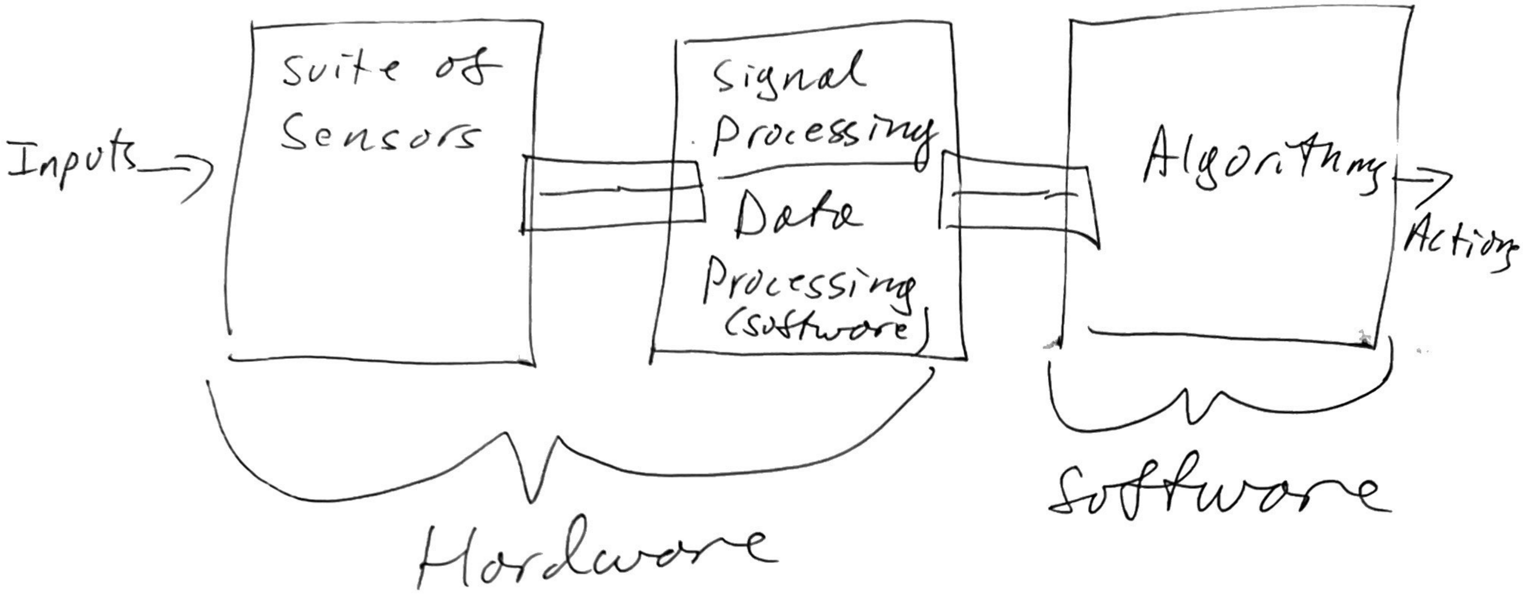
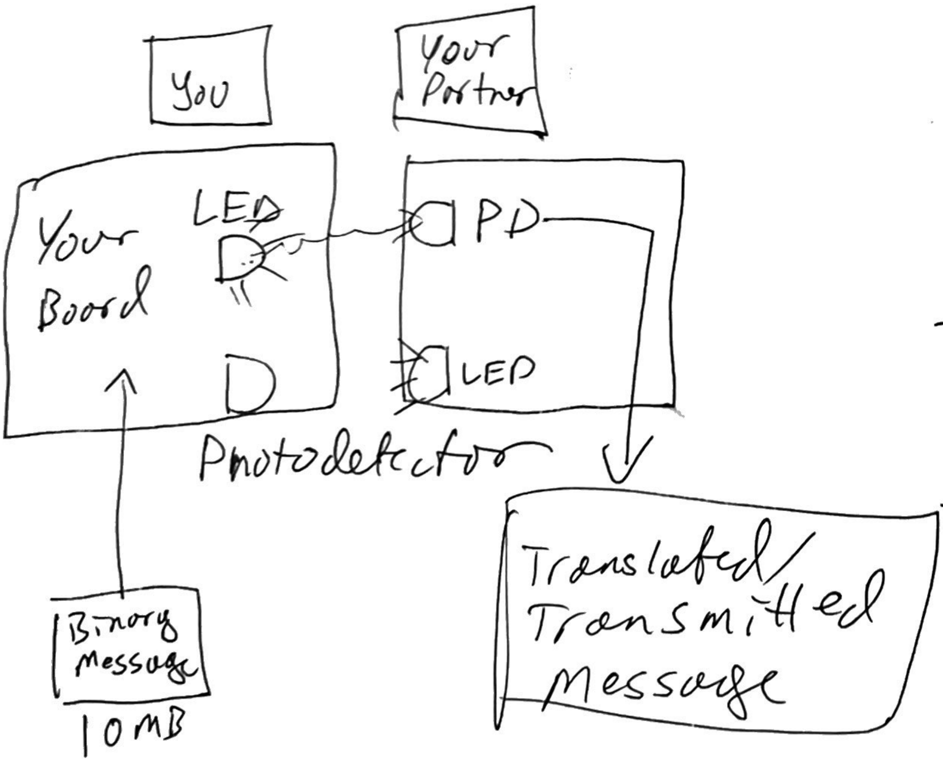
~~KRT~~

