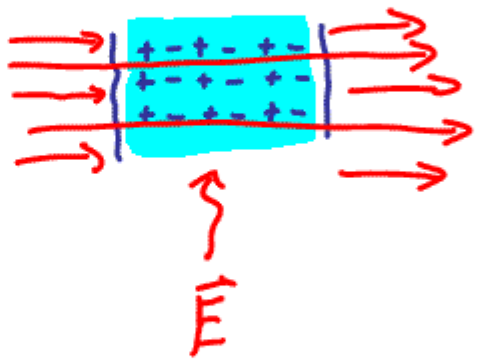
Physics 142 - October 4, 2005

Current Kirchoff's Laws

Exam 1 - Thurs. Oct 6, 2005 at 0800, B+L 109

Last Time -

- Dielectrics



$$\vec{E} = \frac{\vec{E}_0}{\kappa}$$

$\kappa \equiv$ dielectric CONSTANT > 1

$\frac{1}{\kappa} = \epsilon \equiv$ permittivity

- current

$$I \text{ or } i = \frac{dq}{dt}$$

+i is direction of + charge flow

- Resistance

$V = IR$ — Ohm's Law

R: Resistance

Impedes electrons "Looking" for love

Pass current thru resistor — Energy lost as heat or light

Power dissipated $\equiv P = iV = iiR = i^2R$ Mostly

$P = i^2R$

$V = iR$

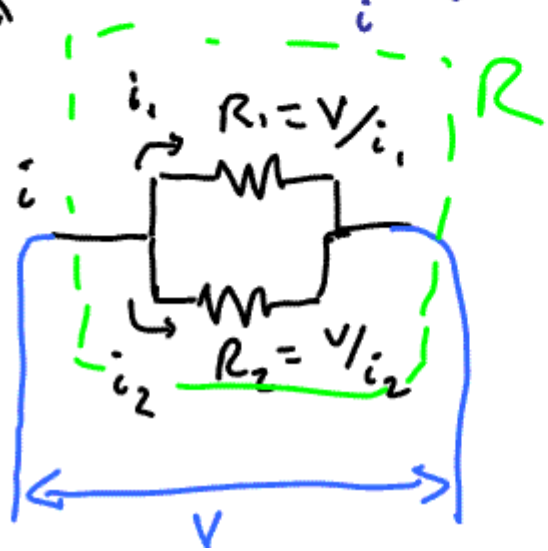
$i = V/R$

$P = \frac{V^2}{R}$

$$V = V_1 + V_2 + V_3 = iR_1 + iR_2 + iR_3 = i\underbrace{(R_1 + R_2 + R_3)}_{R}$$

Resistors in parallel

$$R = \sum R_i$$

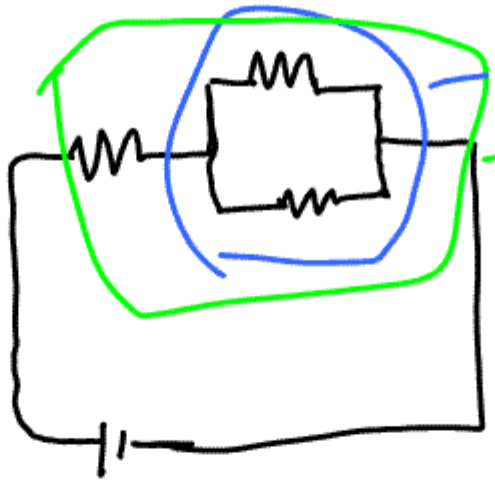


$$V = iR \qquad i = \frac{V}{R}$$

$$i = i_1 + i_2$$

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} \qquad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

