ECE 1250 Lecture 1 Electrical & Computer Engineering Design

Lab section issues & waiting lists

Talk about the syllabus.

Problem sessions ________________________

HW # 1 due Friday by 5:00 pm in a yet-to-be-determined locker

WARNING: HWs are often due on non-class days.

How to survive

1. Easiest way to get through school is to actually learn and try to retain what you are asked to learn.
   Even if you're too busy, don't lose your good study practices.
   What you "just get by" on today will cost you later.

   Don't fall for the "I'll never need to know this" trap. Sure, much of what you learn you may not use, but you will need some of it, some day. Y you will need, either in the current class, or future classes, or maybe sometime in your career. Don't waste time second-guessing the curriculum, It'll still be easier to just do your best to learn and retain.

2. Don't fall for the "traps".
   Homework answers, Problem session solutions, Posted solutions, Lecture notes.

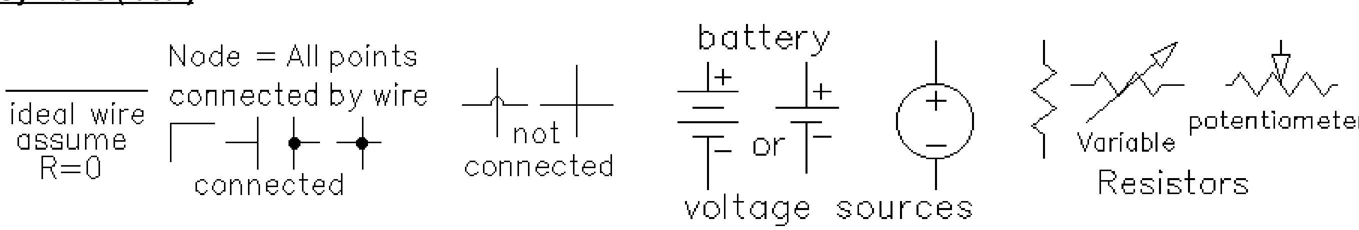
3. KEEP UP! Use calendar.

4. Make "permanent notes" after you've finished a subject or section and feel that you know it.

Lecture

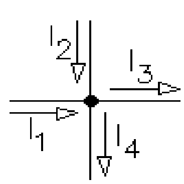
Basic electrical quantities	**Letter used**	**Units**	**Fluid Analogy**
Charge, actually moves	Q	Coulomb (C)	m^3
Current, like fluid flow	$I = \frac{Q}{sec}$	Amp (A, mA, μA,...)	$\frac{m^3}{sec}$
Voltage, like pressure	V or E	volt (V, mV, kV,...)	$Pa = 1 \cdot \frac{N}{m^2}$
Resistance	$R = \frac{V}{I}$	Ohm (Ω, kΩ, MΩ,...)	
Conductance	$G = \frac{1}{R}$	Siemens (S, also mho, old unit)	
Power = energy/time	$P = V \cdot I$	Watt (W, mW, kW, MW,...)	W

Symbols (ideal)

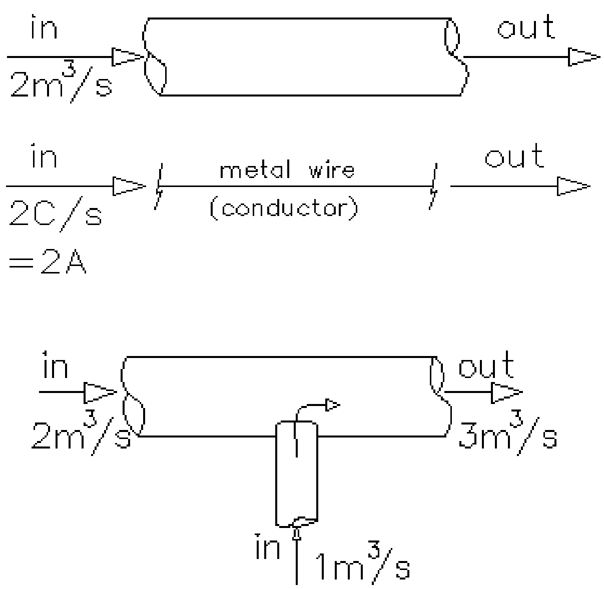


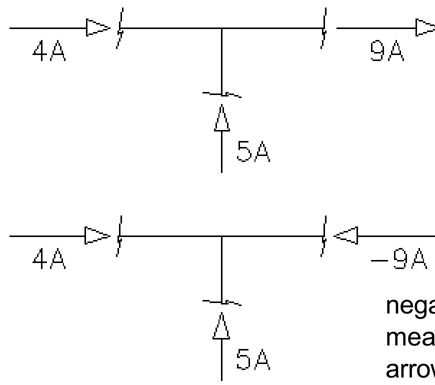
KCL, **K**irchhoff's **C**urrent **L**aw