Systems



EE 105 Challenge # 1



HW Grade

Transmit message w/ > 95% accuracy

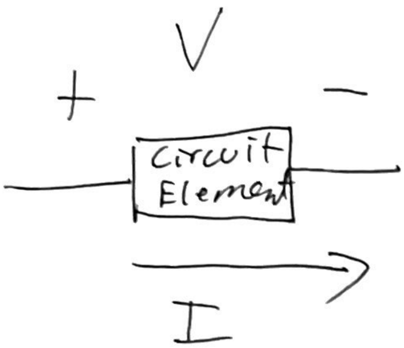
Competition

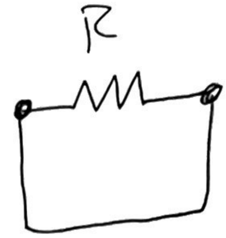
- Who can transmit in the shortest time period.
  → Highest datarate

(1) Voltage: Pressure that leads to current flow

Current: movement of charge

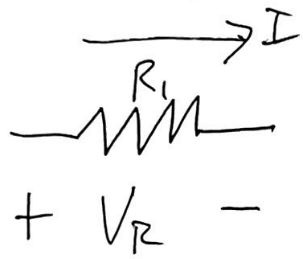
Resistor: A circuit element that has a linear proportionality between current & voltage





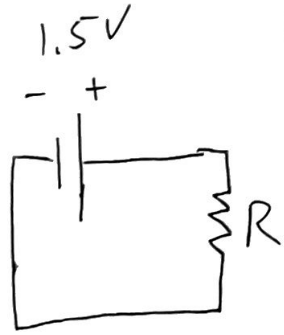
Ohm's Law: $V = IR$

Resistor:



$$\frac{V_R}{R_1} = I$$

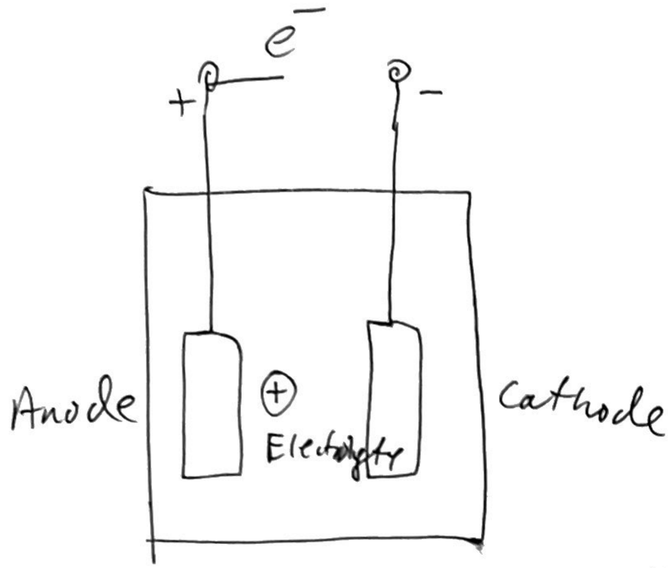
Battery:

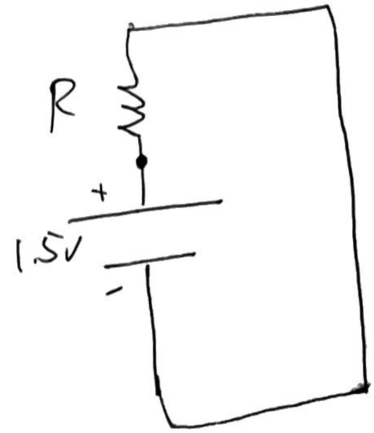


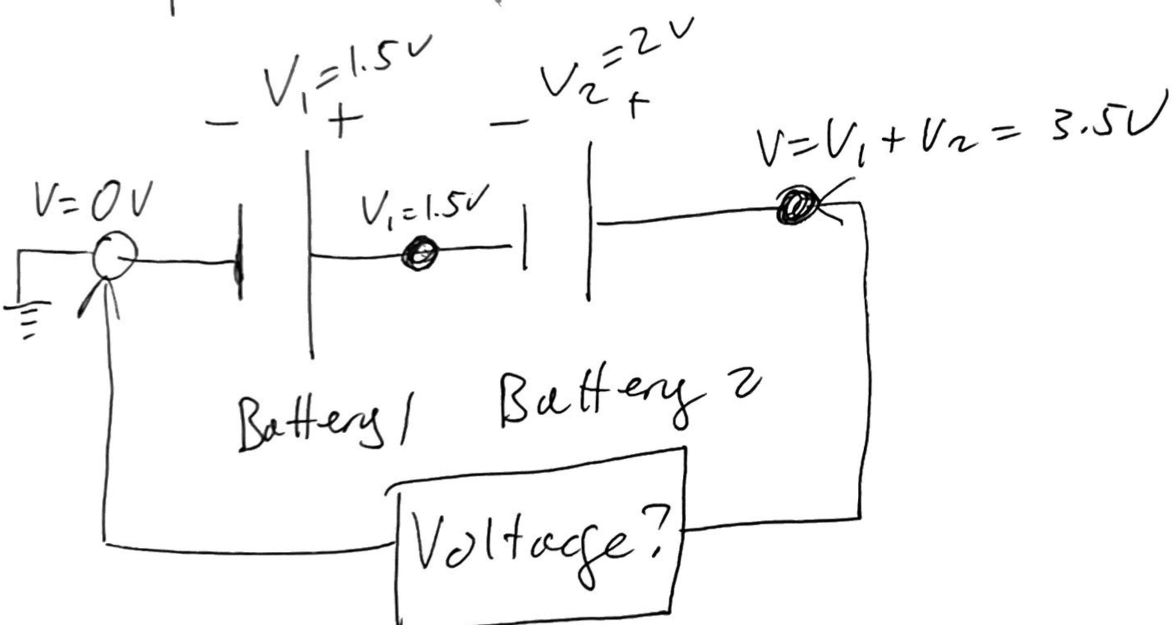
→

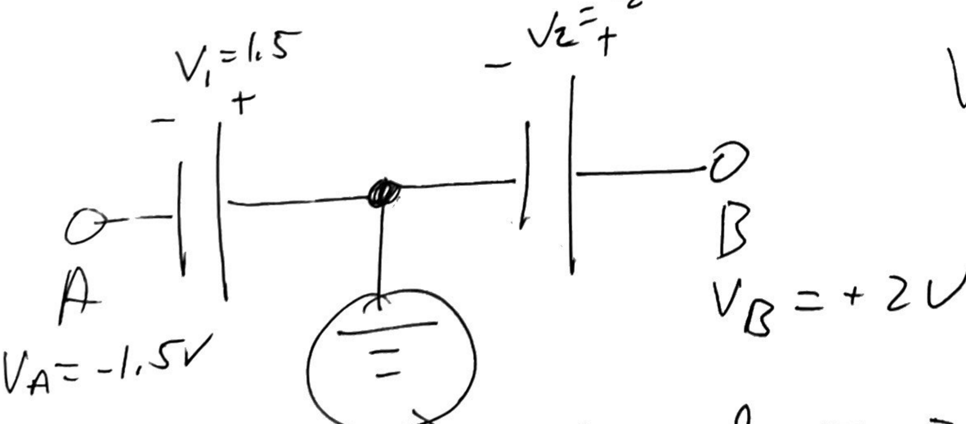
$R = 1.5\ \Omega$

$I = 1\text{ A} = 1\ \frac{C}{s}$









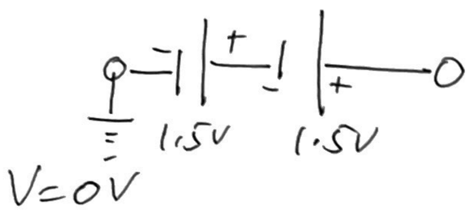
