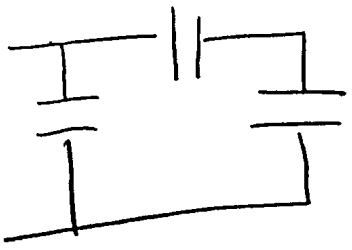
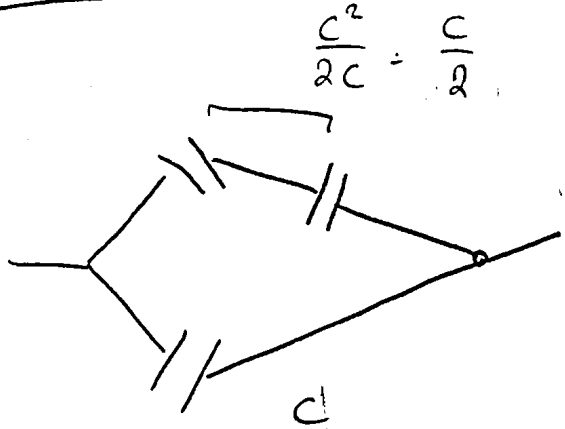
PY 202 Ch. 25, 3-5 for Wed

Quiz

1) 



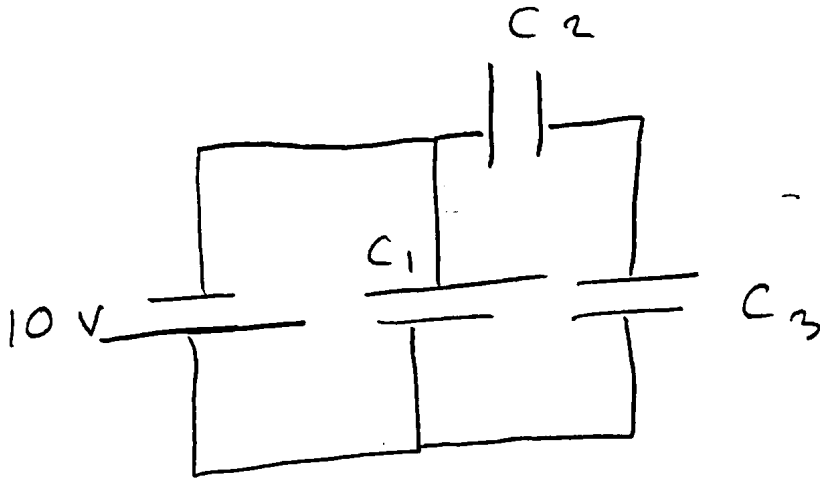
1) ✓

2) $\frac{V_1}{V_2} \rightarrow$ $V_1 > V_2$ (2) ✓

$Q = CV$

$V = \frac{Q}{C}$

Current and Resistors

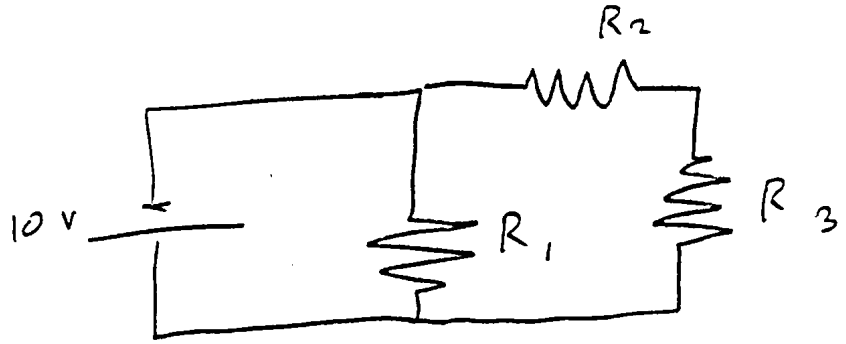


Q, C, V

$V_1 = 10\ V$

$V_2 + V_3 = 10\ V$

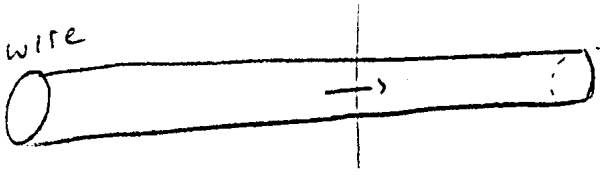
Resistors



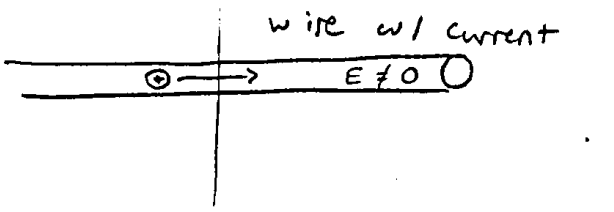
I, R, V

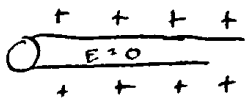
Current (I)

