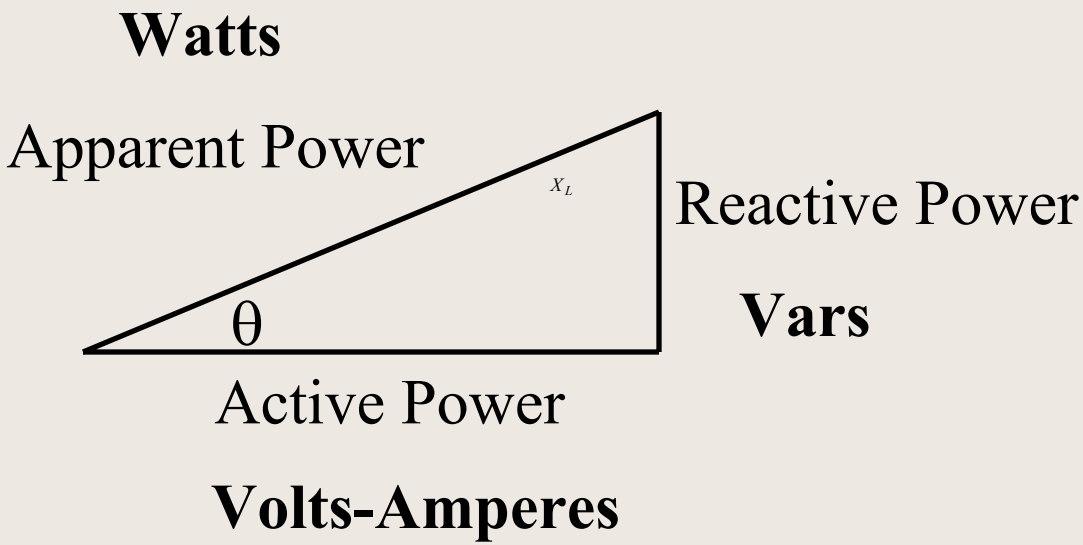
Power in an inductive circuit



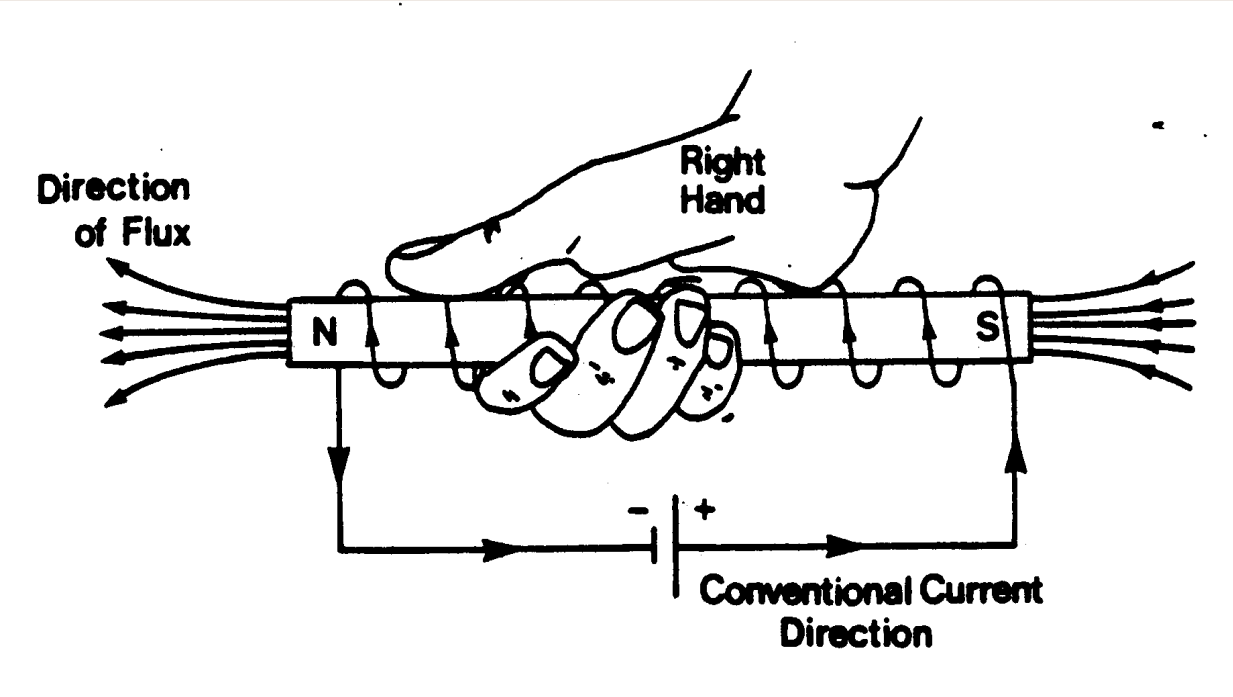
Power in a real circuit



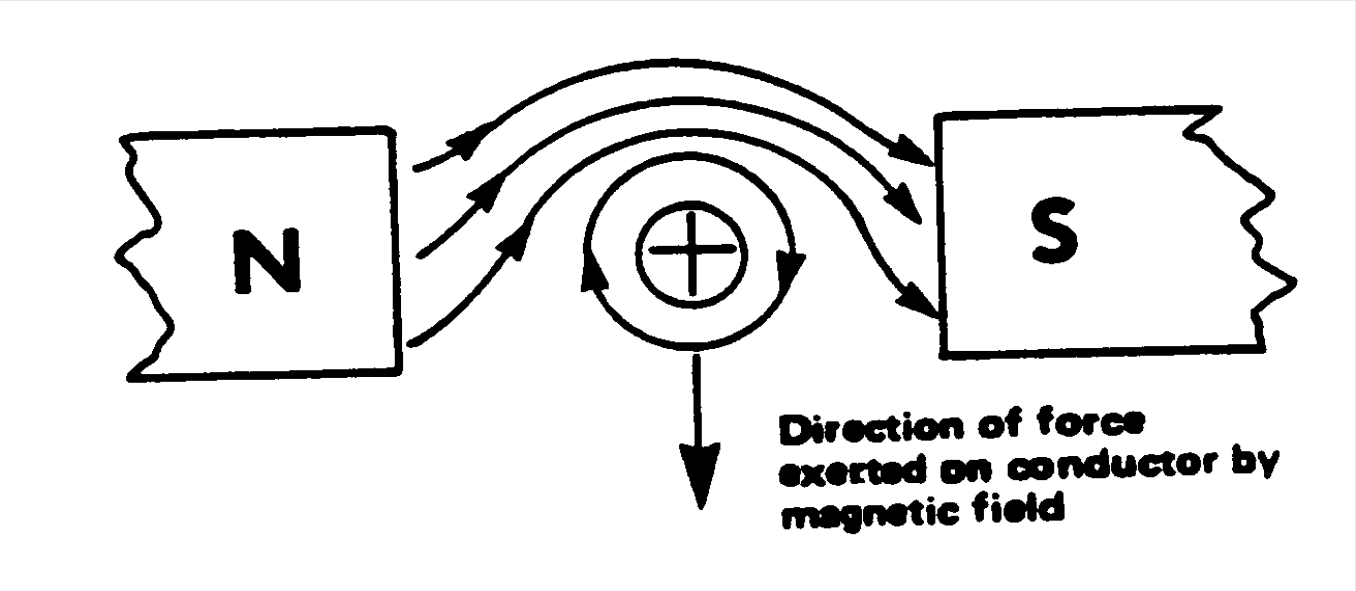
Power Triangle