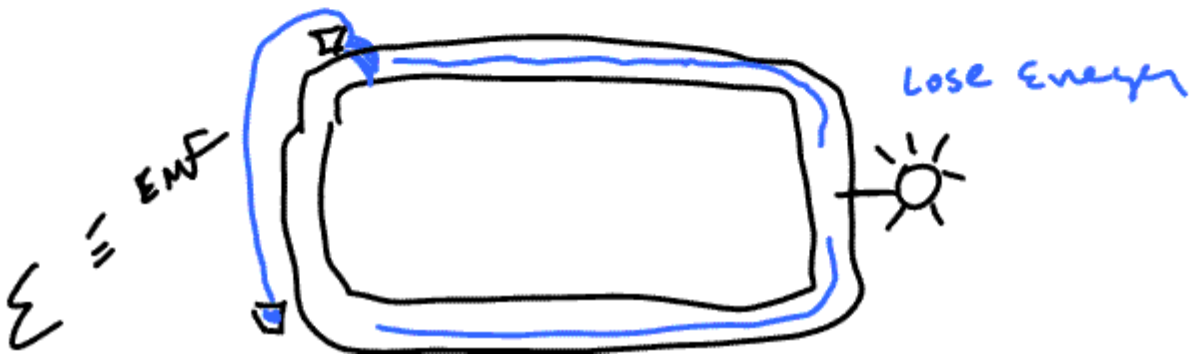
$$\frac{1}{R} = \sum \frac{1}{R_i}$$

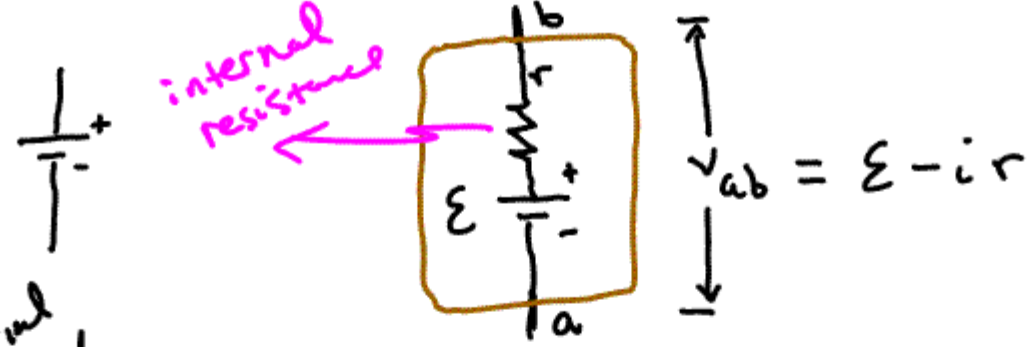


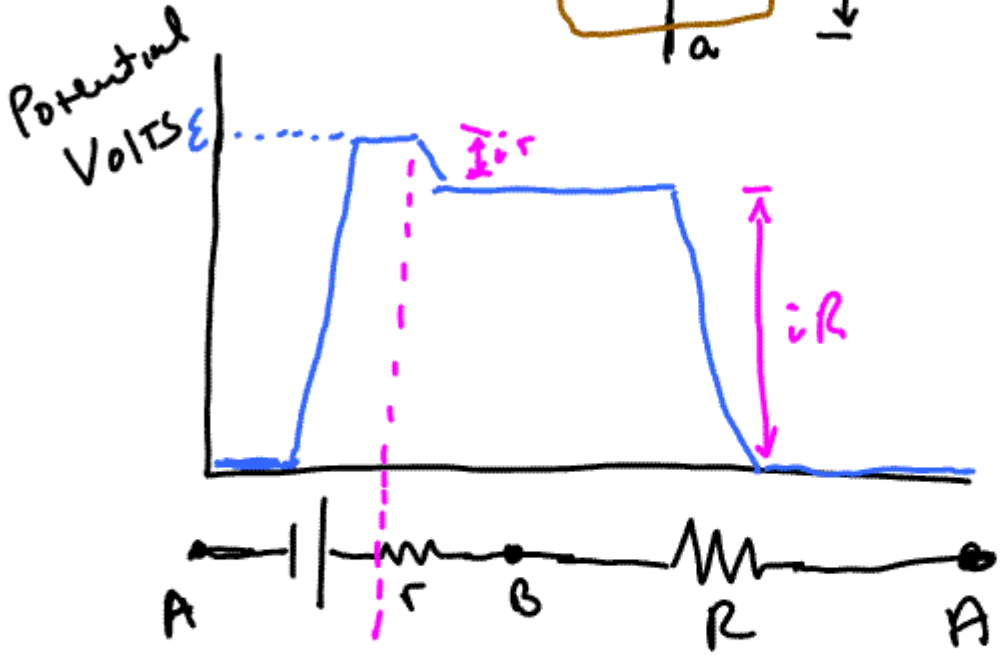
Batteries + EMF ≡ Electromotive force

Generators

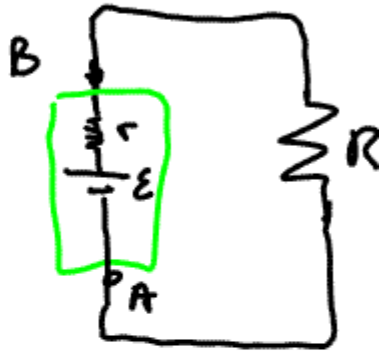
Maintain CONSTANT V across terminals







$V_A \equiv 0$



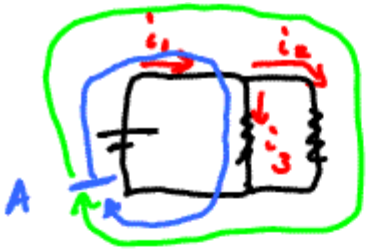
DC Circuits

└ Direct Current

V is STATIC

AC circuit

└ Alternating current } later



$$i_1 = i_2 + i_3$$

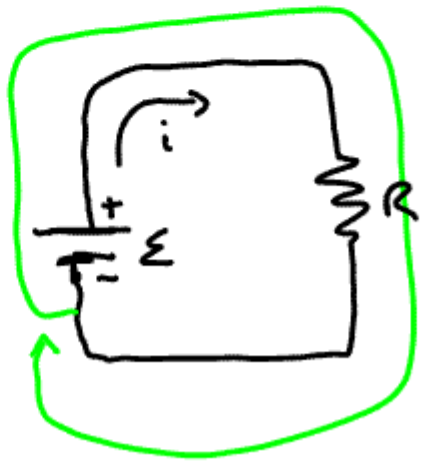
Kirchoff's rules:

1) When any closed-circuit loop is traversed, the algebraic sum of the changes in potential encountered along the way is zero.

2) At any point where current can divide, current is conserved.

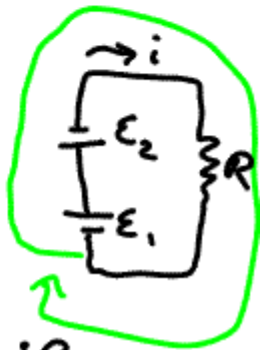
Conventions

