Physics 142 - October 5, 2010

- Exam I - 0800 Thursday B+L 109
- Q+A session Today, B+L 106, 4:30 pm

Last Time

Energy Stored in a Capacitor

$$U = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}QV$$

general Result

Energy Density in $\vec{E}$ field

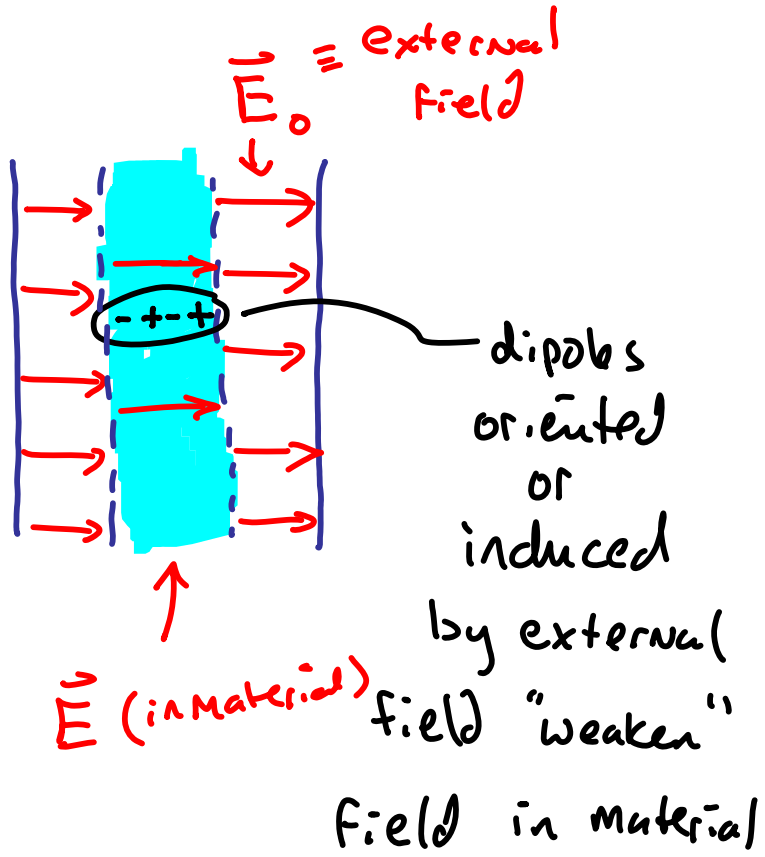
$$\mathcal{U}_E = \frac{\epsilon_0}{2}|E|^2$$

Energy density in Electric field $\quad \mathcal{U}_E = \frac{\epsilon_0}{2}|\vec{E}|^2$

