① Current, Voltage

② Voltage sources

③ Resistors

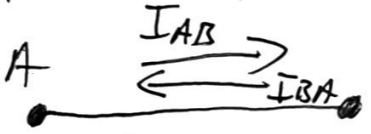
④ Kirchoff's Current Law (KCL)

⑤ Kirchoff's Voltage Law (KVL)

① Current

- flow of chg across some region

- Positive ~~flow~~ charge flow



Case 1: $\overset{+}{\rightarrow}$ $\overset{+}{\rightarrow}$

$I_{AB} > 0$; $I_{BA} < 0$

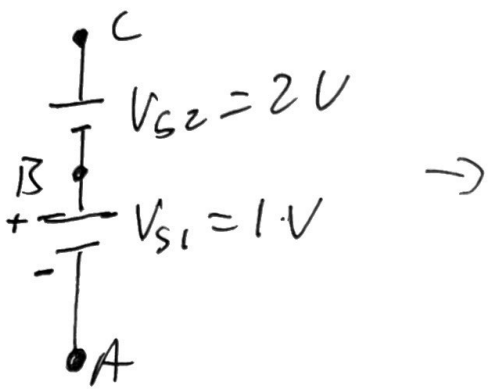
Case 2: $\rightarrow$ $\rightarrow$

$I_{AB} < 0$; $I_{AB} > 0$

② Voltage

- Relative "force" or "pressure" charges moving between 2 points feel
- Voltage is always defined ~~in a~~ relatively

(2) Voltage sources



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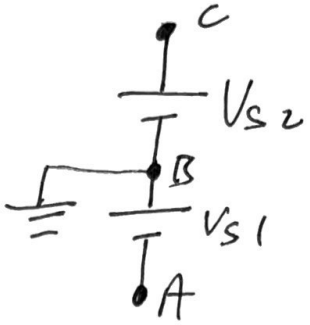


$V_A = -1\,V$

$V_B = 0$

$V_C = 2\,V$

$V_{AB} = V_A - V_B = -1\,V$

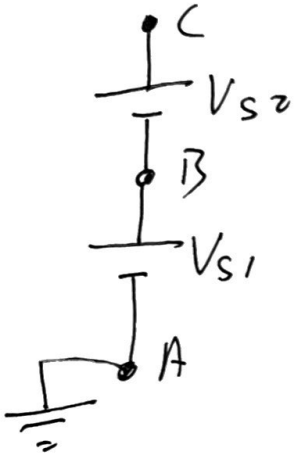
$V_{BA} = V_B - V_A = 1\,V$

$V_{CB} = V_C - V_B = 2\,V$

$V_{BC} = -V_{CB} = -2\,V$

$V_{CA} = V_C - V_A = 3\,V$

$2\,V - (-1\,V) = 3\,V$



$V_A = 0$

$V_B = 1$

$V_C = 3$

$V_{BA} = 1\,V$

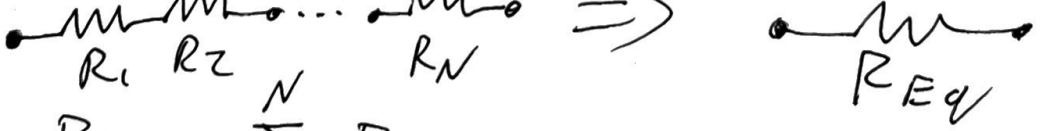
$V_{CB} = 2\,V$

$V_{CA} = 3\,V$

(3) Resistors

$V = IR$

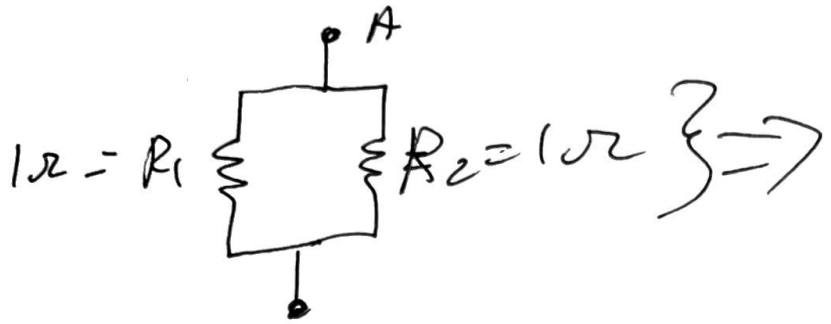
Series R_s



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

(3) Resistors

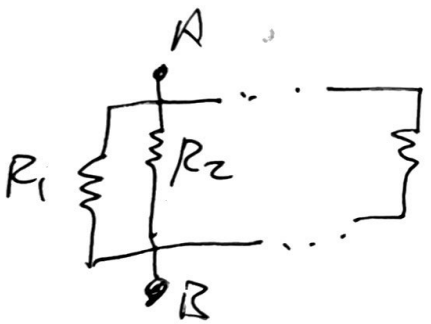
Parallel R_S



$\Rightarrow$

$$\left(\frac{1}{R_1}+\frac{1}{R_2}\right)=\frac{1}{R_{Eq}}=\left(\frac{1}{1}+\frac{1}{1}\right)=2$$