$$I = \frac{\Delta Q}{\Delta t} = \frac{\text{Charges}}{\text{time}}$$

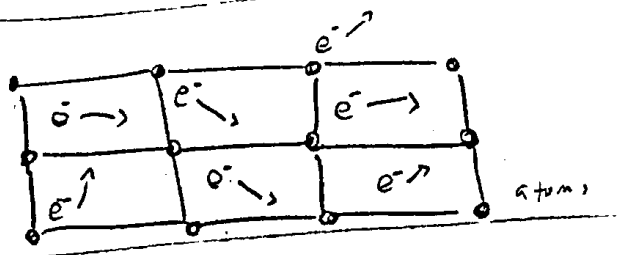


$[I] = A$, Ampere





wire in equilibrium: no current



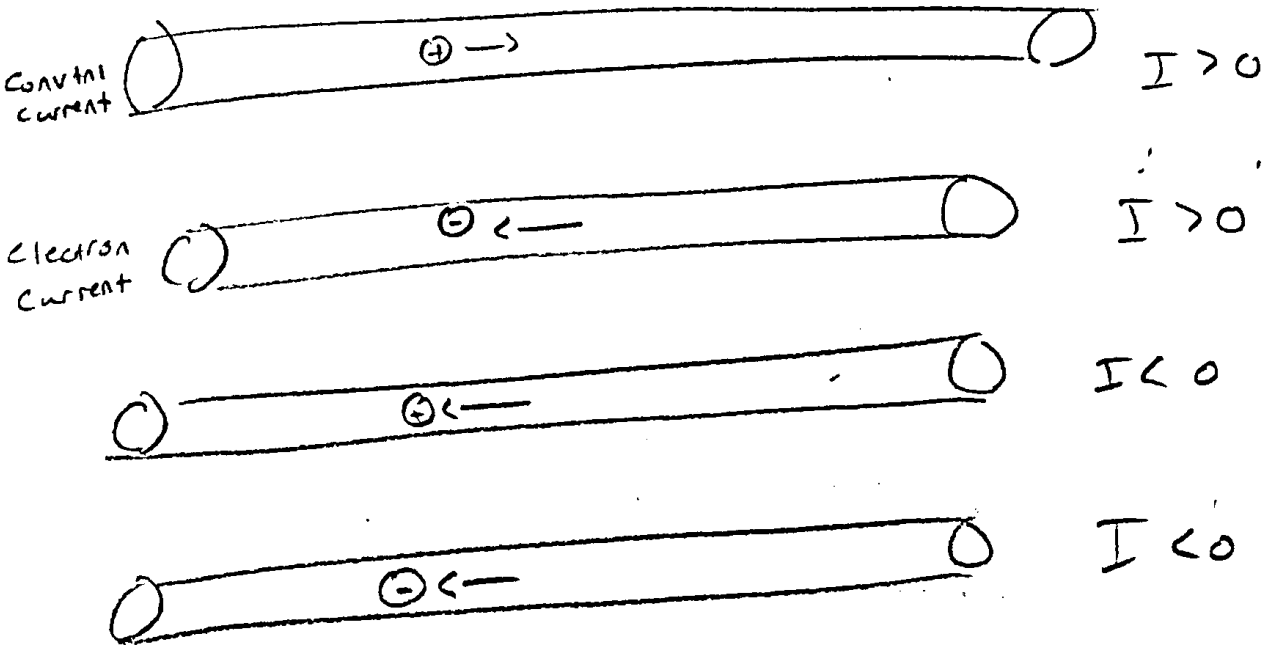
motion on average

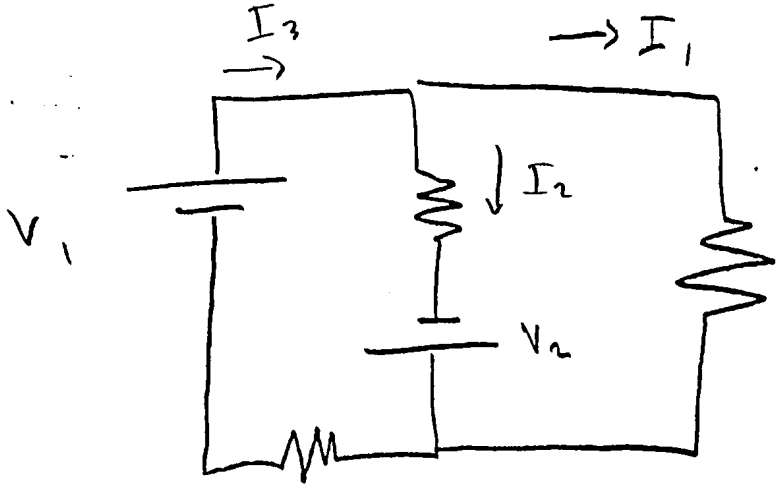
Current: large # of charges with small V_{drift}