Direction of magnetic field



Motor Action



Electromagnetic Induction

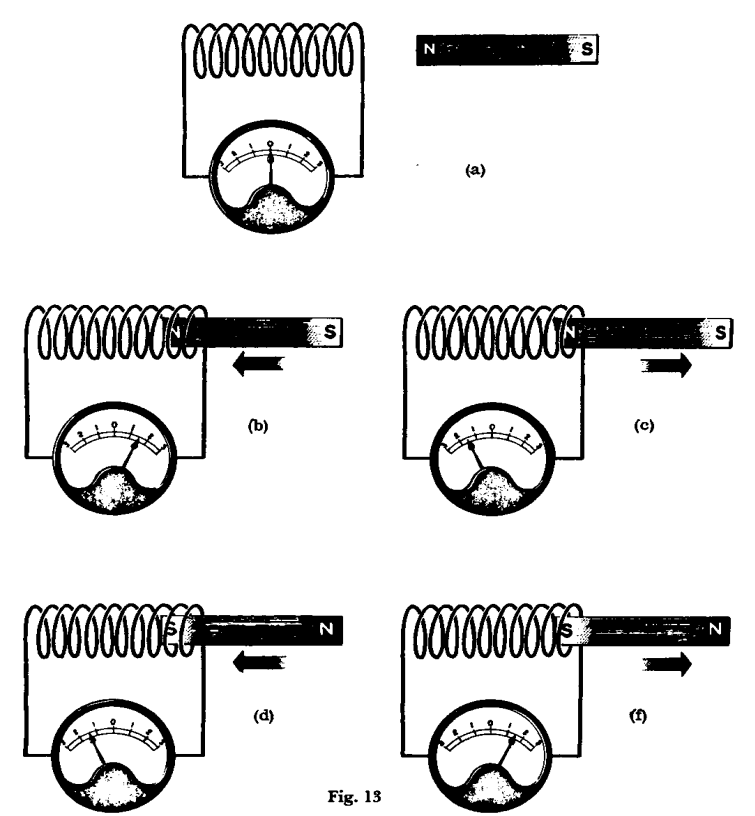
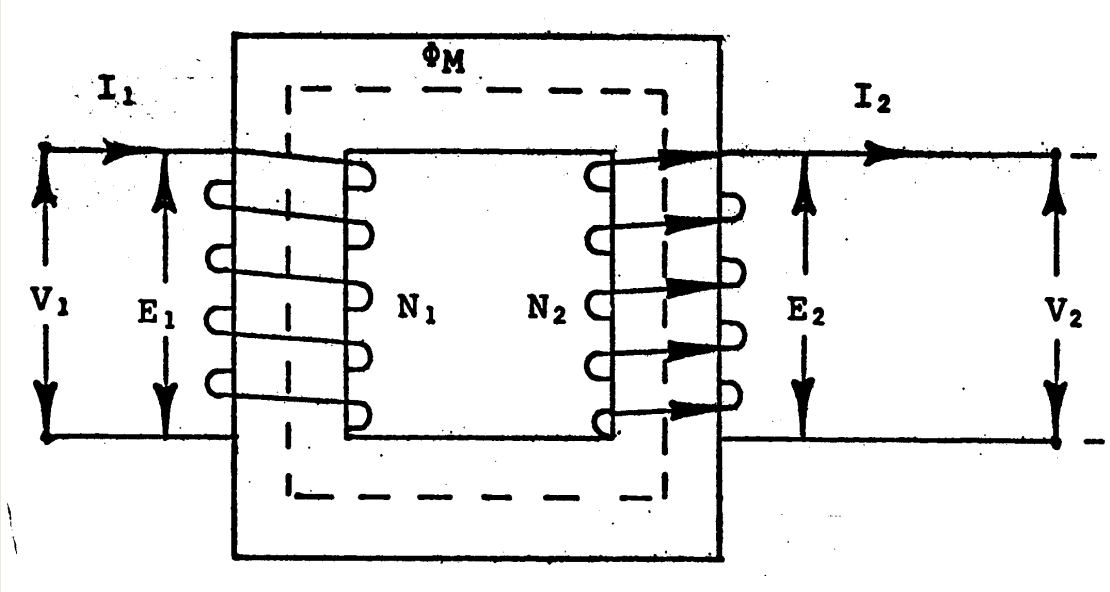
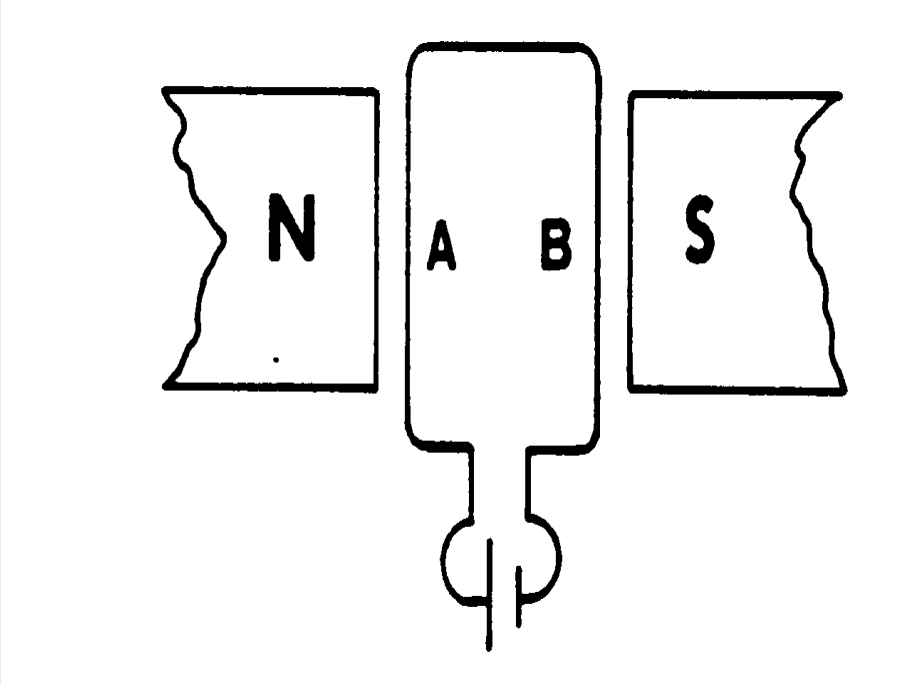


