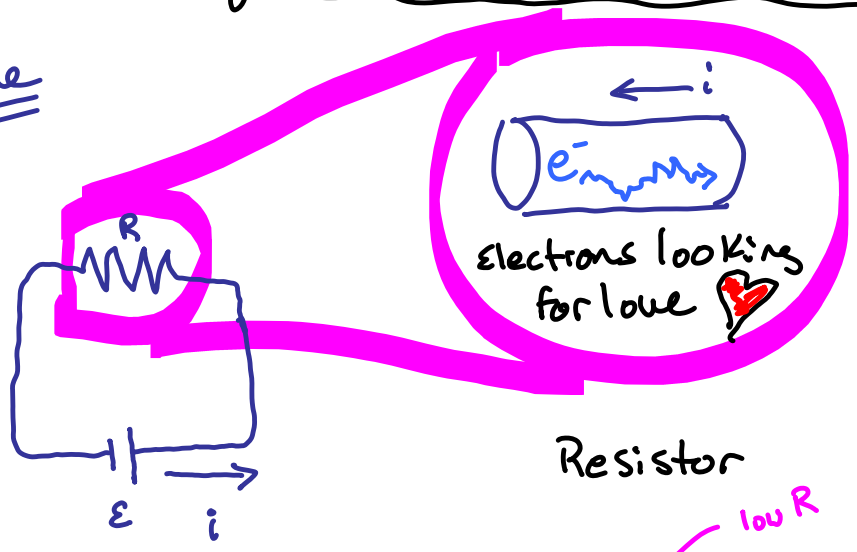
Physics 114 – February 26, 2015

Last Time

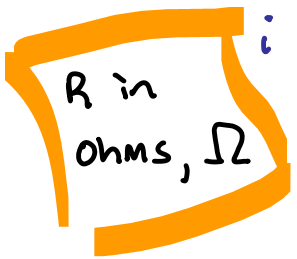


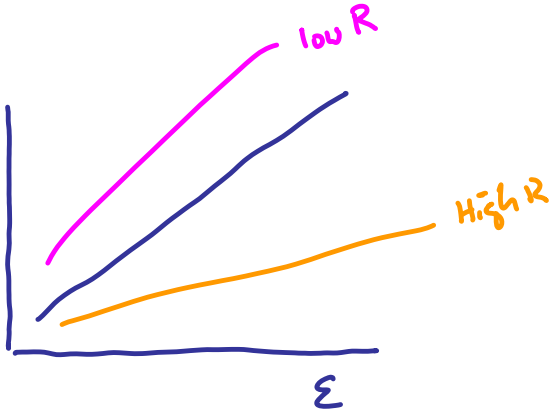
Resistor

Resistance

$\mathcal{E} = iR$

$\begin{pmatrix} \mathcal{E} \\ V \end{pmatrix} = \begin{pmatrix} i \\ I \end{pmatrix} \begin{pmatrix} R \\ r \end{pmatrix}$