$V_A = 0$?
$= -1.5V$?

Ground → Zero Voltage Reference

Voltage

1. Voltage source enforces a votage difference across 2 points.

2. Voltage sources in series add



$V = 1.5 + 1.5V = 3V$

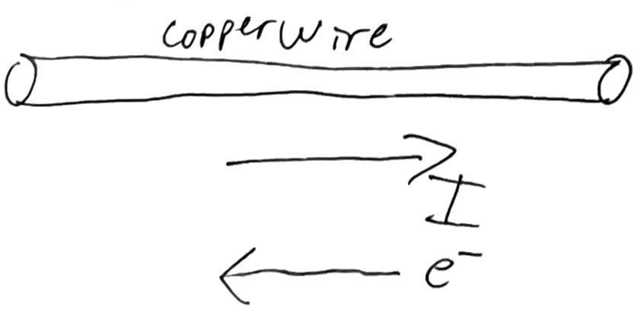
3. A ~~each~~ circuit element enforces some specific I-V relationship

4. A resistor has the I-V relationship

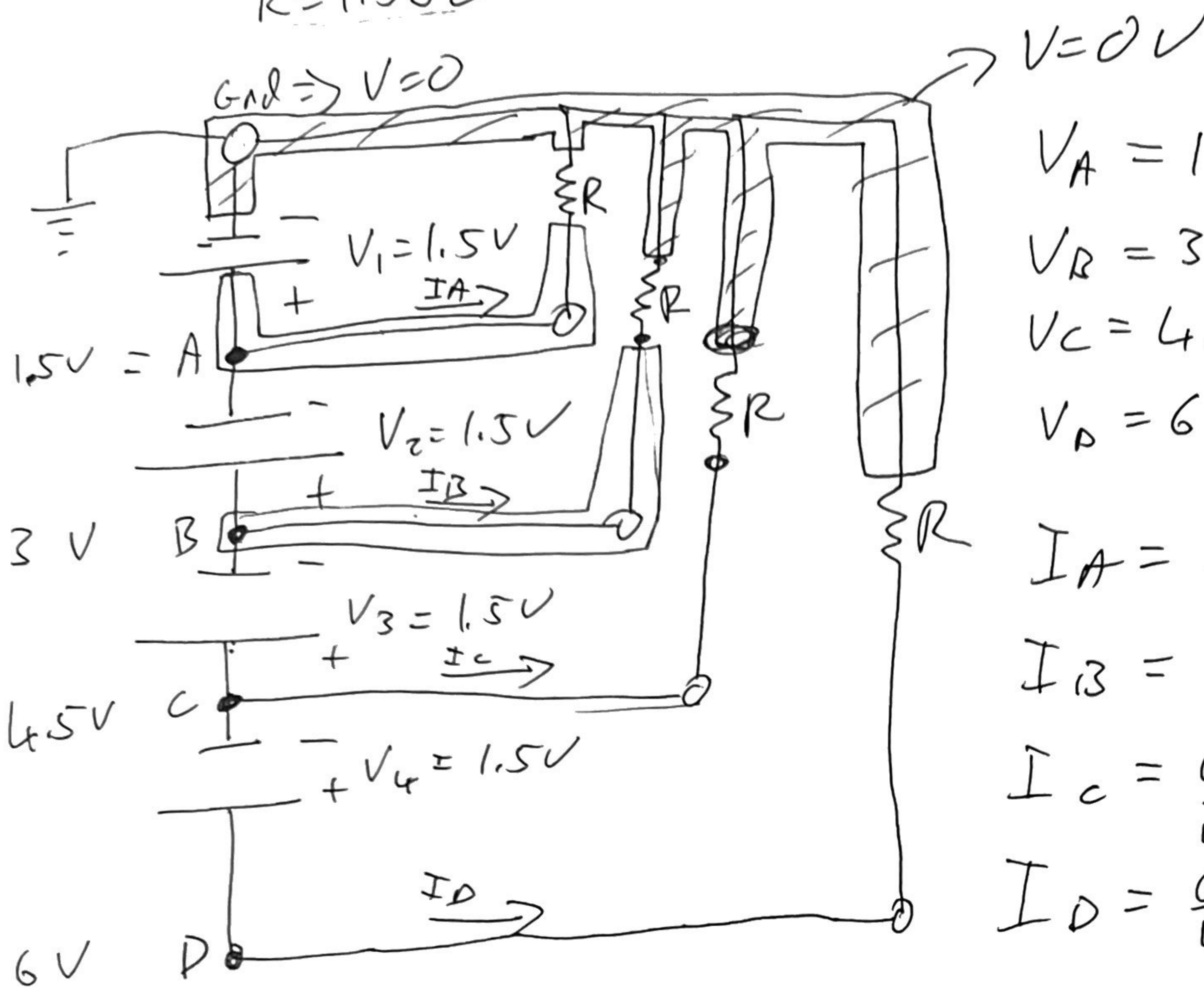
$V = IR$ (Ohm's Law)