Fig. 13

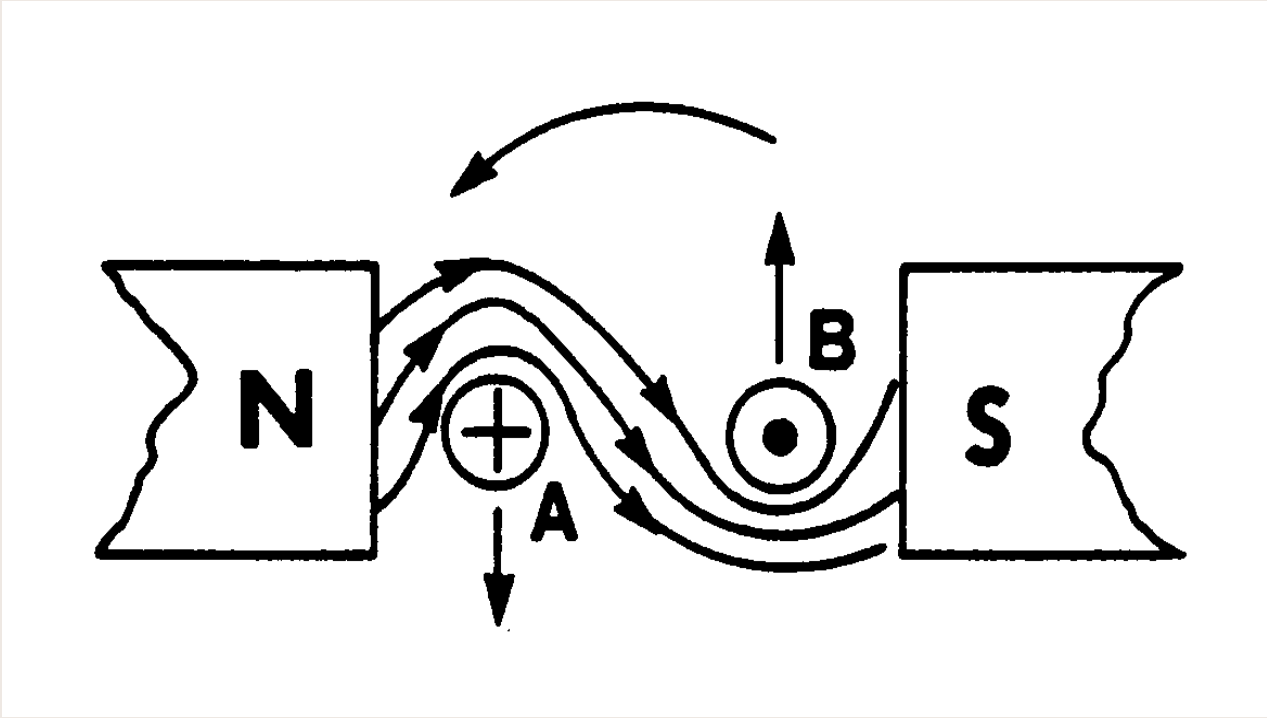
Transformer



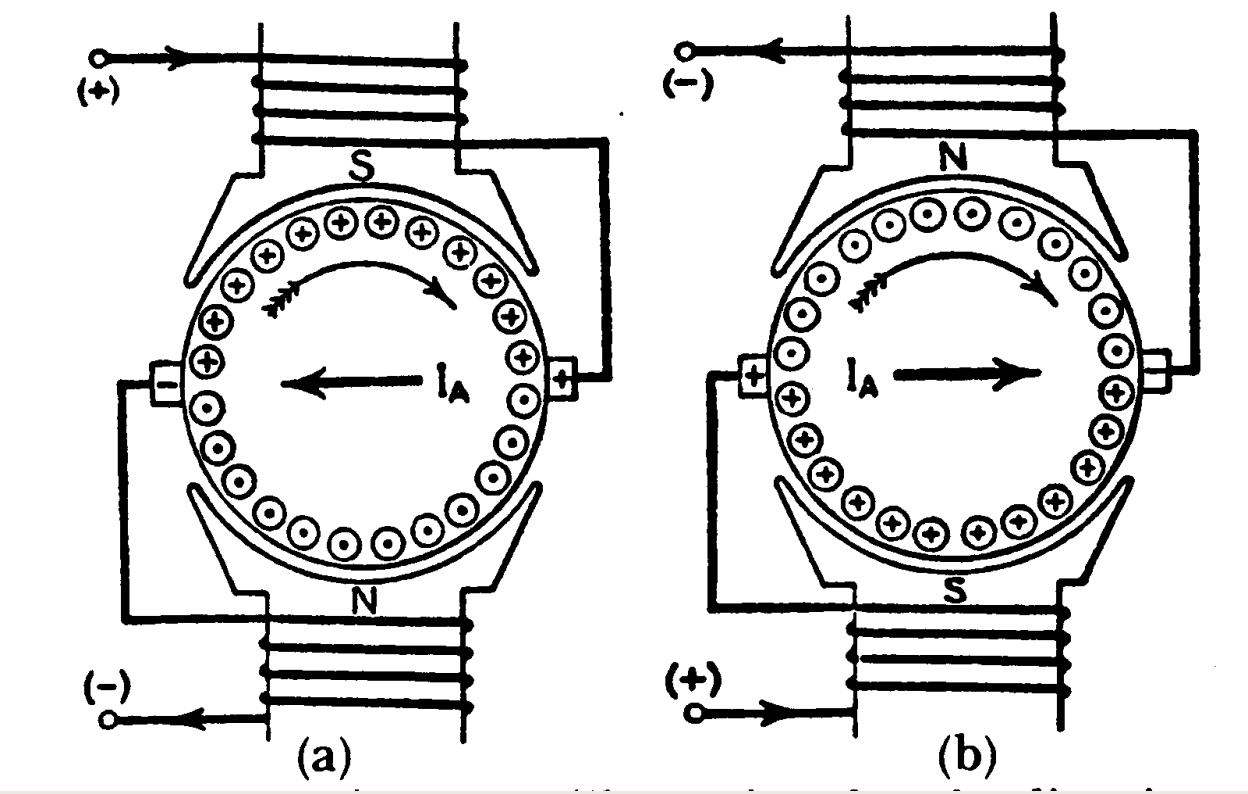
Motor



