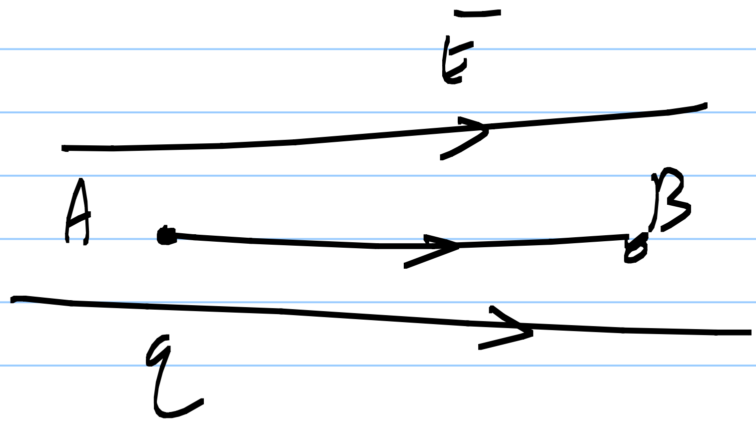
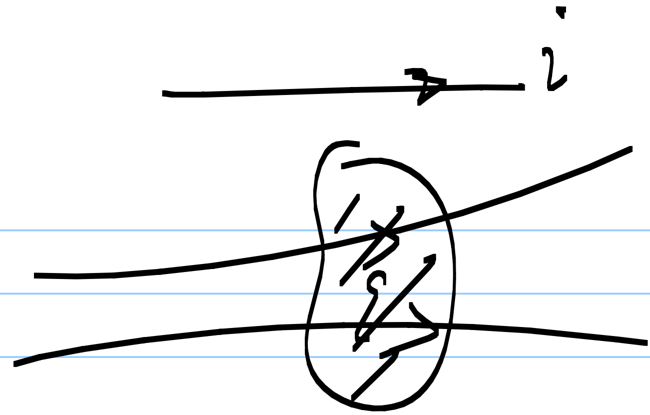
EE 2015 — 4/8/2017

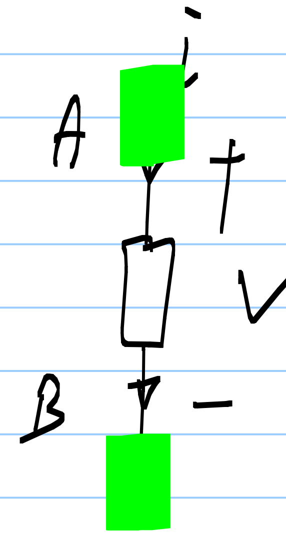


A charge q moving from A to B loses potential energy $= q(V_A - V_B)$

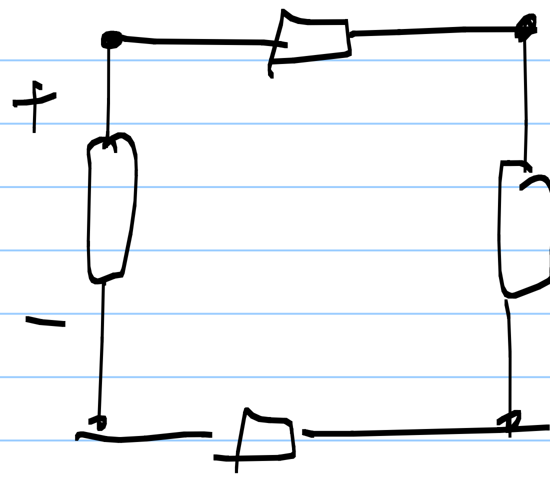
$V_A - V_B$: Potential difference (Voltage)