Current

- The flow of charge
- The unit for current is the Amp, which is $\frac{\text{Charge}}{\text{time}} = \frac{\text{Coulomb}}{s}$



$R = 1.5\,\Omega$



$V_A = 1.5V$

$V_B = 3V$

$V_C = 4.5V$

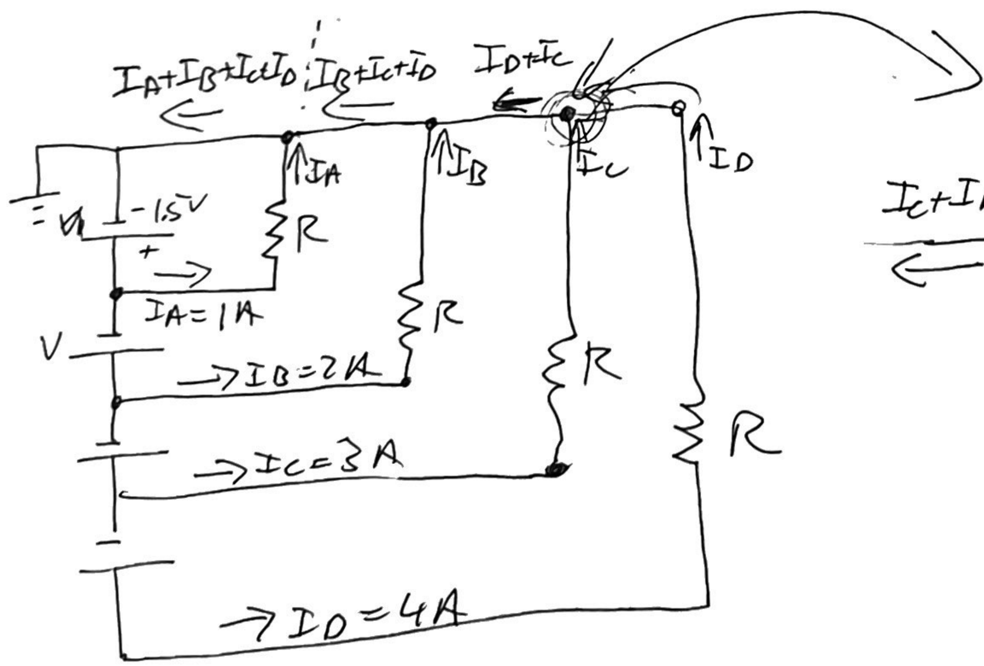
$V_D = 6V$

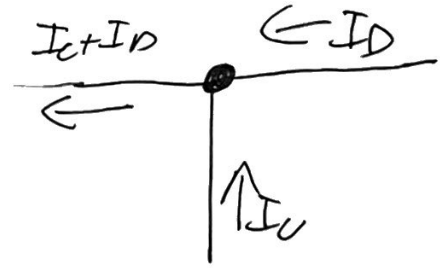
$I_A = \frac{1.5V}{1.5\,\Omega} = 1A$

$I_B = \frac{3V}{1.5\,\Omega} = 2A$

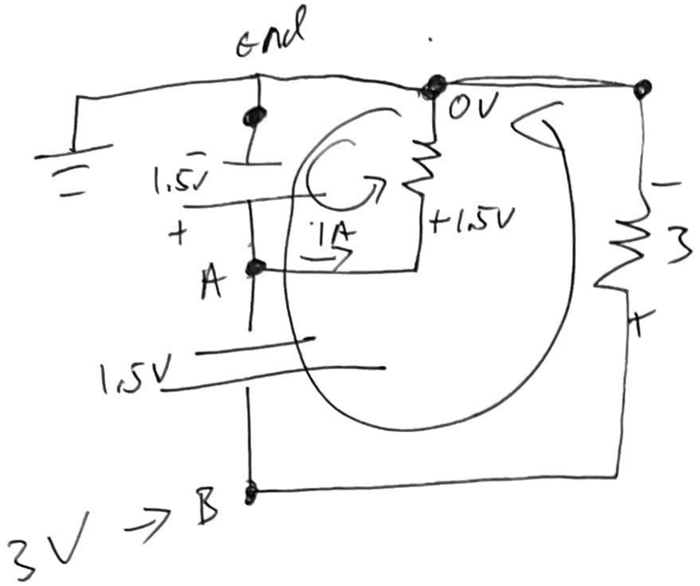
$I_C = \frac{4.5V}{1.5\,\Omega} = 3A$

$I_D = \frac{6V}{1.5\,\Omega} = 4A$





Kirchoff's Current Law
The current entering a node is equal to the current leaving a node



Kirchoff's Voltage law
The voltage around a loop in the circuit is = 0V

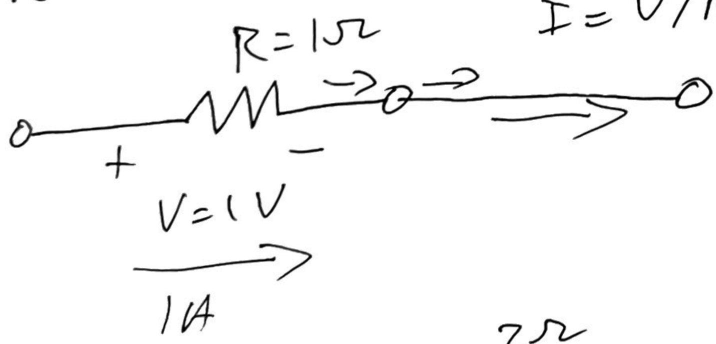
Gnd → A → B → Gnd (via resistor)