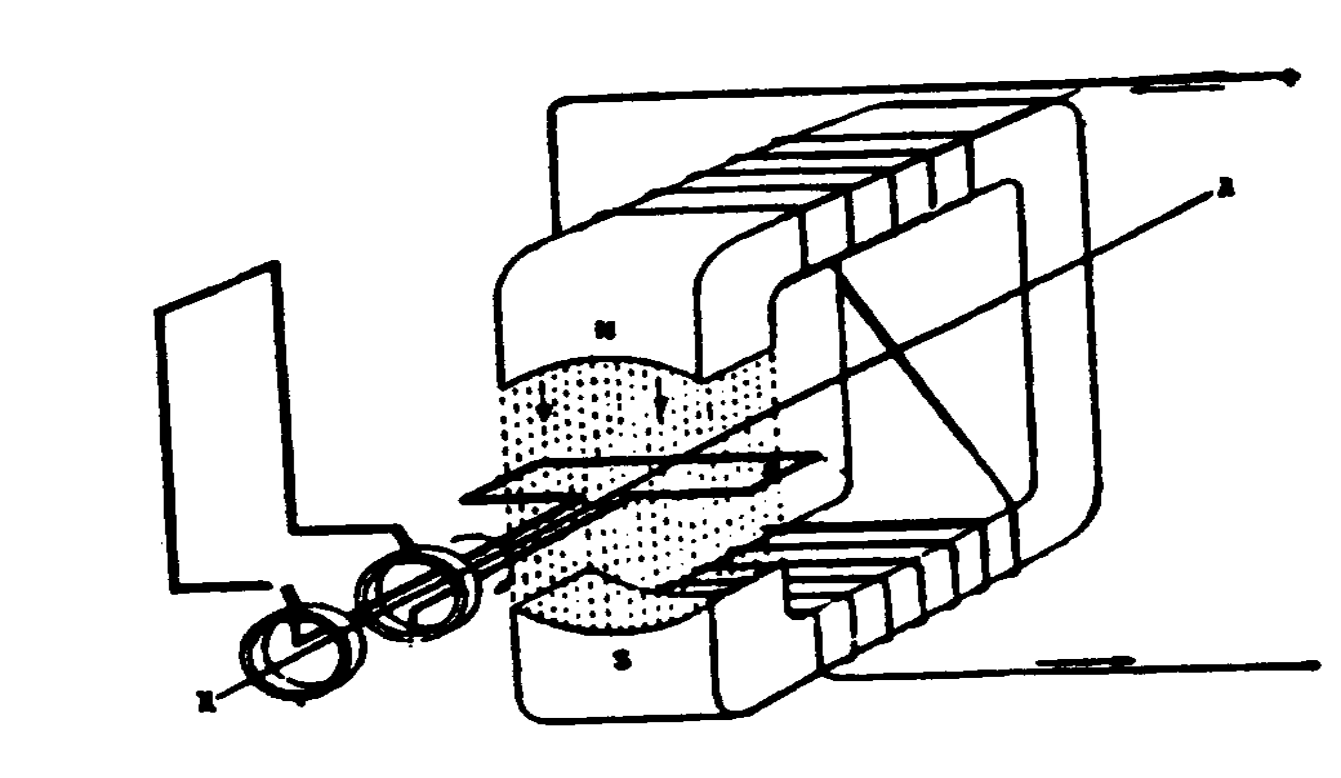
Motor



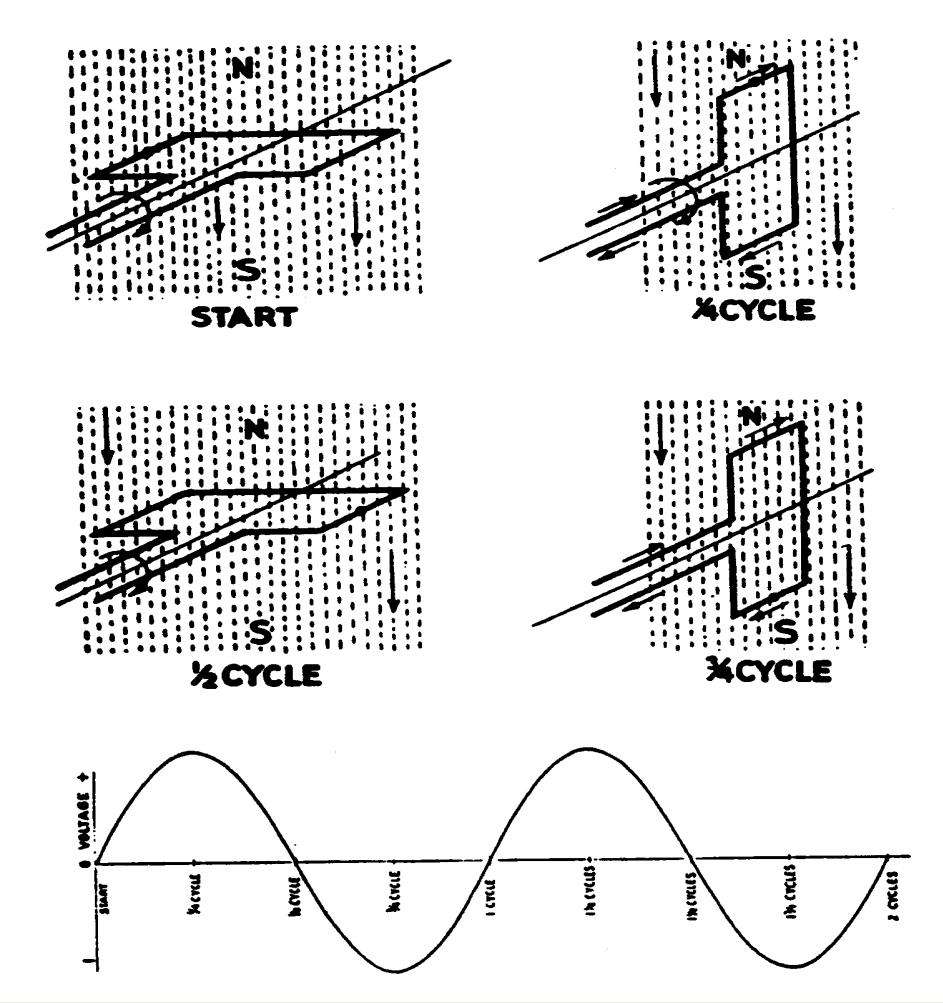
Series Motor



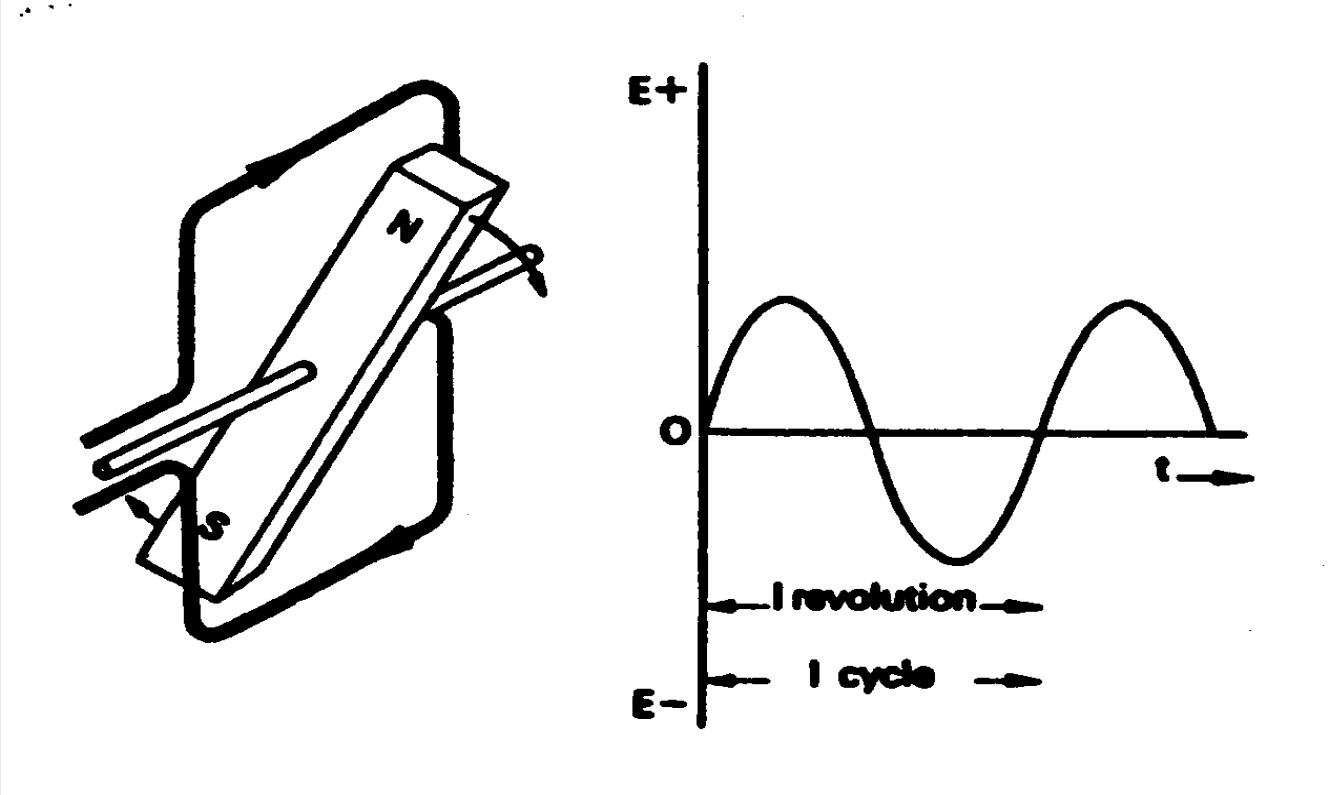
