Intro to ECSE - CLASS 2

KCL, KVL, Series, Parallel

ECSE

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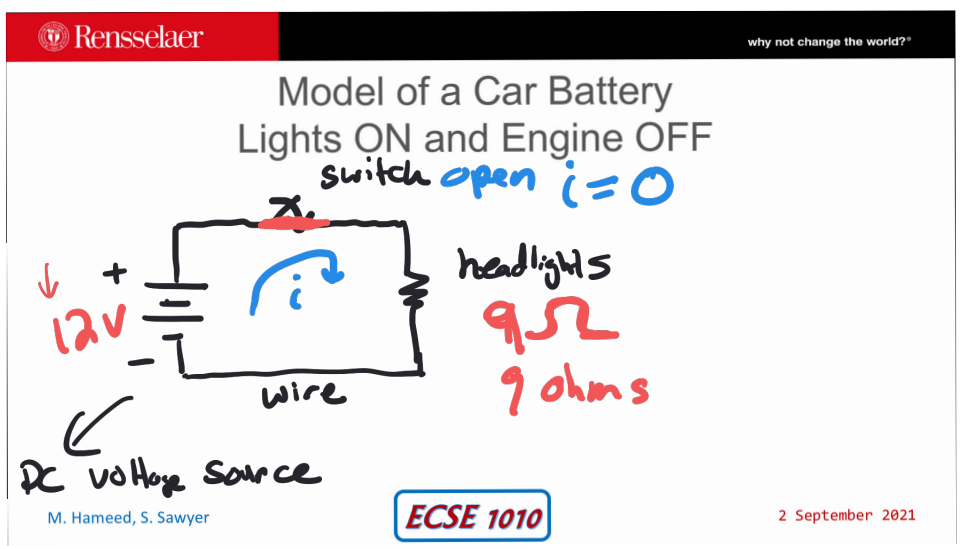
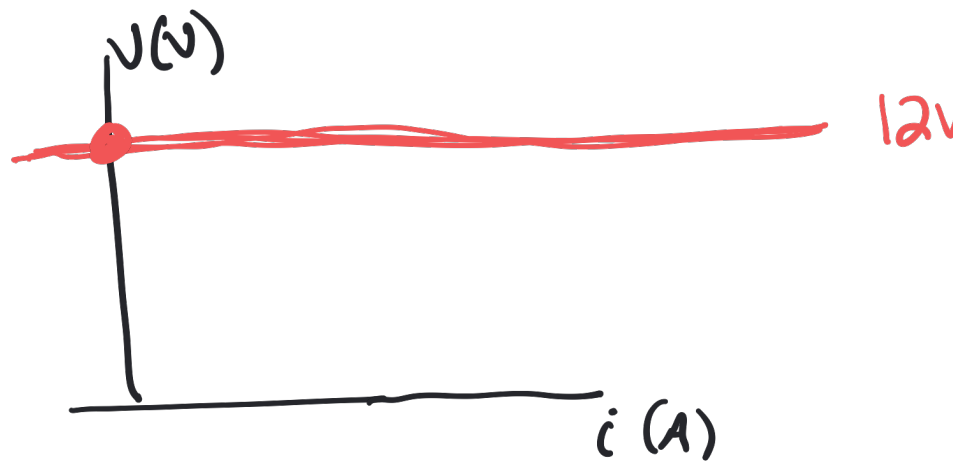