if know $\vec{E}$

$$U = \int_{Vol} \mathcal{U}_E \, dV$$

(linear) Dielectrics
$\vec{E}$ in materials



$$\vec{E} = \frac{\vec{E}_o}{K}$$

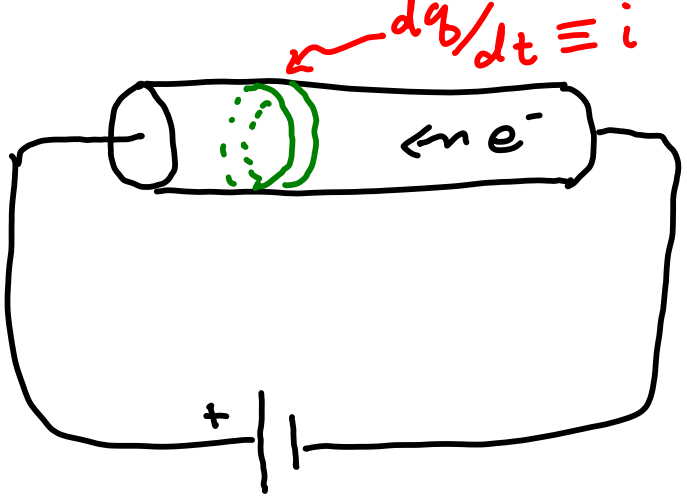
$K \equiv$ Dielectric constant

$K > 1$

K material dependent

$\frac{1}{K} \equiv \epsilon \equiv$ permittivity

Currents and Resistance



+ current flow is direction + charge would move

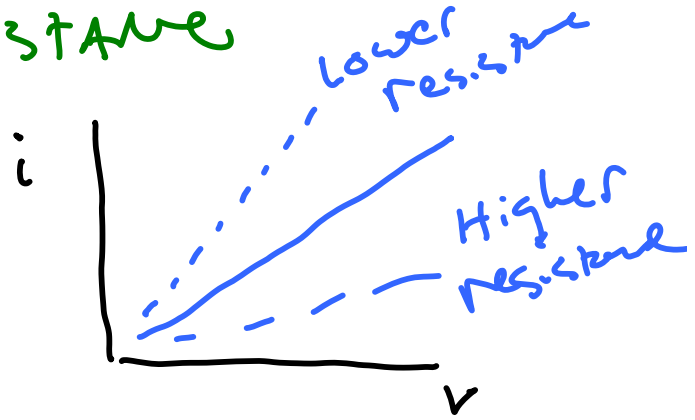
"Resistance" impedes electrons looking for love

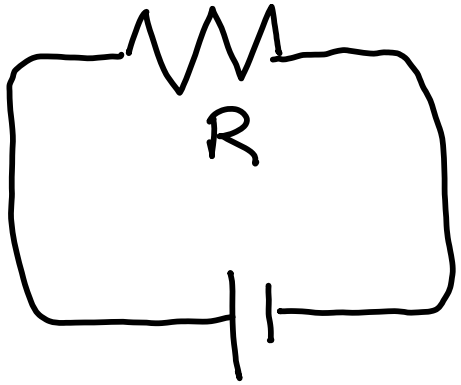
$i \equiv \frac{dq}{dt}$ in units $\frac{\text{Coul}}{\text{sec}} \equiv$ Ampere