Current, i or I, Amperes $\equiv A \equiv$ Coul/sec

$$I = dq/dt$$

$$V = iR$$

$$P = iV = i^2 R = V^2/R$$

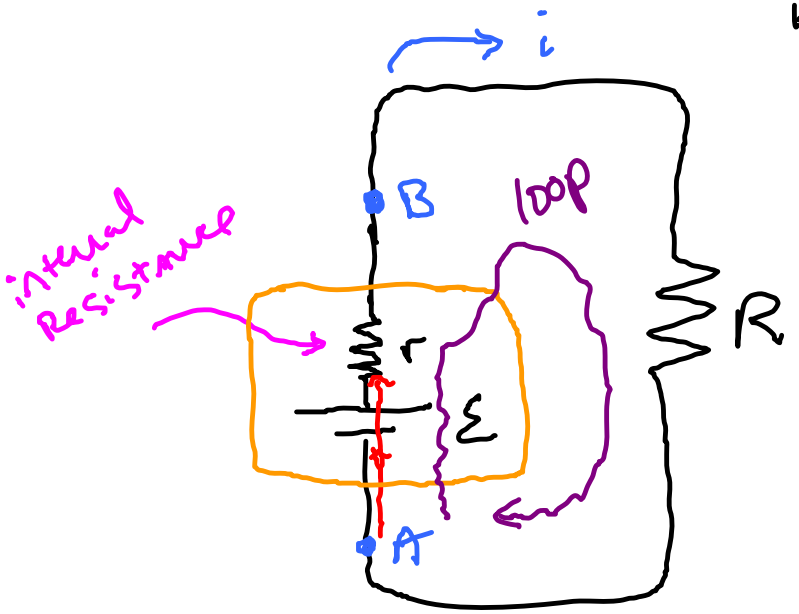
Resistors in series

$$R = \sum_i r_i$$

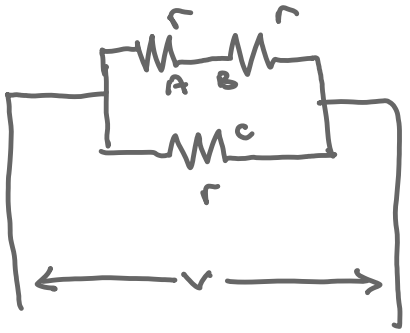
Resistors in parallel

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

How the potential changes as we
Move around a closed loop in the circuit

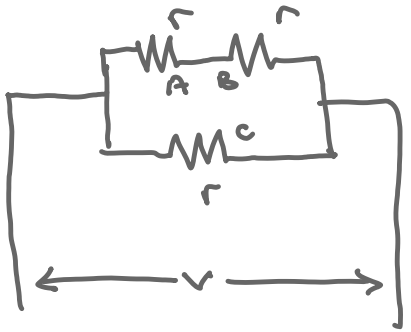


Define $V_A = 0$



3 lightbulbs Arranged as shown

order the brightness of the Bulbs

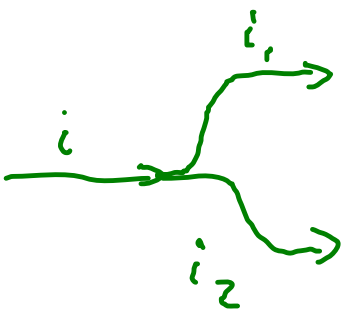


3 lightbulbs arranged as shown

order the brightness of the Bulbs

Brightness ordering

C > A = B



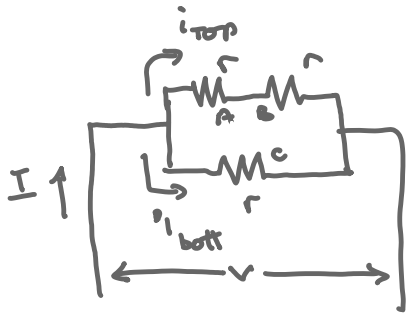
i same in A, B

$P = i^2 r = Vi$

$\frac{V^2}{4r}$

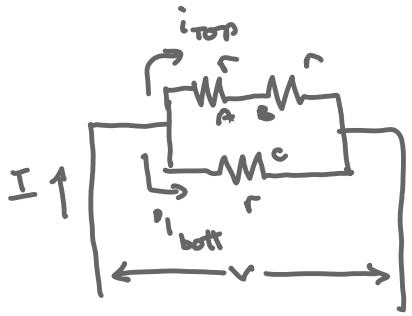
Top $V = i(2r)$ $i_t = \frac{V}{2r}$ $P = \frac{V^2}{4r^2} r$

Bot $V = i r$ $i_b = \frac{V}{r}$ $P = \frac{V^2}{r}$



3 lightbulbs arranged as shown

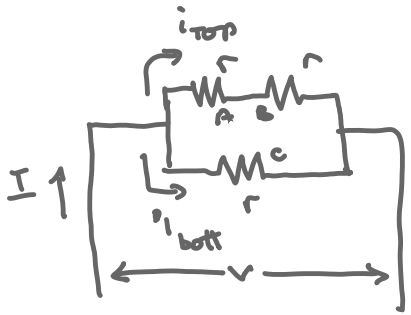
What happens to the brightness of C if bulb A is unscrewed



3 lightbulbs arranged as shown

What happens to the brightness of C if bulb A is unscrewed

Does what ?