DC voltage source



+ —

$i_{headlights} = \frac{V_{headlights}}{R_{headlights}}$

I-V characteristic

current ← → voltage

ohm's law

$V = IR$

$i_{HL} = \frac{12V}{9\Omega}$

Ohm's Law $V = iR$

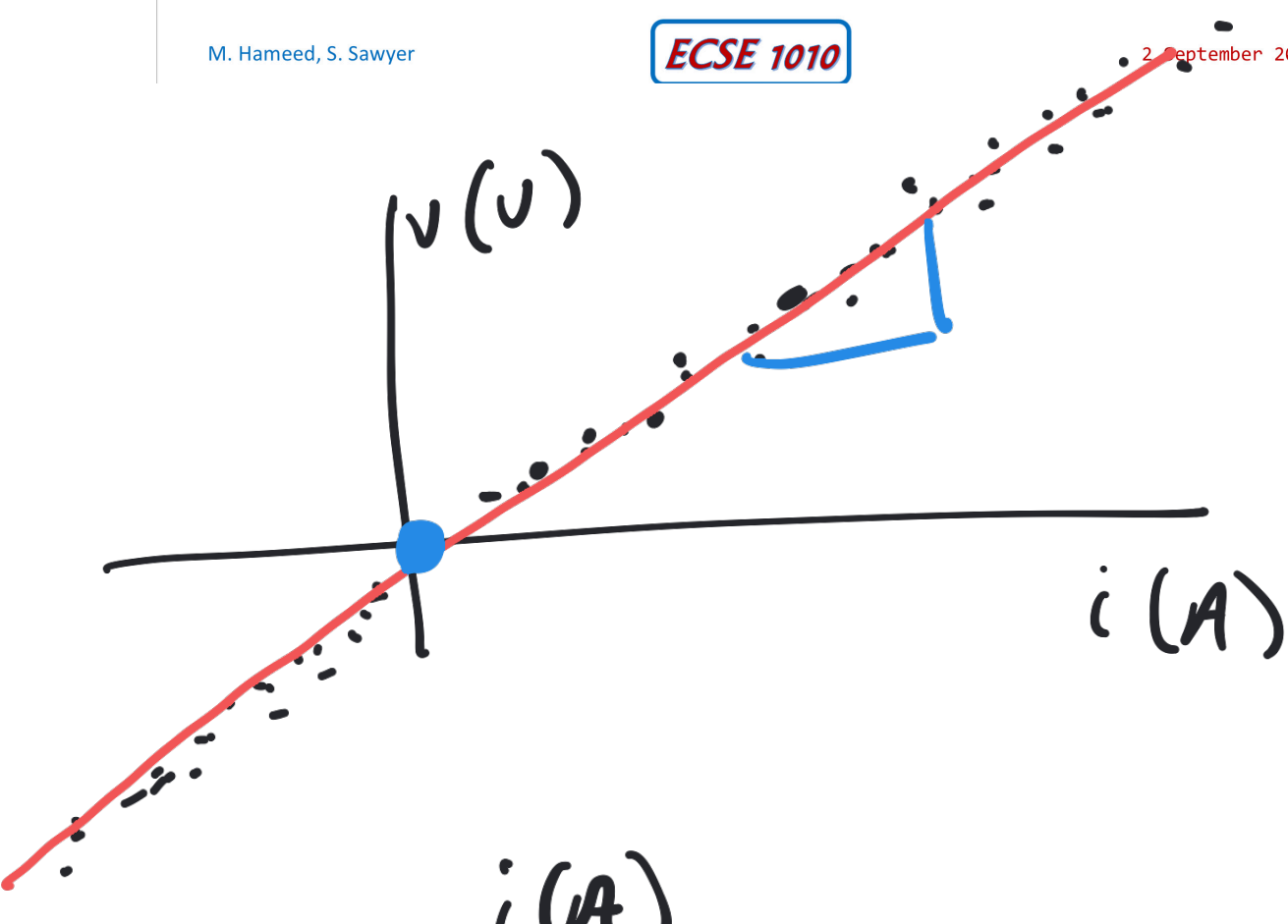
Voltage across an element is directly proportional to the current through it