ΣV across loop in circuit $= 0$



$$\mathcal{E} - iR = 0$$

$$\mathcal{E} = iR$$



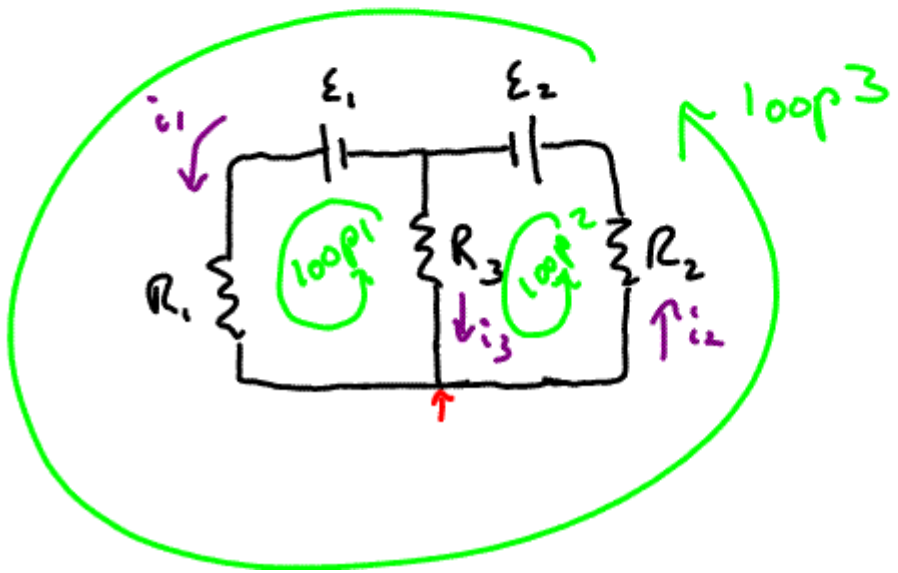
$$\mathcal{E}_1 - \mathcal{E}_2 - iR = 0$$

chosen loop

- Traverse $\mathcal{E}$ in direction of $\mathcal{E}$ → $\mathcal{E}$ is ⊕
- " " in opposite " " → $\mathcal{E}$ is ⊖

- Traverse R in direction of current thru resistor then "iR drop" or iR comes in as ⊖
- " R in opposite direction of current " "
  " " iR comes in as ⊕

Ohanian p 711 – Branch Method



KNOW $\mathcal{E}_1, \mathcal{E}_2$
R_1, R_2, R_3

WANT currents throughout circuit

K's second Law at red arrow

$$\Sigma i_i = i_1 + i_3 - i_2 = 0$$

1 eqn

K's 1st Law

loop 1 start lower left corner

$$i_3 R_3 + \mathcal{E}_1 - i_1 R_1 = 0$$

Eqn 2

Loop 2

$$-\mathcal{E}_2 - i_3 R_3 - i_2 R_2 = 0$$

Eqn 3