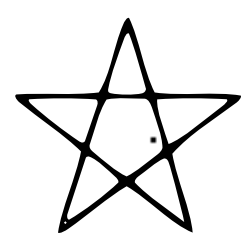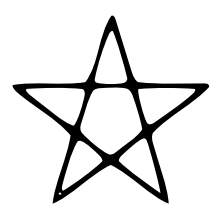# Voltage and Current Sources
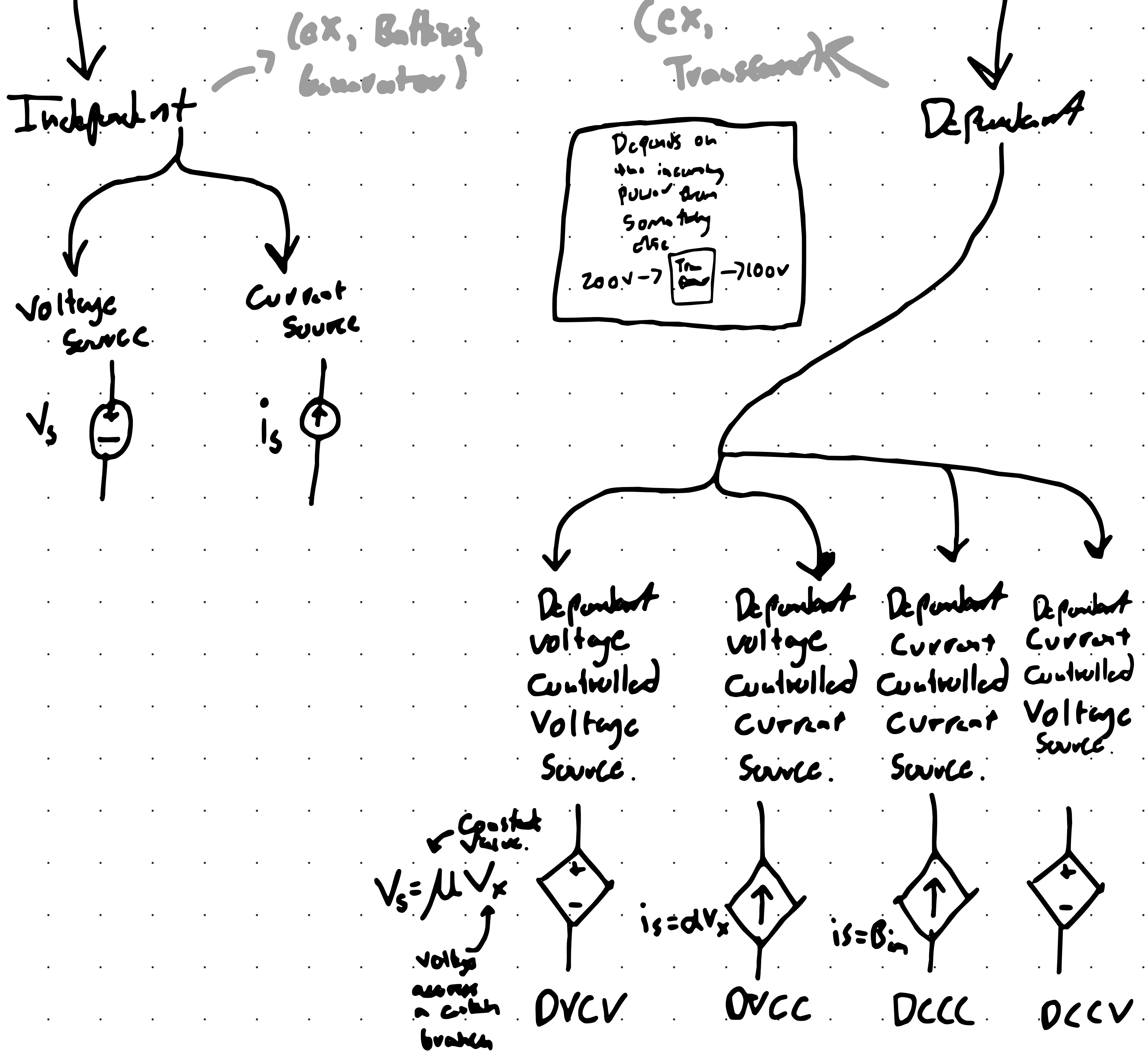
☆ <u>Ideal Voltage Source</u>: is a current element that maintains a prescribed voltage across its terminals <u>regardless of the current flowing</u> in these terminals.