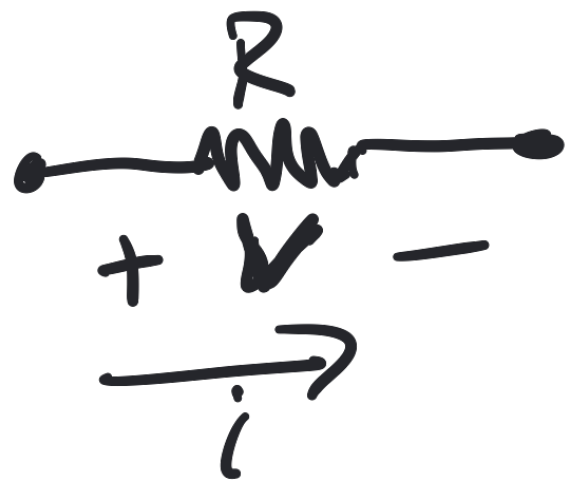
$V \propto i$ proportionality constant is R

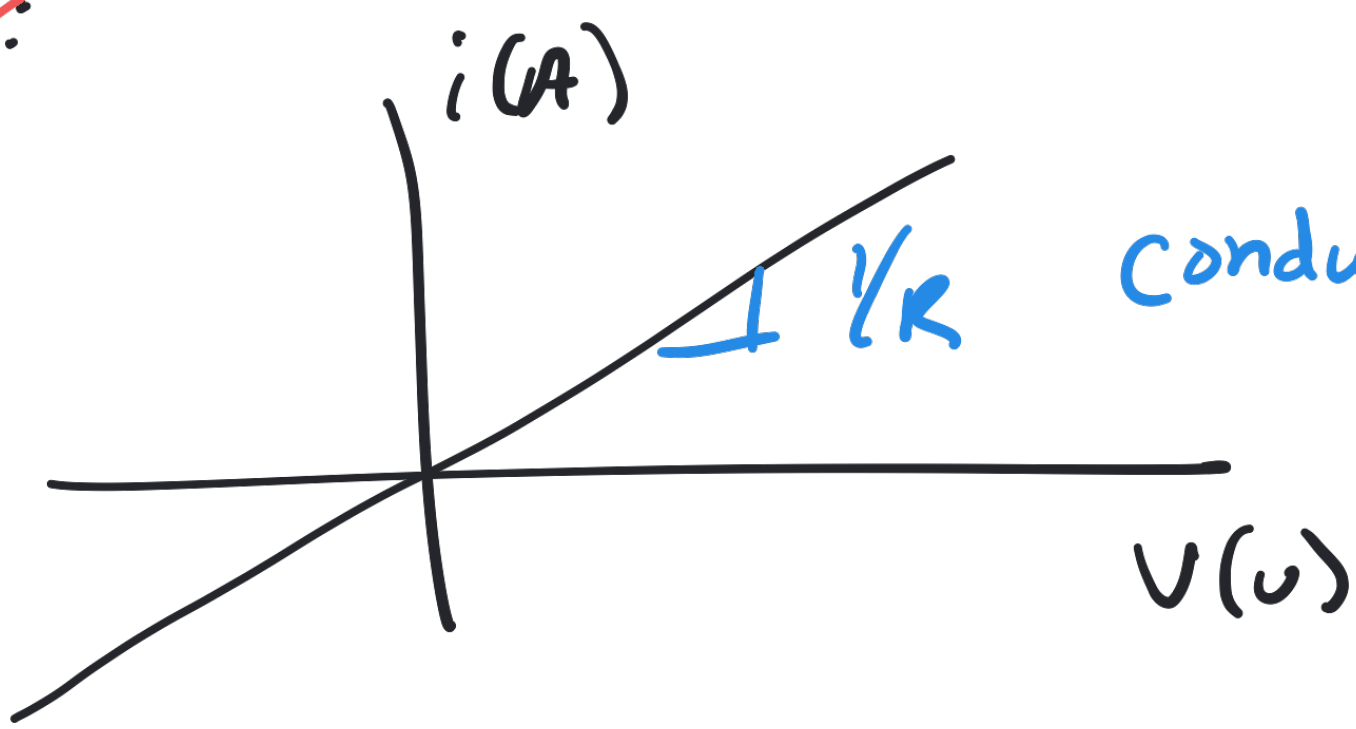
$y = mx + c$

$V = mi + 0$

$m = R$







conductance

mhos

℧

siemens

What is so cool about resistors?