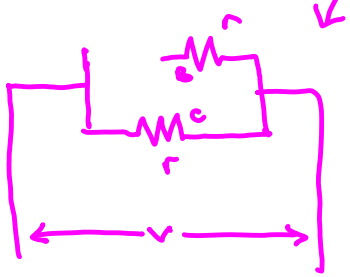


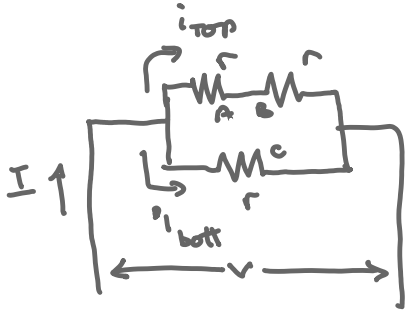
3 lightbulbs arranged as shown

What happens to the brightness of C if bulb A is unscrewed

Means

Becomes

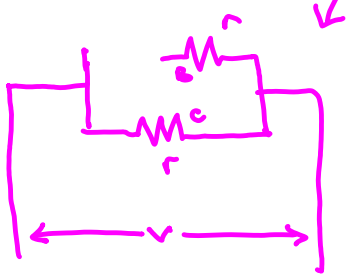




3 lightbulbs arranged as shown

What happens to the brightness of C if bulb A is unscrewed

Becomes



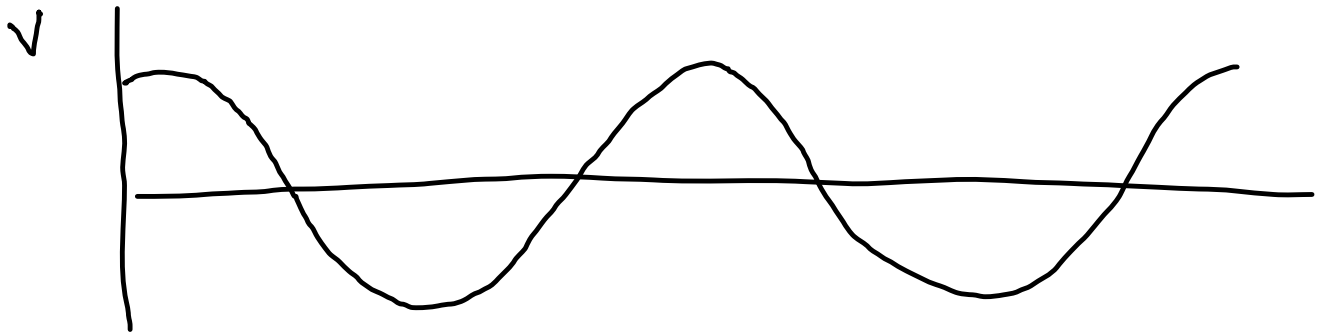
Means that part of circuit is broken

V across bulb C is unchanged → i through bottom branch is unchanged → Brightness of C is unchanged

Current no longer flows thru top branch

R in circuit changes, total I changes → $I = i_{top} + i_{bott} \rightarrow I = i_{bott}$

Direct current — DC $\mathcal{E}$ fixed and unchanging



60 Hz

Alternating current AC

Kirchoff's Rules

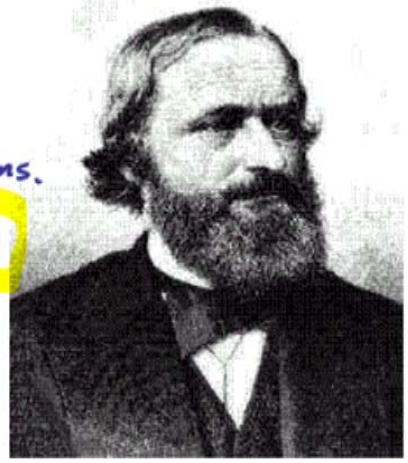
① $\Sigma V = 0$ around closed loop

② $\Sigma i = 0$ at junctions

Gustav Robert Kirchoff
Germany (1824-1887)