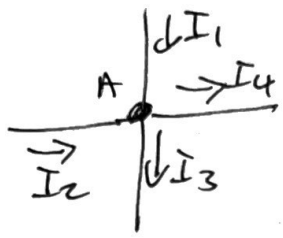
$$R_{Eq}=\frac{1}{2}\,\Omega$$



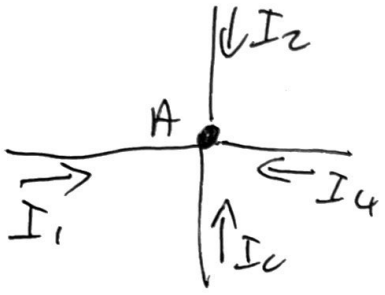
$\Rightarrow$

$$\sum_{i=1}^{N}\frac{1}{R_i}=\frac{1}{R_{Eq}}\;;\qquad R_{Eq}=\left[\sum_{i=1}^{N}\left(\frac{1}{R_i}\right)\right]^{-1}$$

④ Kirchoff's Current Law ④



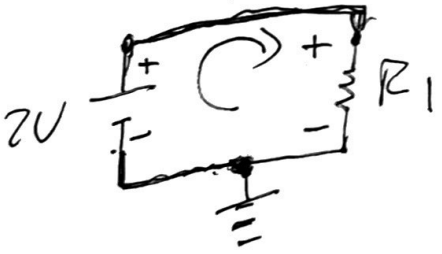
Currents in: $I_1 + I_2$ = Currents out: $I_3 + I_4$



Currents in / Currents out

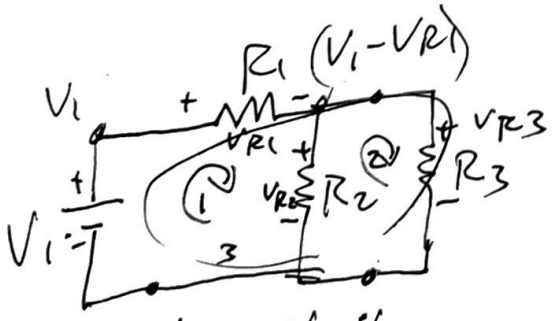
$I_1 + I_2 + I_3 + I_4 = 0$

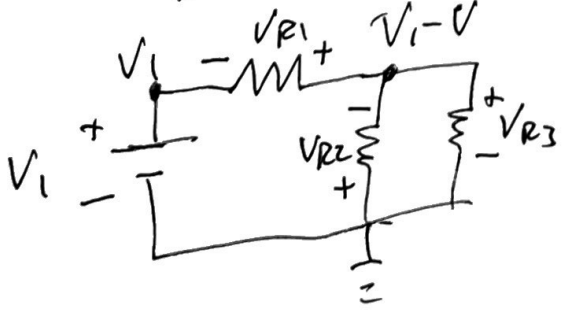
⑤ Kirchoff's Voltage Law?



$-2V + V_{R1} = 0$

$V_{R1} = 2V$





Loop 1:

$-V_1 + V_{R1} + V_{R2} = 0$

Loop 3:

$-V_1 + V_{R1} + V_{R3} = 0$

Loop 2:

$-V_{R2} + V_{R3} = 0$

Loop 2

$V_{R2} = V_{R3}$

L1

$-V_1 + V_{R1} + V_{R2} = 0$

$-V_1 +$

$V_{R1} + V_{R2} = V_1$

$V_{R1} + V_{R3} = V_1$

$V_1 - V_{R1} = V_{R2}$

$V_1 - V_{R1} = V_{R3}$

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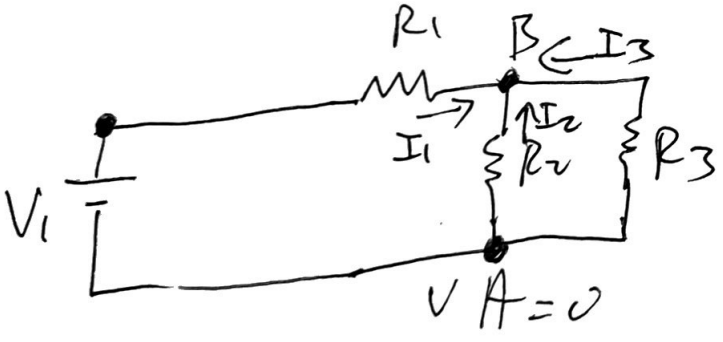
(5) Kirchoff's Current Law



Current in Current out

$I_1 + I_2 + I_3 = 0$

Node B ↗

$-I_1 - I_2 - I_3 = 0$

$-1(I_1 + I_2 + I_3) = 0$

$I_1 = \frac{V_{R1}}{R_1} = \frac{V_1 - V_B}{R_1}$

$I_3 = \frac{V_A - V_B}{R_3}$

$I_2 = \frac{V_A - V_B}{R_2}$

Resistor

$V_R = I_R R$

Inductor

$V = L \frac{di}{dt}$

Capacitor

$I = C \frac{dv}{dt}$