Resistors are dope

Light Dependent Resistors (LDRs)
thermistor (temperature dependent resistors)
piezoelectric
strain gauge

What about power absorbed by resistors

- Resistors are passive linear elements
- They can only absorb power
- Power relationships:

Watts (w)

$V = iR$ ← $p = vi = (iR)\frac{v}{R}$

$i = \frac{v}{R}$

$p = \frac{v^2}{R}$

$p = i^2R$

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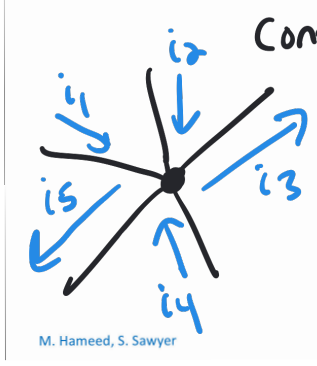
Kirchoff's Current Law (KCL)

Conservation of charge



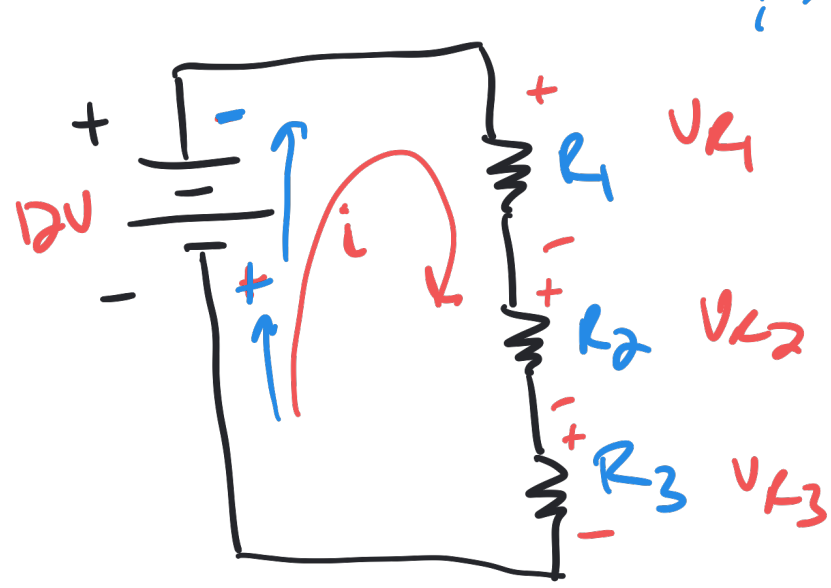
Current coming into a node (point in the circuit) and out of a node = 0