$i \propto V$

$V = iR$ ≡ Resistance

Ohm's law





$\mathcal{E}$ or V

R units are ohms

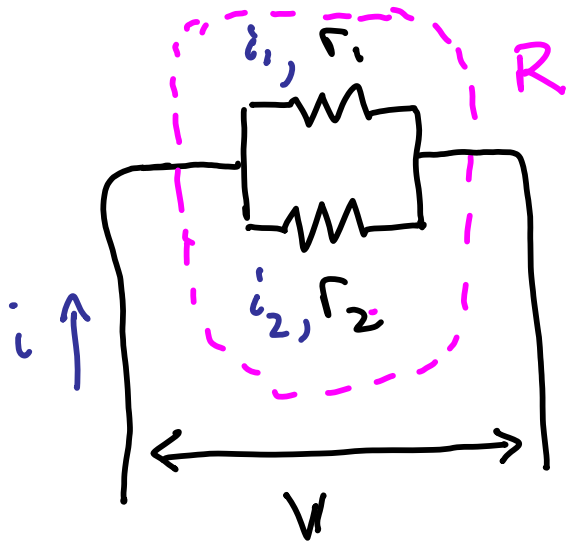
$V = W/q$

$W = qV$

$V = iR$

$\text{Power} = \frac{dW}{dt} = dq/dt\, V = iV$

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



Resistors in Parallel

$$V = i_1 r_1$$

$$V = i_2 r_2$$

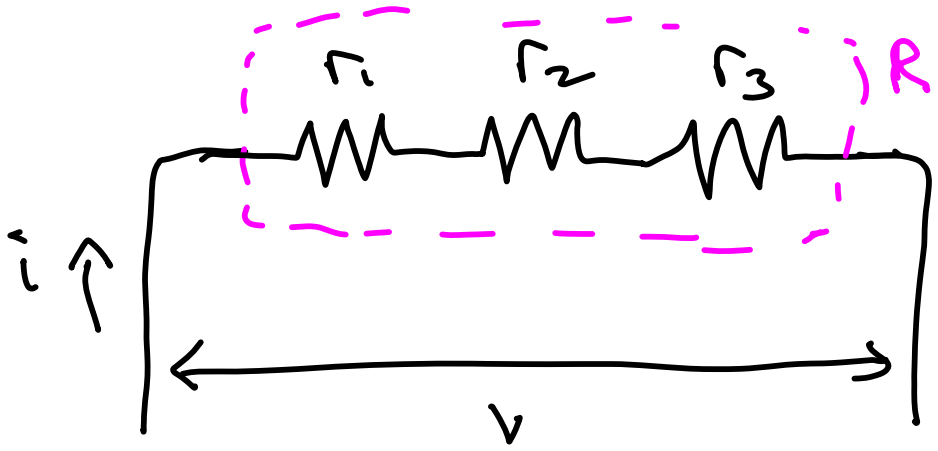
$$V = i R$$

$$i = i_1 + i_2$$

$$i = i_1 + i_2$$

$$\frac{V}{R} = \frac{V}{r_1} + \frac{V}{r_2} \longrightarrow \frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$$