☆ <u>Ideal Current Source</u>: is a circuit element that maintains a prescribed current through its terminals <u>regardless of the voltage across</u> these terminals.

- Active circuit elements <u>generate</u> power
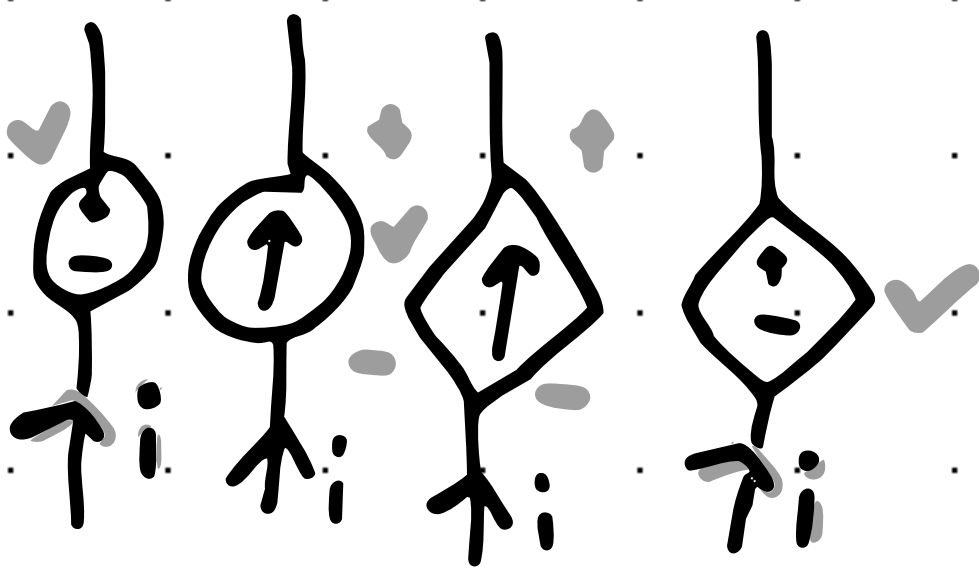- Passive circuit elements <u>absorb</u> power

(i.e, Resistor)

Types of Sources

Independent

(ex, Transformer)

Dependent

Depends on the incoming pulse from something else

$200V \rightarrow$ [Transformer] $\rightarrow 100V$

Independent

Voltage Source

V_s

Current Source

i_s

Dependent

Dependent Voltage Controlled Voltage Source.

Dependent Voltage Controlled Current Source.

Dependent Current Controlled Current Source.

Dependent Current Controlled Voltage Source.

Constant value.

$V_s = \mu V_x$

voltage across a certain branch

DVCV

$i_s = \alpha V_x$

DVCC

$i_s = \beta i_{in}$

DCCC

DCCV

The Current flows from ⊖ to ⊕

Types of elements in any circuit

Active

The current flows from ⊖ to ⊕

The power is generated

$$P = -vi$$

Dead/
Charging
Batteries

Inductor   Resistor   capacitor

Passive

The Current flows from ⊕ to ⊖

The power is absorbed.

$$P = vi$$

Batteries Can be either or!
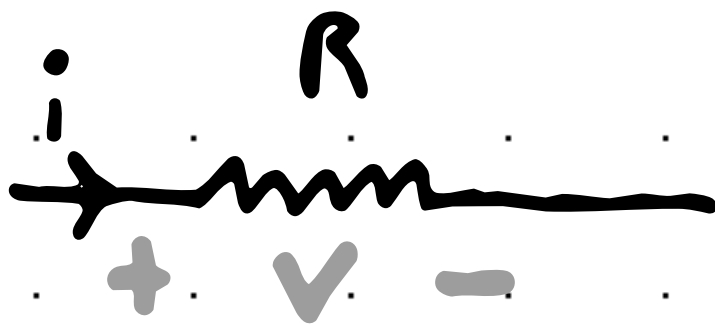
Depending on charging or not.