$-i_1 - i_2 + i_3 - i_4 + i_5 = 0$

$i_1 + i_2 + i_4 = i_3 + i_5$

M. Hameed, S. Sawyer — ECSE 1010 — 2 September 2021

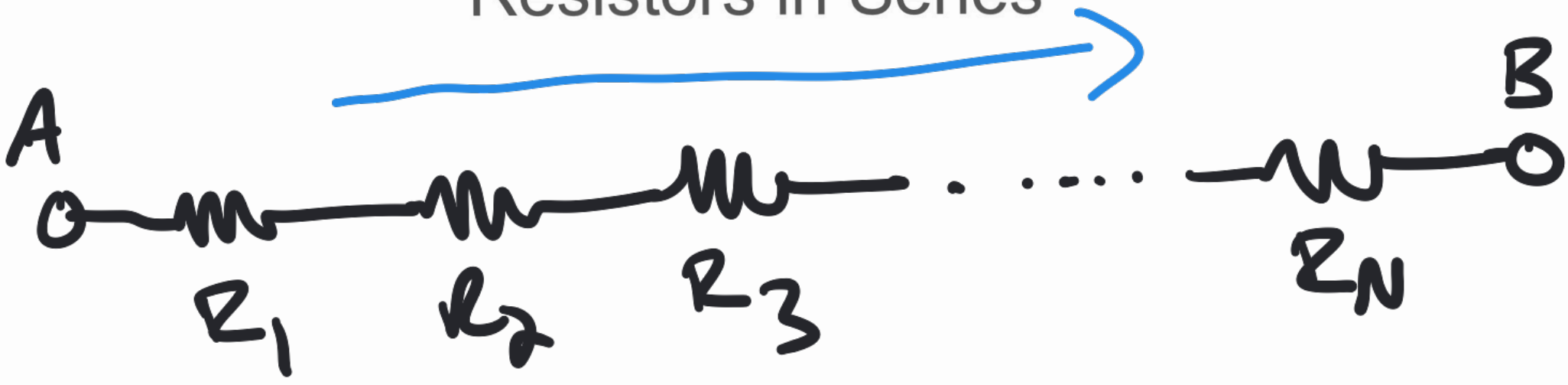
KVL — Conservation of energy



$-12 + V_{R_1} + V_{R_2} + V_{R_3} = 0$

$$V_{R_1} + V_{R_2} + V_{R_3} = 12$$

Resistors in Series

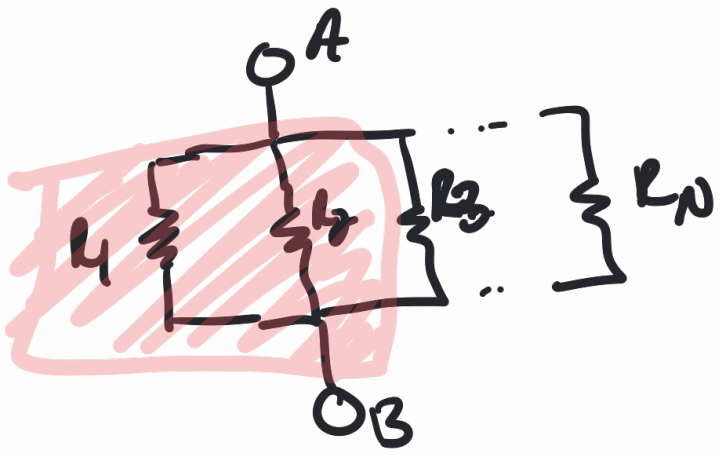


Resistor in series have the same current

$$R_{AB} = R_1 + R_2 + R_3 + \dots R_N$$

$$= \sum_{i=1}^{N} R_i$$

Resistors in Parallel



$$R_{AB} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \cdots + \frac{1}{R_N}\right)^{-1}$$

more than 2 resistors

$$R_{12} = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

$$R_{123} = \frac{R_2 \cdot R_3}{R_2 + R_3}$$

$$R_{SAm} =$$

$$R_{357621}$$

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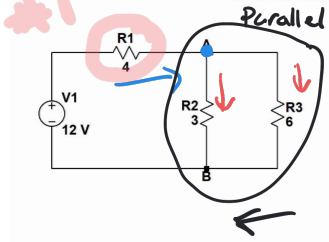
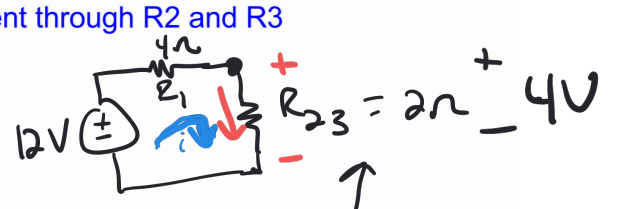
Example 1: Circuit Analysis