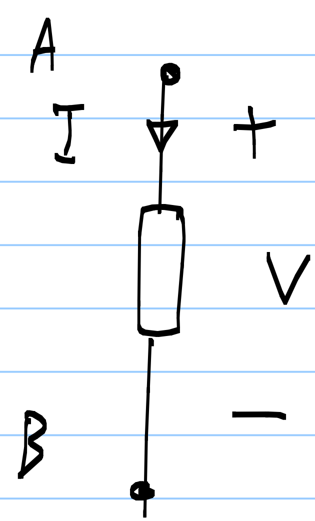
$i = \frac{dq}{dt}$



<u>wires</u>: connecting elements



Two-terminal element



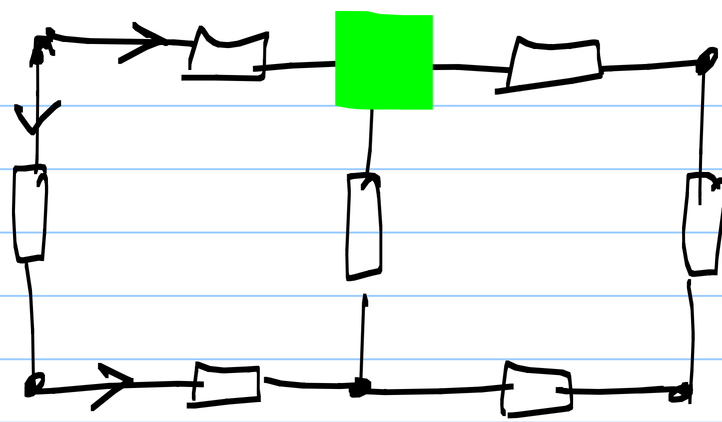
Passive sign convention

interval Δt

charge Δq goes from A to B

Rate of P.E. lost $\left(\frac{\Delta q}{\Delta t}\right) \cdot V$

Power lost in the device : $I \cdot V$



Circuit analysis:

Determine

V across

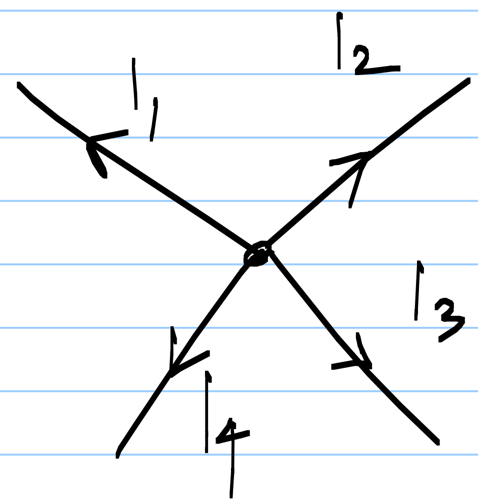
I through every element

Kirchhoff's current law

voltage law

Node: Point of connection of 2 or more elements

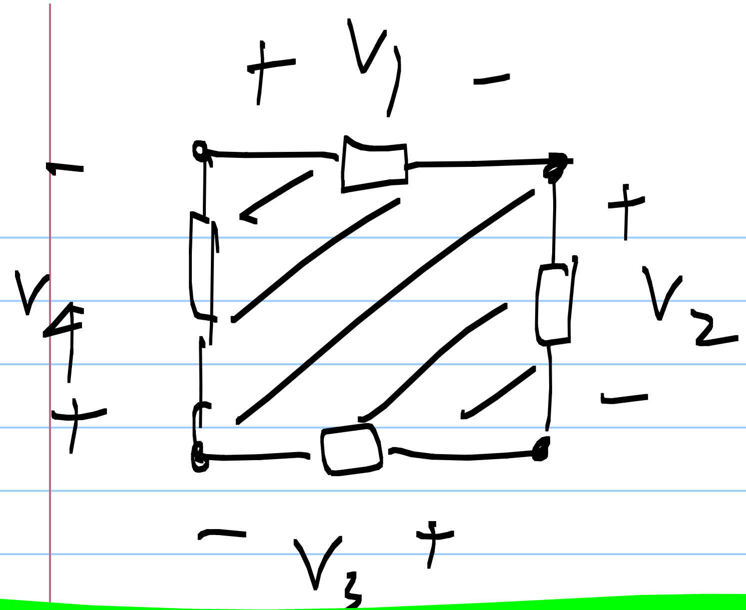
KCL



$I_1 + I_2 + I_3 + I_4 = 0$

Sum of currents leaving a node (closed surface) = 0

No local charge accumulation



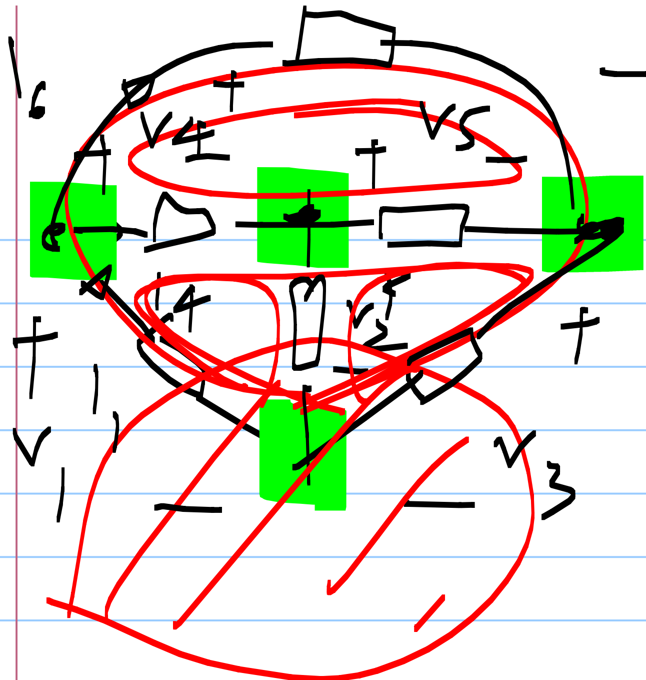
Kirchhoff's voltage law

$$v_1 + v_2 + v_3 + v_4 = 0$$

$$\nabla \times \bar{E} = -\frac{\partial \bar{B}}{\partial t}$$

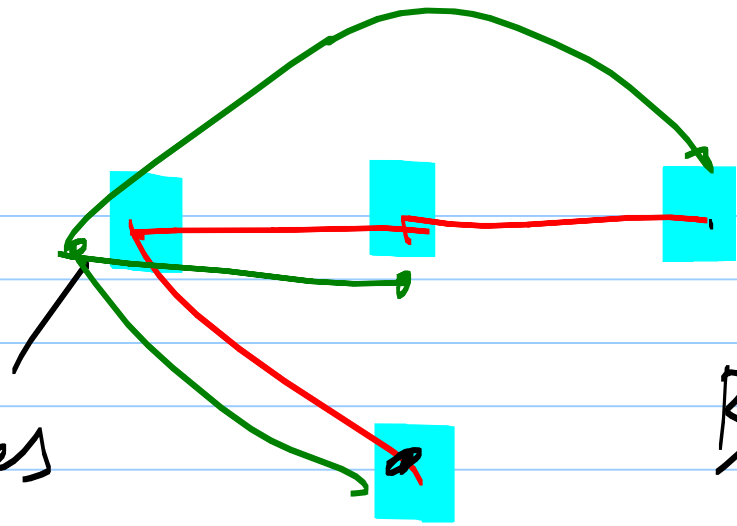
Neglecting changing magnetic flux in the loop.

sum of voltage drops around a loop = 0



N

Nodes



B branches

$$N \le B \le \frac{N(N-1)}{2}$$

$$I_1 + I_4 + I_6 = 0$$

$$V_4 + V_2 - V_1 = 0$$

$$B - (N-1)$$

VL eg.