Basic Generator



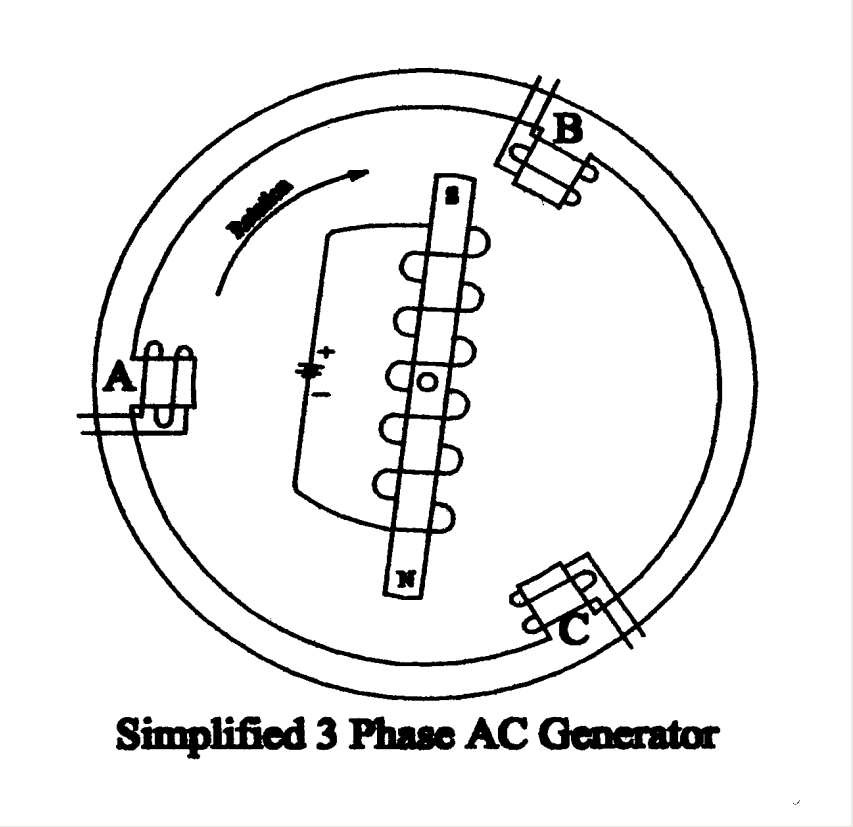
Generation of Sinusoidal Voltage



Spinning Magnet