Conventional Current: ⊕ moving

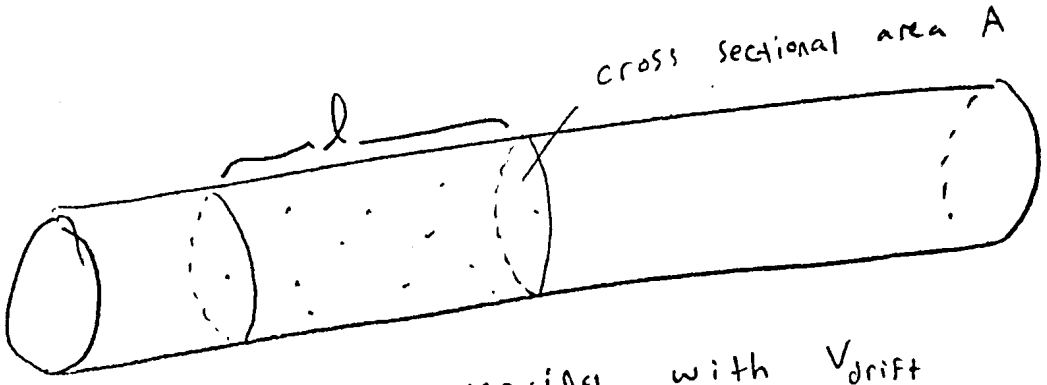
electron current: ⊖ moving in opposite direction

You get to choose → positive direction





Current direction



Charges are moving with V_{drift}

in time Δt:

all charges in volume lA

Pass through A

$$I = NA\,v_{drift} = q\,n\,A\,v_{drift} = I$$

(usually 1e)