+1.5V +1.5V −3V

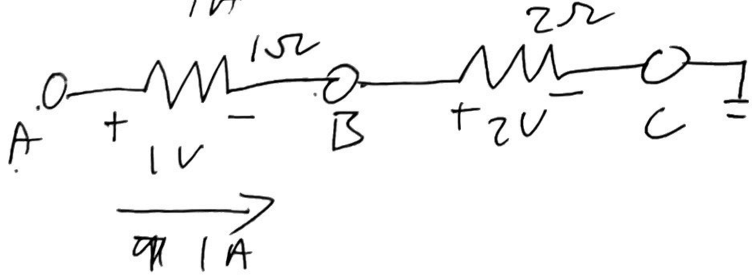
V = 3V

$V_{Tot} = \cancel{3}\, 1.5 + 1.5 - 3 = 0$

Resistors



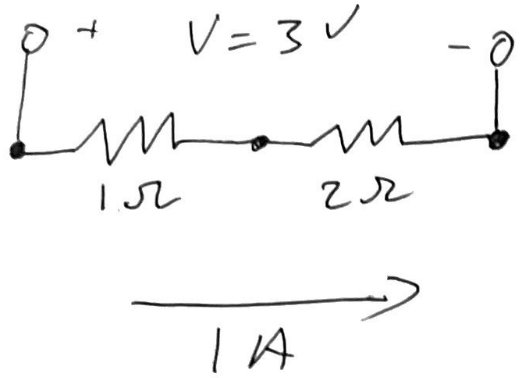
$I = V/R = 1V/1\Omega = 1A$

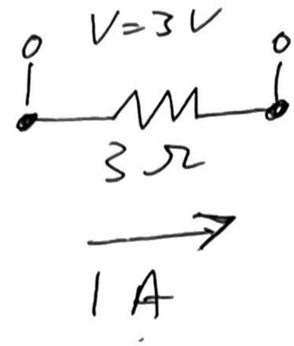


$V = IR = 1A\ 2\Omega = 2V$

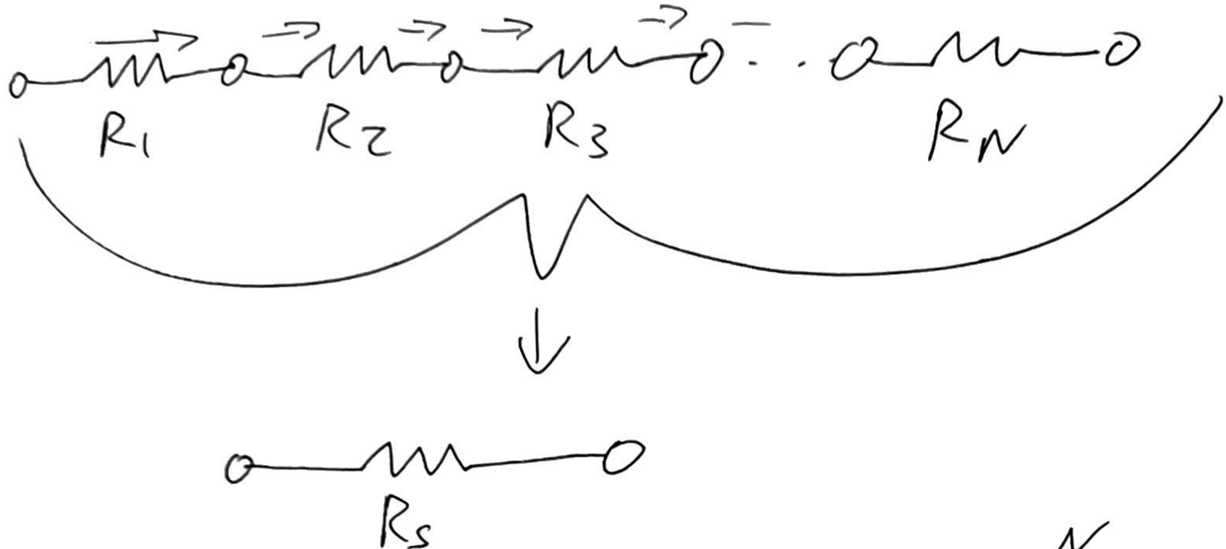
$V_A - V_C = ?$

$3V - 0V = 3V$

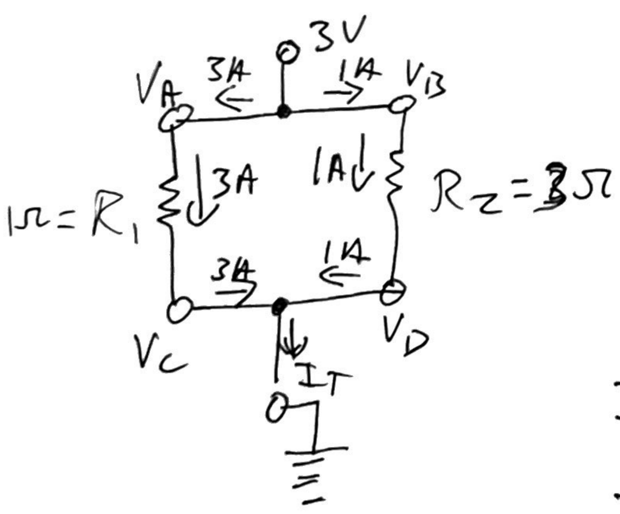




Series Resistors



$$R_S = R_1 + R_2 + R_3 + \cdots + R_N = \sum_{i=1}^{N} R_i$$



$$V_A = V_B$$

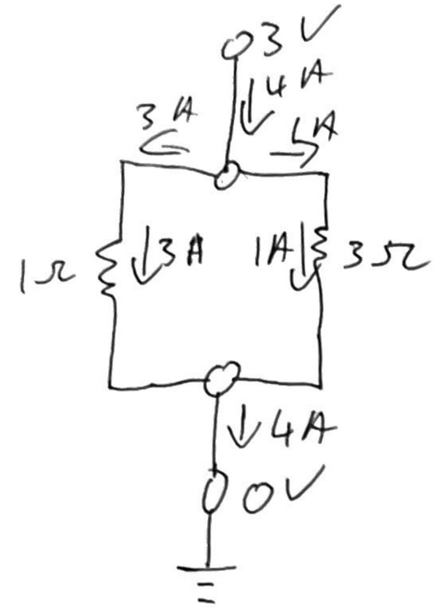
$$V_C = V_D$$

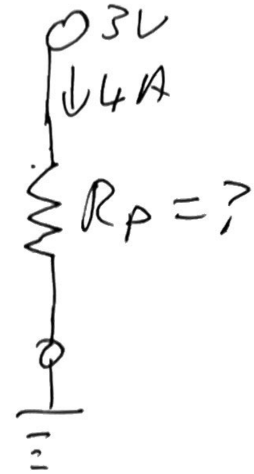
$$I_{R1} = 3V/1\Omega = 3A$$

$$I_{R2} = 3V/3\Omega = 1A$$

$$I_{R1} + I_{R2} = I_T$$

$$3A + 1A = 4A$$



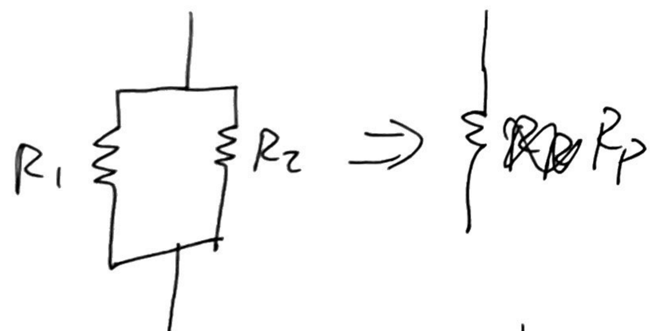


$$V = IR$$

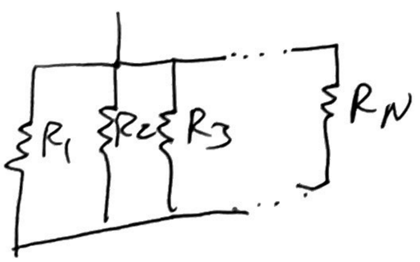
$$R = \frac{V}{I}$$

$$R = \frac{3V}{4A}$$

$$0.75\Omega$$



$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$$



$$\frac{1}{R_P} = \frac{1}{1\Omega} + \frac{1}{3\Omega} = \frac{4}{3}\,\frac{1}{\Omega}$$

$$\frac{1}{R_P} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots + \frac{1}{R_N}\right) \qquad R_P = \frac{3}{4}\,\Omega$$

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

$$R_P = \left(\sum_{i=1}^{N} \frac{1}{R_i}\right)^{-1}$$

Voltage $\Rightarrow$ Pressure ; Voltage sources define a voltage diff across 2 pts.

Current $\Rightarrow$ moving Chg

Resistors $\Rightarrow$ $V = IR$

Kirchoff's Current Law:

- The currents going into a node = the currents exiting a node
- All the currents entering a node = 0

KCL $\sum_{i=1}^{N} I_i = 0$

Kirchoffs Voltage Law:

- The voltages around a Loop in the circuit = 0 V

$i = 1, 2, 3, 4 \cdots$

$$\sum_{i=1}^{N} V_i = 0$$

- Series Resistors: $R_S = \sum_{i=1}^{N} R_i = R_1 + R_2 + R_3 + 1$
- Parallel Resistors: $R_P = \left(\sum_{i=1}^{N} \frac{1}{R_i} \right)^{-1}$