$I_{in} = I_{out}$ of any point, part, or section

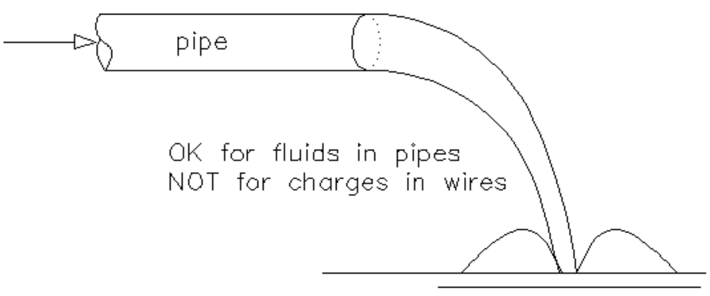


$$I_1 + I_2 = I_3 + I_4$$





negative current means the direction arrow is wrong



Conductors

Nonconductors

Massless fluid in our analogy
   No gravity effects
   No Bernoulli effects

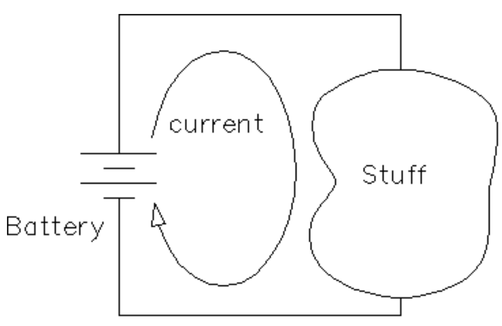
Reasonable because:

Electron mass is $9.11 \cdot 10^{-31} \cdot kg$

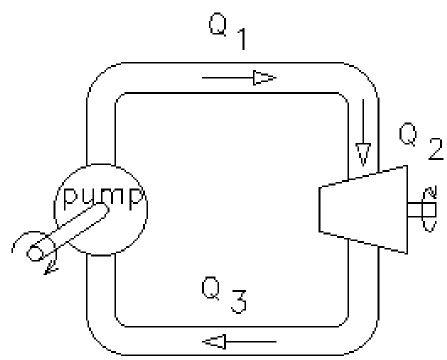
Election mass is $-1.6 \cdot 10^{-16} \cdot C$

Negative charge flows in negative direction

Battery also obeys KCL
No accumulation of charge anywhere, so it must circulate around
Leads to the concept of a "Circuit"



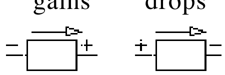
A circuit



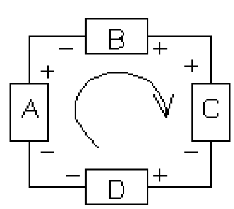
Voltage is like pressure

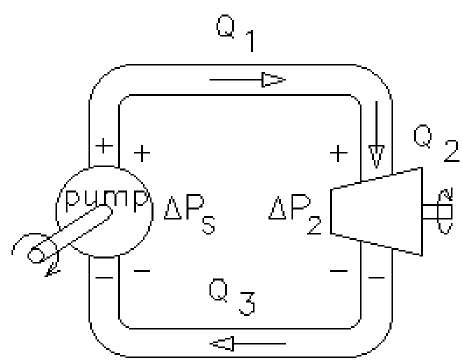
KVL, **K**irchhoff's **V**oltage **L**aw

$V_{gains} = V_{drops}$



around any loop





First Class period usually ends here, pick up in next lecture

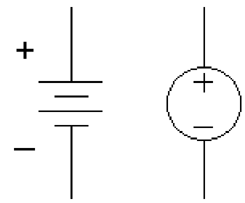
Handouts & Copy Center Packets

Labs Start -- Bring Notebook

Ideal elements

Batteries or voltage sources always the same voltage regardless of current

Wires have no resistance



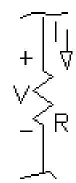
Resistors

Basic electrical quantities		**Unit**
Resistance	$R = \frac{V}{I}$	Ohm (Ω, kΩ, MΩ,...)
Conductance	$G = \frac{1}{R}$	Siemens (S, also mho, old unit)
Power energy/time	$P = V \cdot I$	Watt (W, mW, kW, MW,...)

Resistors

Ohm's law

$V = I \cdot R$



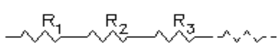
$I = \frac{V}{R}$

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

ideal

Resistors

series:



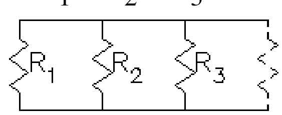
$R_{eq} = R_1 + R_2 + R_3 + \ldots$

Exactly the **same current** through each resistor

Voltage divider:

$$V_{Rn} = V_{total} \cdot \frac{R_n}{R_1 + R_2 + R_3 + \ldots}$$

parallel: $R_{eq} = \dfrac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$

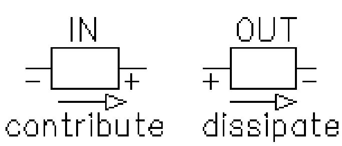


Exactly the **same voltage** across each resistor

current divider:

$$I_{Rn} = I_{total} \cdot \frac{\frac{1}{R_n}}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$$