$[v] = m/s$

$[A] = m^2$

$[Av] = \frac{\text{Volume}}{\text{time}}$

# of charges

charge per particle

$N = q\,n$ ← # density of charges $\left[\frac{1}{\text{Volume}}\right]$

Current Density $\vec{J}$

$$\vec{J} = q\, n\, \vec{v}_{drift} = \frac{\text{current}}{\text{area}}$$

$$\text{Current } I = \int_{\text{area}} \vec{J} \cdot \hat{n}\, dA$$

accelerator: beam 5 MeV (KE of a proton here) proton beam of 0.5 nA

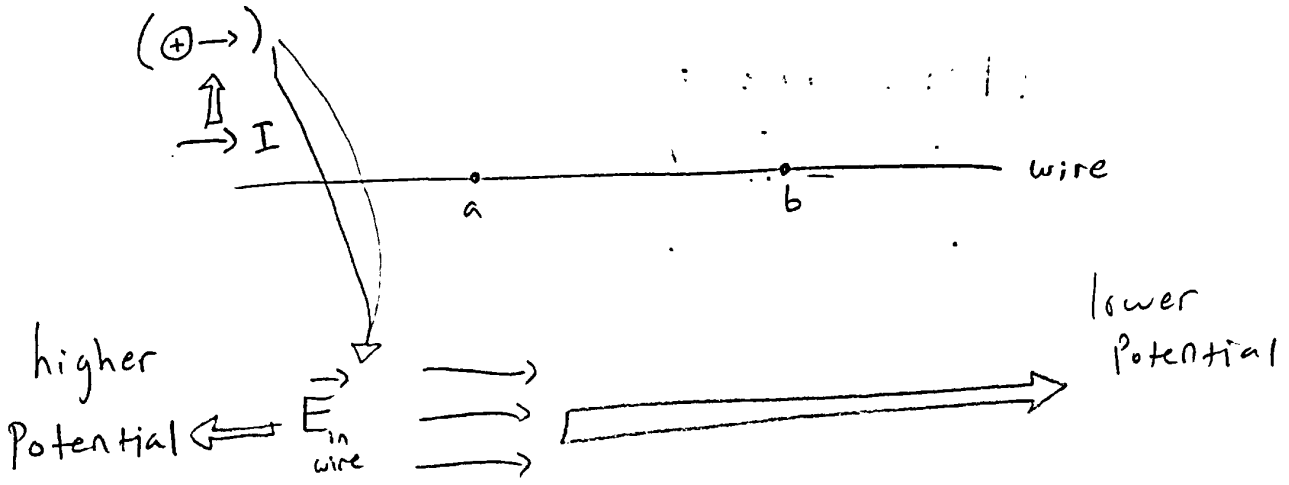
beam spot: circle of radius 1.5 mm

$I = q\, n A v$ ← from $5\ \text{MeV} = \frac{1}{2} m_p v^2$

0.5 nA → I; $+e$ → q

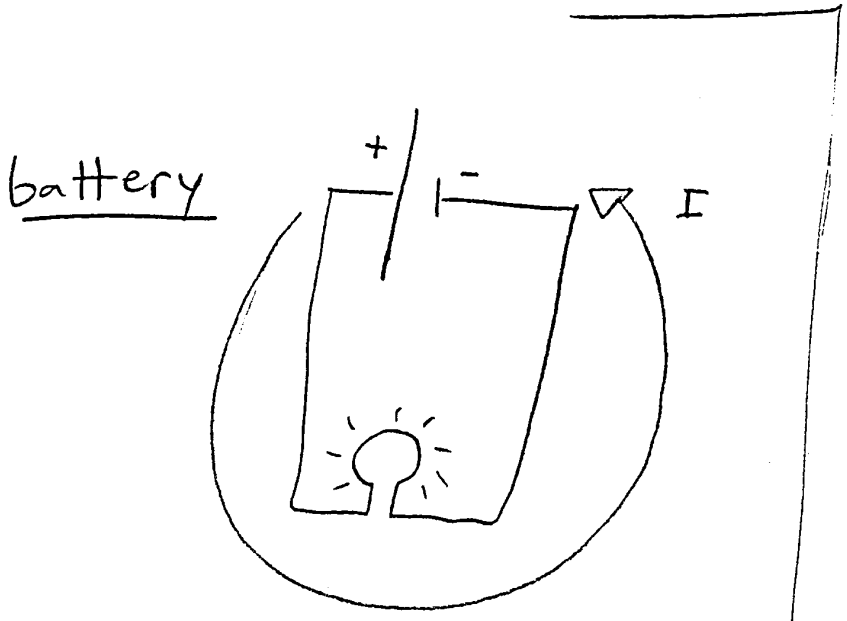
$$n = \frac{I}{q\, A\, v}$$

n ← number density



$$V_a > V_b$$

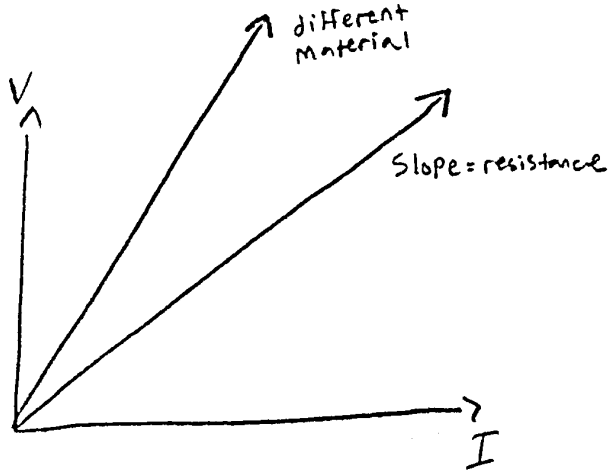
- Conventional current goes from high to low potential.

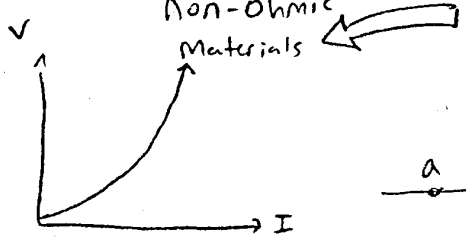


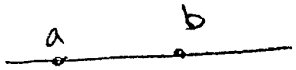
If $V_a > V_b$,

resistance in wire!