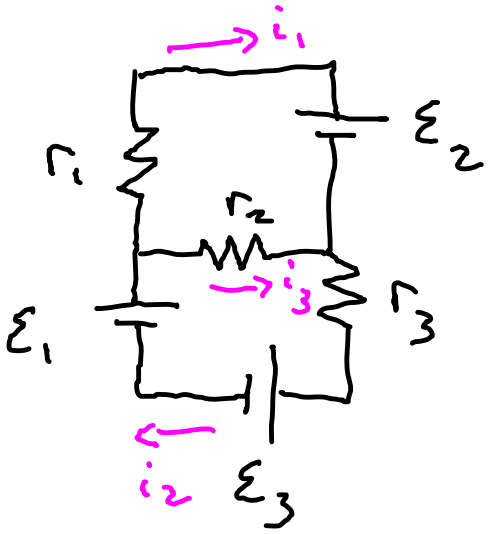
Apply to independent loops and junctions.
Derive N independent eqns
can solve for N indep. unknowns.

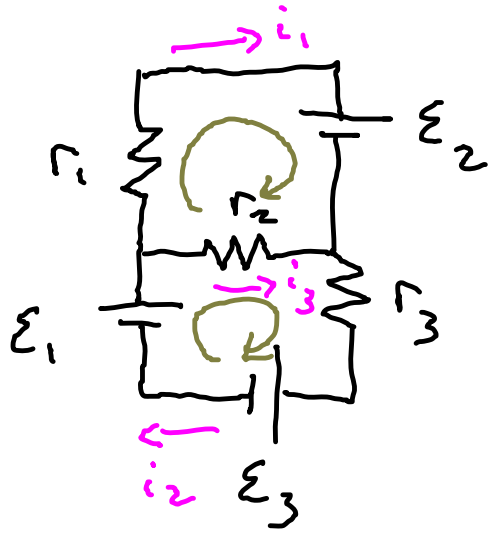
guts + Conventions + Consistency



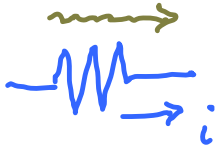
determined Kirchoff's laws at age 21

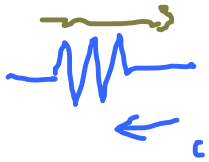
played for ZZ Top in the early days

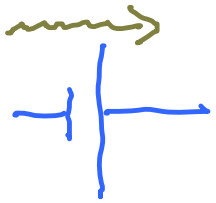




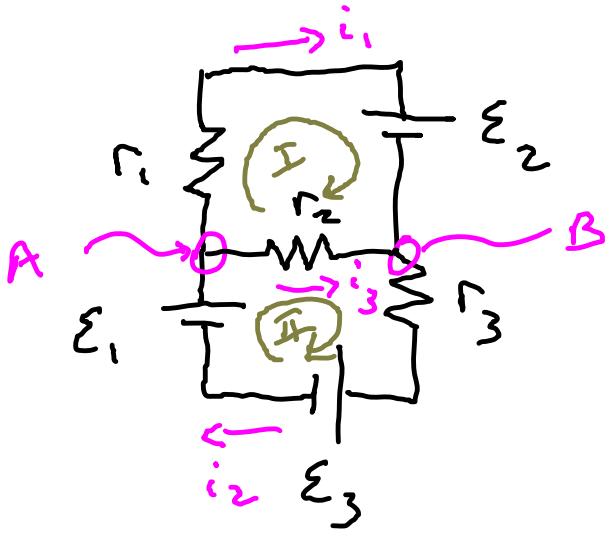
Sum ΔV as walk around each loop

ΔV is $-$ if 

ΔV is $+$ if 

ΔV is + if 

ΔV is − if 



$\sum_{\text{junction}} i = 0$

junction A

$i_2 - i_1 - i_3 = 0$

$i_2 = i_1 + i_3$

junction B NOT indep info

$\Delta V = 0$ for loop I

$-i_1 r_1 - \mathcal{E}_2 + i_3 r_2 = 0$

Loop II

$\mathcal{E}_1 - i_3 r_2 - i_2 r_3 - \mathcal{E}_3 = 0$