Find current through R2 and R3



#1 Parallel



$R_{23} = \frac{R_2 \cdot R_3}{R_2 + R_3}$ $\frac{3 \cdot 6}{9} = 2\Omega$

Way #2

#1 $i R_{23} = V_{R23} = 2A(2V) = 4V$

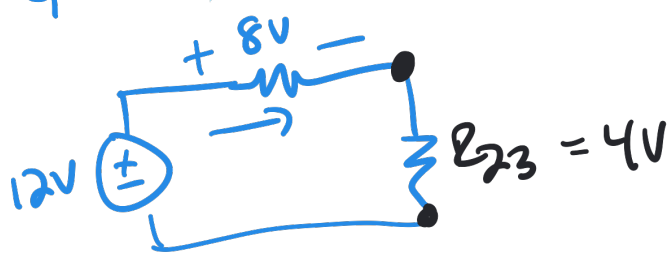
#2 Recognize || resistors have same voltage

$V_{R2} = V_{R3} = 4V$

$i = \frac{12}{4 + R_{23}} = \frac{12}{4+2} = 2A$

Way 1

$V_{R1} = i R_1 = 4\Omega(2A) = 8V$

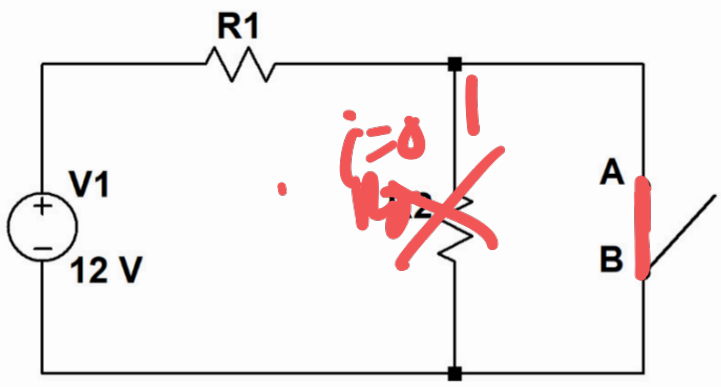


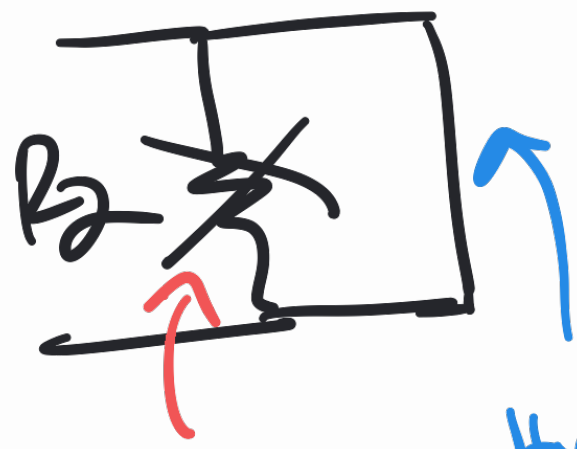
Things in parallel have same voltage

$V_{R2} = 4V$ $V_{R3} = 4V$

Example 2: Circuit Analysis

Find current through R1

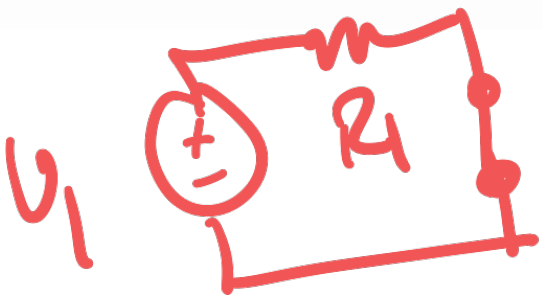




Shorting a resistor

Hoosick on FRIDAY

Hyperloop with no traffic



Activity 2: KCL, KVL, Series and Parallel Resistors

- Go to the class website
- Look under class 2
- Find activity 2
- Do the activity
  - One submission per group
  - Encouraged to discuss with others in the class
- Answer the activity using template (attached class 2)
- When complete – upload to Gradescope
  - Due Thursday, September 9th at 11:59 pm
  - Use guides to learn how to upload documents
  - Add your partner to submission after upload is complete.