Power $P_{IN} = P_{OUT}$ for resistor circuits



$P = V \cdot I$ for everything

$= I^2 \cdot R = \frac{V^2}{R}$ for resistors

DC Notes

ECE 1250 / 00

A.Stolp
2/8/00, rev 1/28/06

Basic electrical quantities		Unit
Charge, actually moves	Q	Coulomb (C)
Current, like fluid flow	$I = \frac{Q}{s}$	Amp (A, mA, µA,...)
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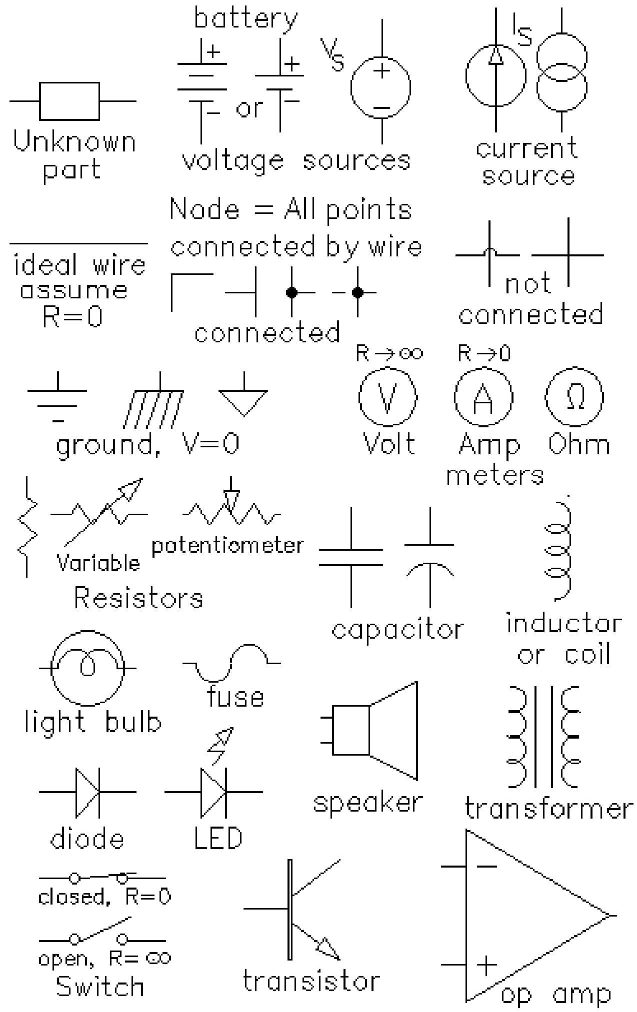
Conductance	$G = \frac{1}{R}$	Siemens (S, old unit mho)
Power energy/time	$P = V \cdot I$	Watt (W, mW, kW, MW,...)

Schematic symbols



KCL, **K**irchhoff's **C**urrent **L**aw

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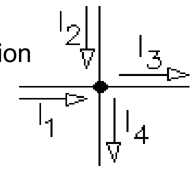
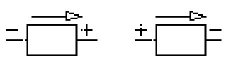
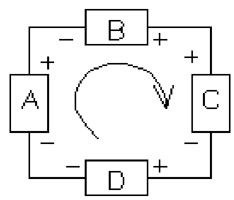


KVL, **K**irchhoff's **V**oltage **L**aw

$V_{gains} = V_{drops}$ around any loop

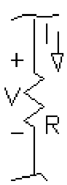




Node = all points connected by wire, all at same voltage (potential)

Ohm's law (resistors)

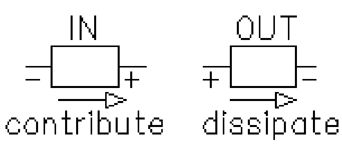
$$V = I \cdot R$$



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

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

Power $P_{IN} = P_{OUT}$ for resistor circuits



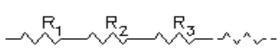
$P = V \cdot I$ for everything

$= I^2 \cdot R = \frac{V^2}{R}$ for resistors

Maximum power transfer: $R_L = R_{Th}$

Load = Thevenin's

Resistors



series: $R_{eq} = R_1 + R_2 + R_3 + \ldots$

Exactly the **same current** through each resistor

Voltage divider:

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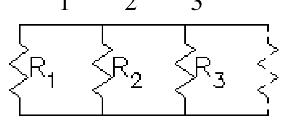

Exactly the **same voltage** across each resistor

current divider:

$$I_{Rn} = I_{total} \cdot \frac{\frac{1}{R_n}}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$$

Multiple unknowns:

1. Combine resistors into equivalents where possible.
2. Use superposition if there are multiple sources and you know all the resistors.
3. Use KCL, KVL, & Ohm's laws to write multiple equations and solve.