Ohm's Law

Ohm did a bunch of cool experiments with wires, to discover __Resistance!__
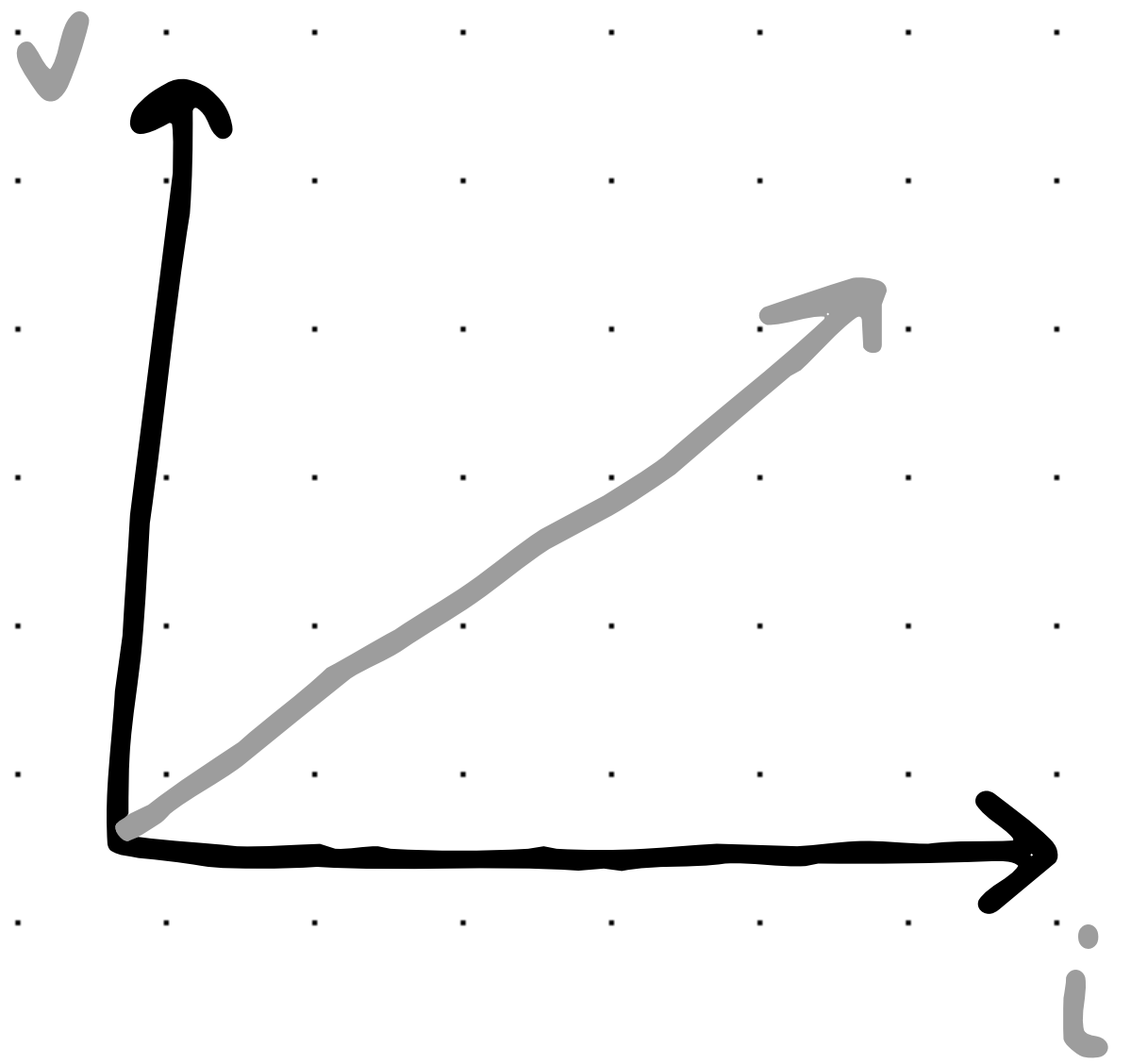
Giving us what we all know es...