Circuit w/ B Branches & N nodes

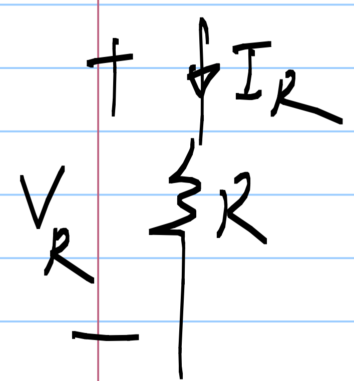
KCL : $N-1$

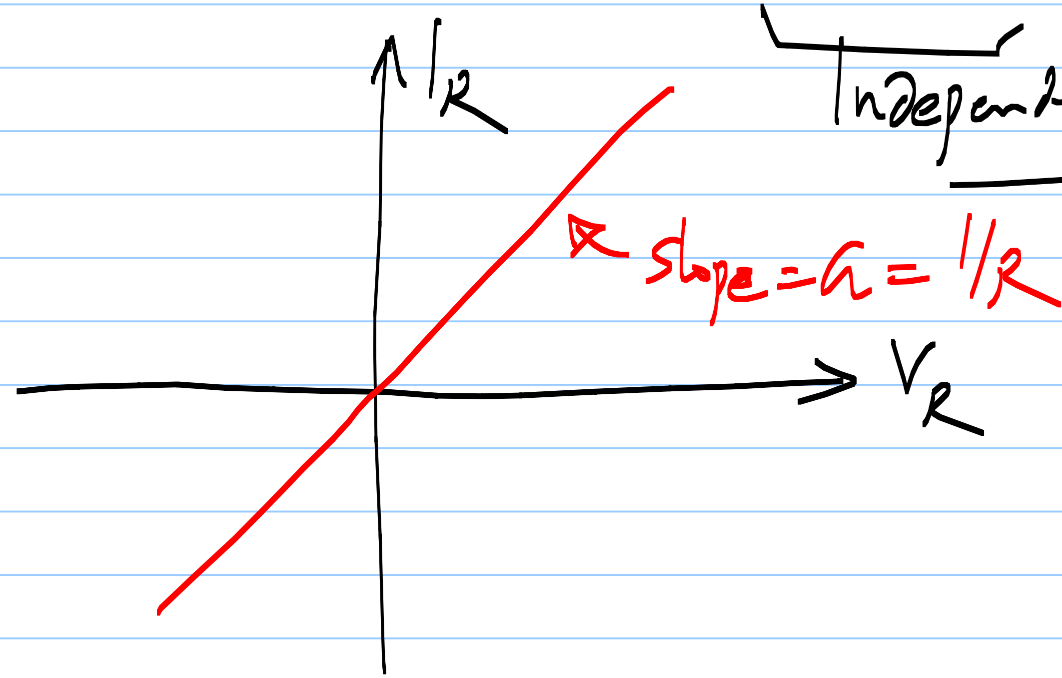
KVL : $B-N+1$

Need $2B$ equation

B

Two-terminal elements: R, C, L, V_s, I_s, (Independent source)

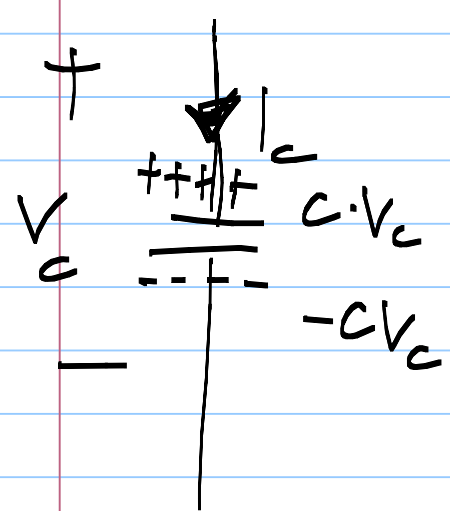




$V_R = I_R \cdot R$ (Resistance)

$I_R = G \cdot V_R$ (Conductance)

C



$$I_c = C\frac{dV_c}{dt}$$

$$\frac{d}{dt}(CV_c)$$

$$C\frac{dV_c}{dt}$$