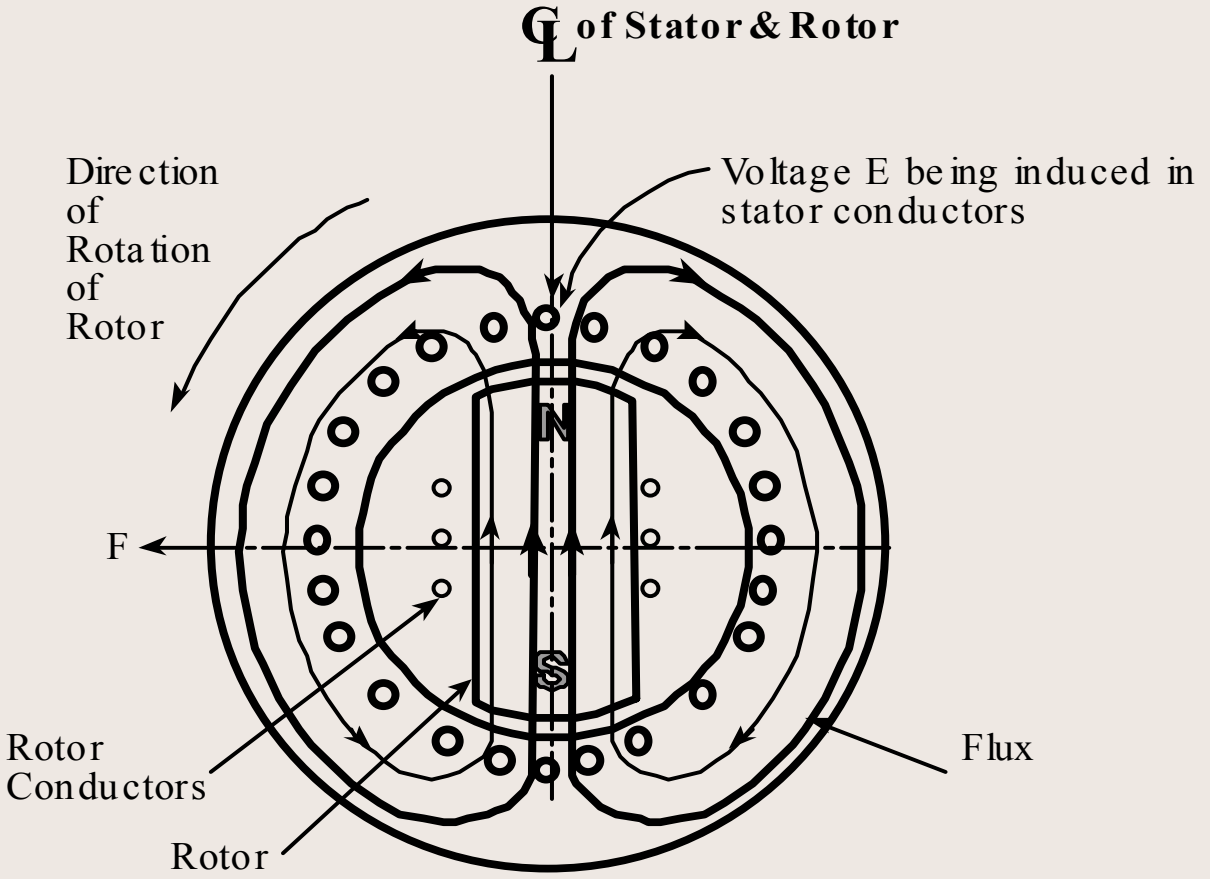


Three phase Generation

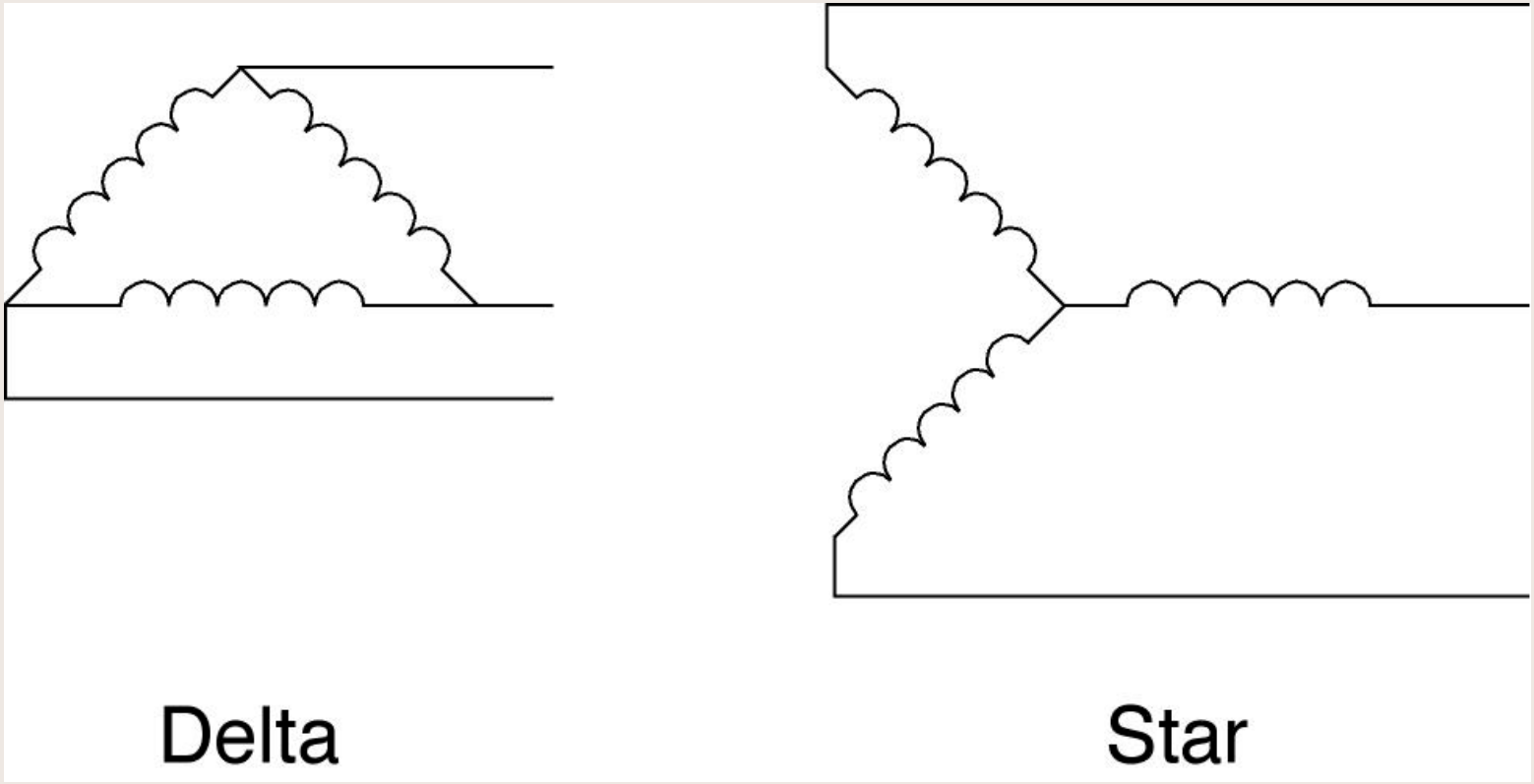


Simplified 3 Phase AC Generator