- but take wires to be ideal, generally.







Any material where $R = \frac{V}{I}$ is an Ohmic Material!

Ohmic Material:

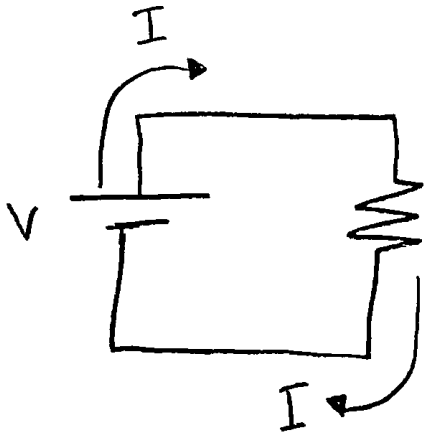
$\boxed{V = IR}$ Ohm's Law

resistance: $R = \frac{\ell}{A}\rho$ ← resistivity

Resistors in Circuits

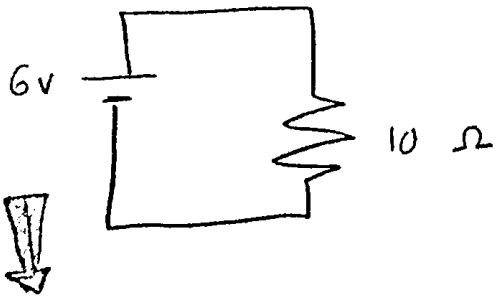
resistor: 

"a safety car, not a school bus"

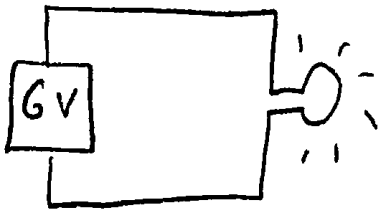


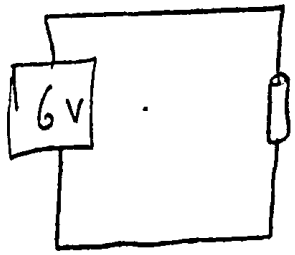
→ same $I = \frac{\Delta Q}{\Delta t}$ bc charges conserved

ex)

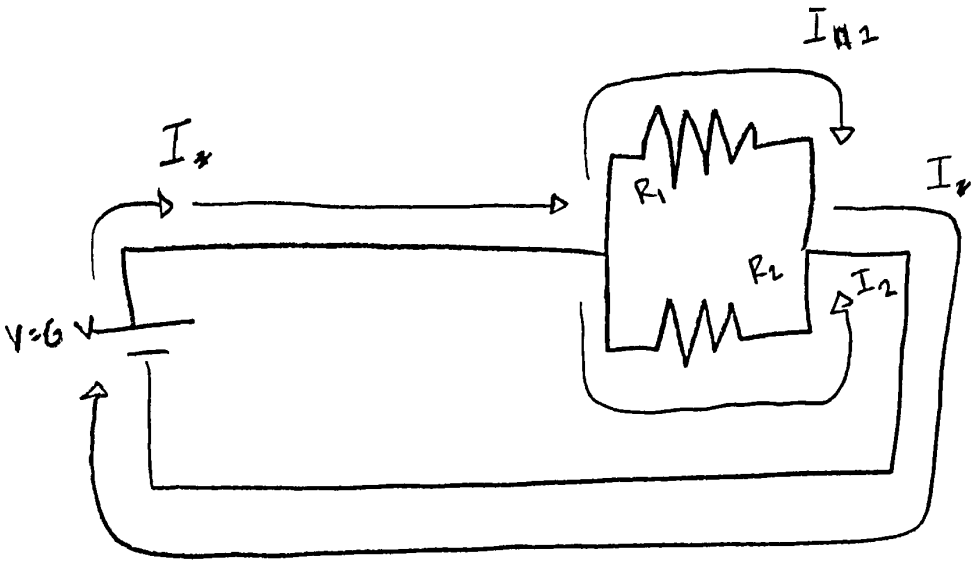


$I = \frac{6\text{ v}}{10\ \Omega} = \frac{6}{10} = \frac{3}{5}$





$I = \frac{6\text{ V}}{20\ \Omega} = \frac{6}{20} = \frac{3}{10}$



$$I = I_1 + I_2$$