$$\frac{1}{R} = \sum_i \frac{1}{r_i}$$



Resistors in series

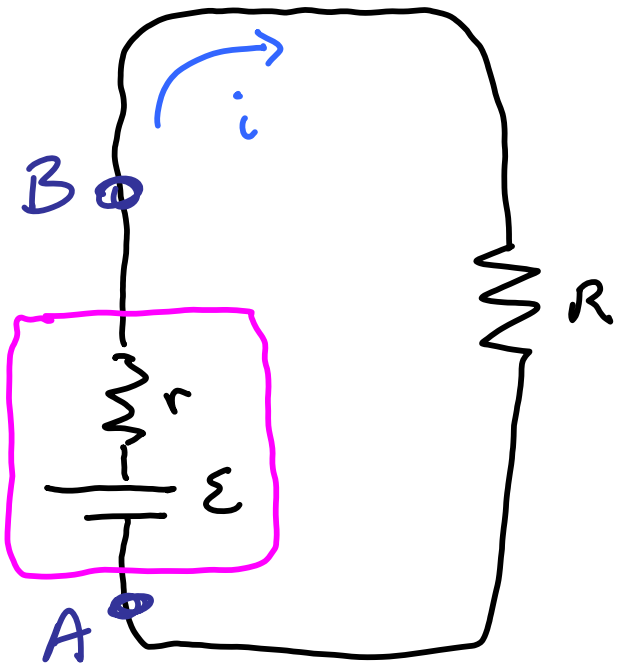
$$R = \sum_i r_i$$

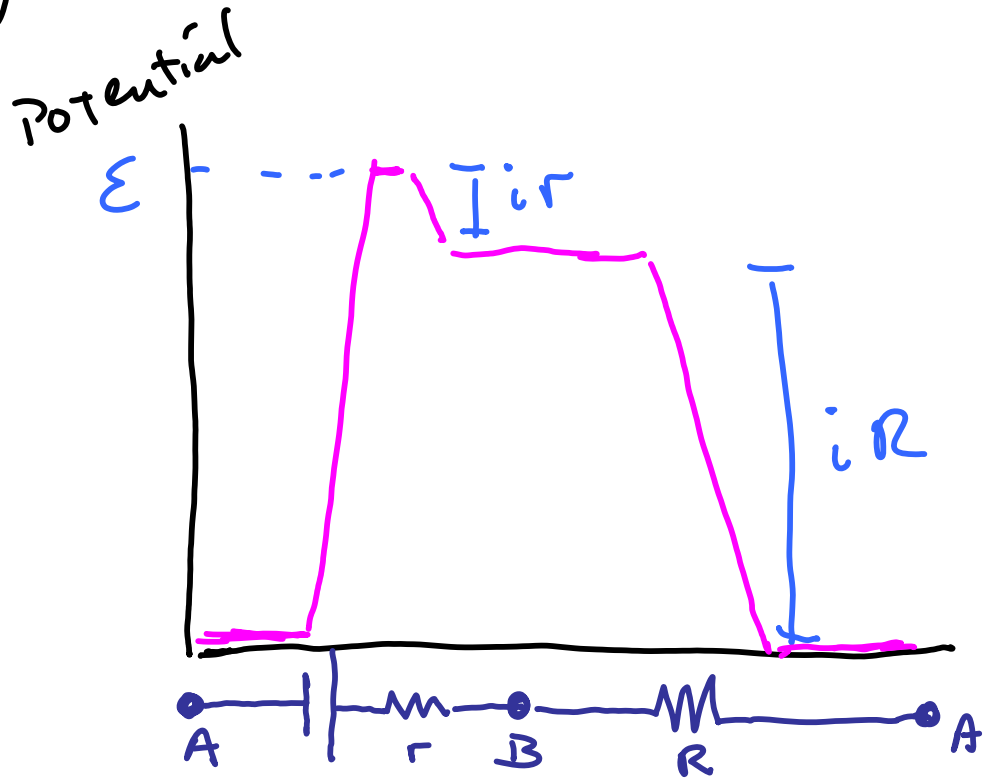
$$V = iR$$

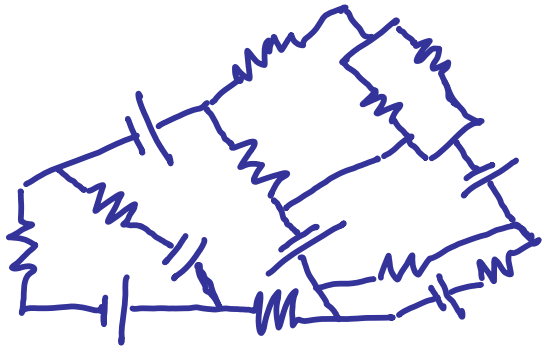
$$V = V_1 + V_2 + V_3$$

$$iR = ir_1 + ir_2 + ir_3$$

$$R = r_1 + r_2 + r_3$$


i
B
R
r
ε
A


Potential
ε
i r
i R
A
r
B
R
A



Suppose you meet a circuit in a dark Alley one night...

...And the electrons ARE NOT looking for love...

Kirchoff's Rules:

1. $\Sigma V = 0$ around closed loop in circuit
2. Current is conserved at any BRANCH point in circuit

- use these rules to create N independent equations to solve for N unknowns

- Choose independent loops
- Use sign conventions consistently + with care

Convention [told this is opposite that of ECE 210]

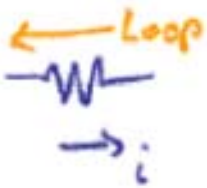
↳ No matter if Consistent

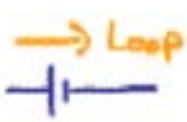
Choose currents in each branch (arbitrary)

Sum ΔV across each circuit component as you go around an imaginary closed loop in the circuit

$\Delta V -$ if 

$\mathcal{E} +$ if 

$\Delta V +$ if 

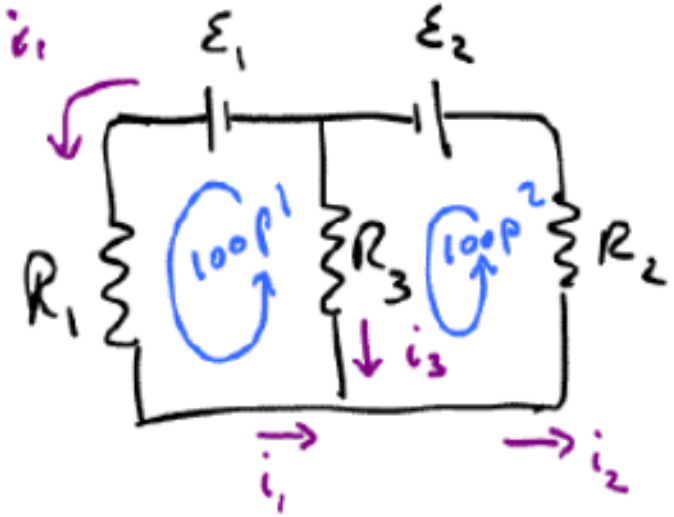
$\mathcal{E} -$ if 

Get N eqns, N unknowns and Solve

Tedious → must be careful and consistent

↳ Conventions and Signs

Use only independent loops



Know $\mathcal{E}_1, \mathcal{E}_2$

R_1, R_2, R_3

Solve for current thruout circuit

Kirchoff's 2ND rule $i_1 + i_3 = i_2$ (I)

$$\mathcal{E}_1 - i_1 R_1 + i_3 R_3 = 0 \quad \text{(II)}$$

$$-i_3 R_3 - i_2 R_2 - \mathcal{E}_2 = 0 \quad \text{(III)}$$