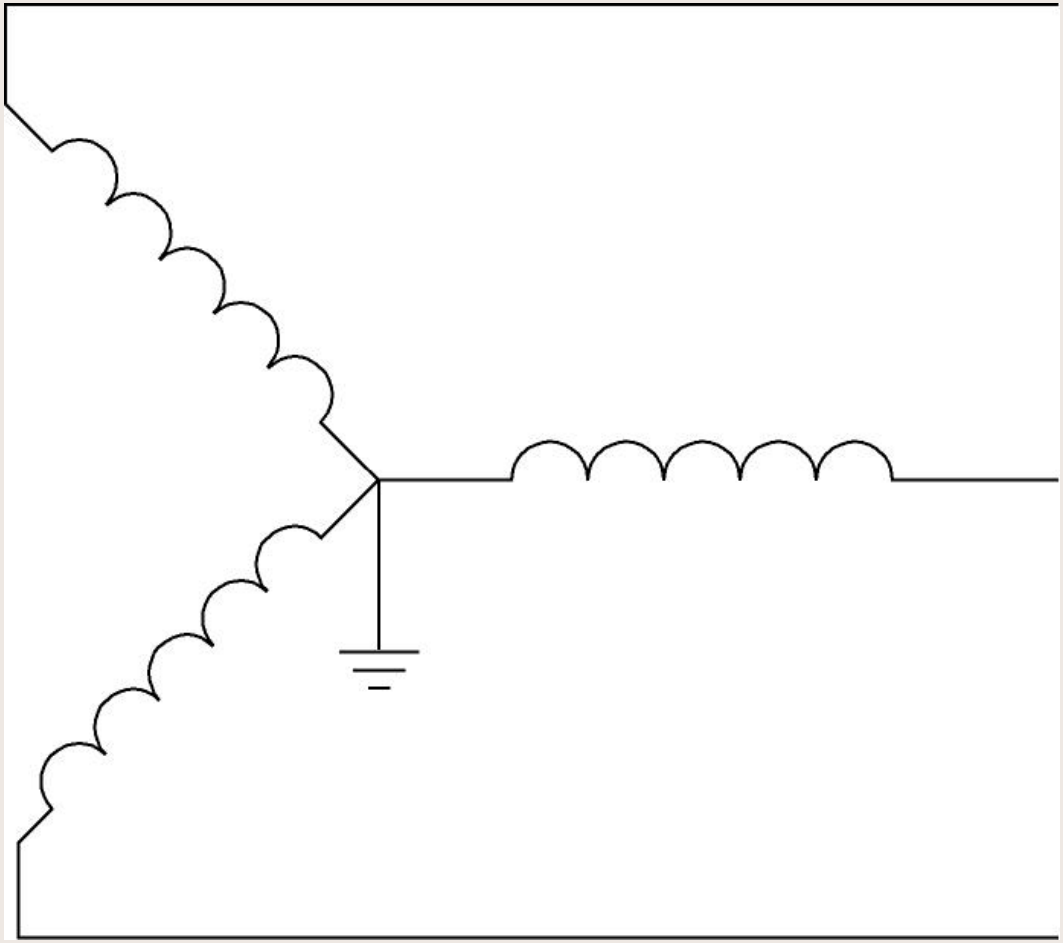
Field and Stator Windings



3 Phase Connections



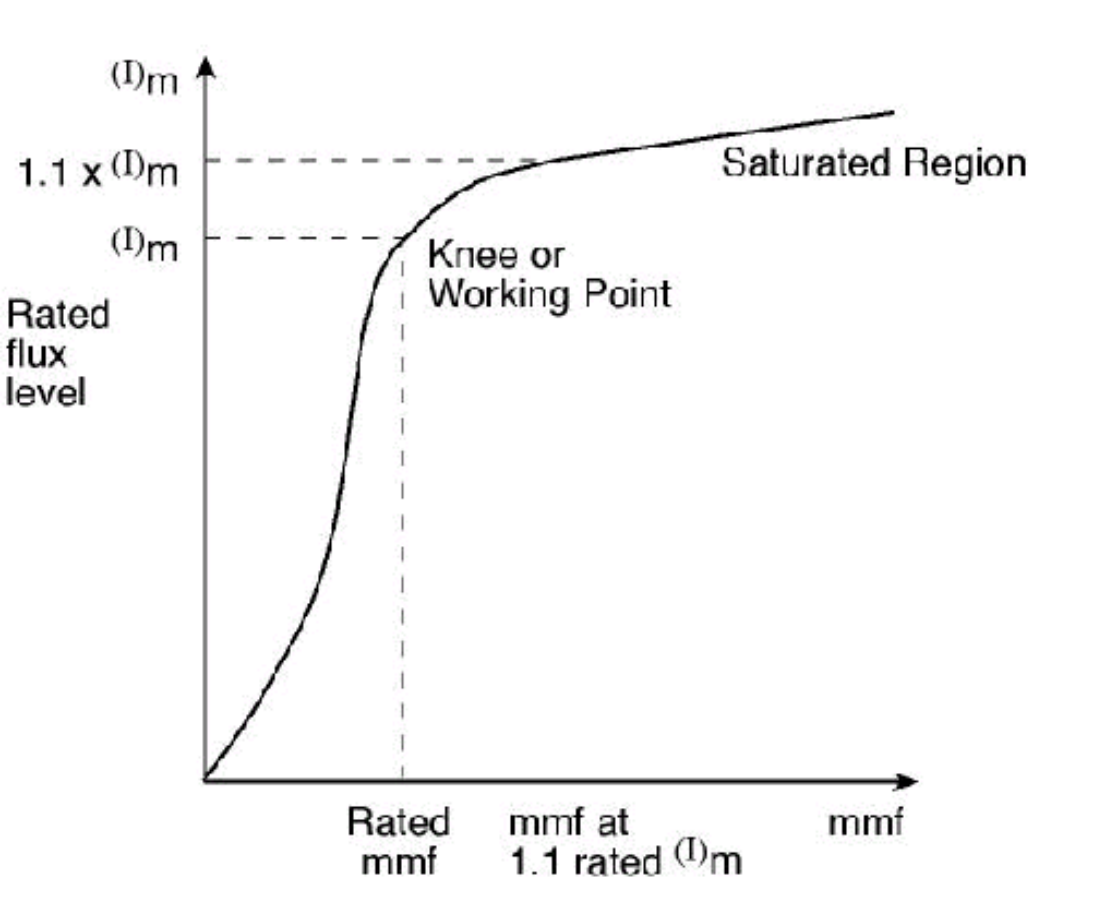
Grounded Star



Magnetic Circuit Losses

- Hysteresis
- Eddy currents

Saturation Curve



For you to do