$$V = IR$$

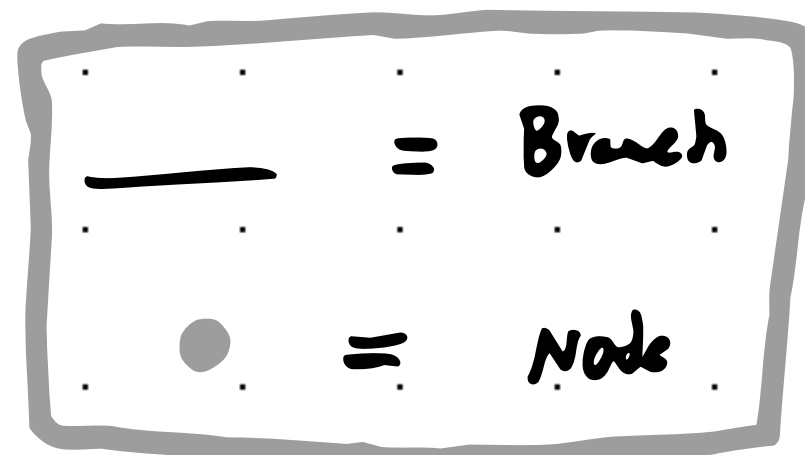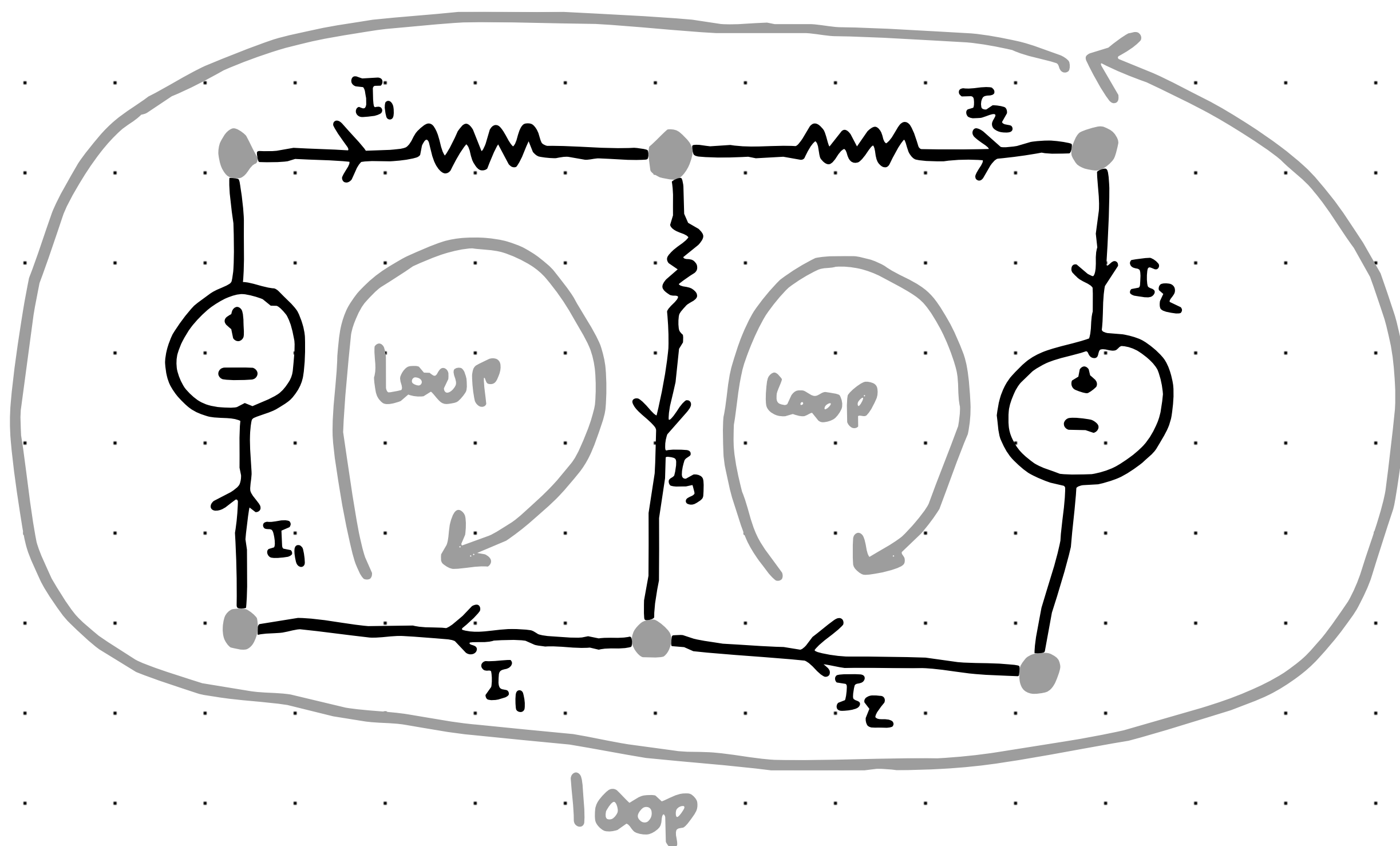R: __Resistance__ ⟶ Unit Ohms (Ω)

$$\frac{1}{R} = G: \underline{Conductance} \longrightarrow Unit \quad Siemens\ (S)$$

Mhos ($\mho$)

Kirchoff's Laws

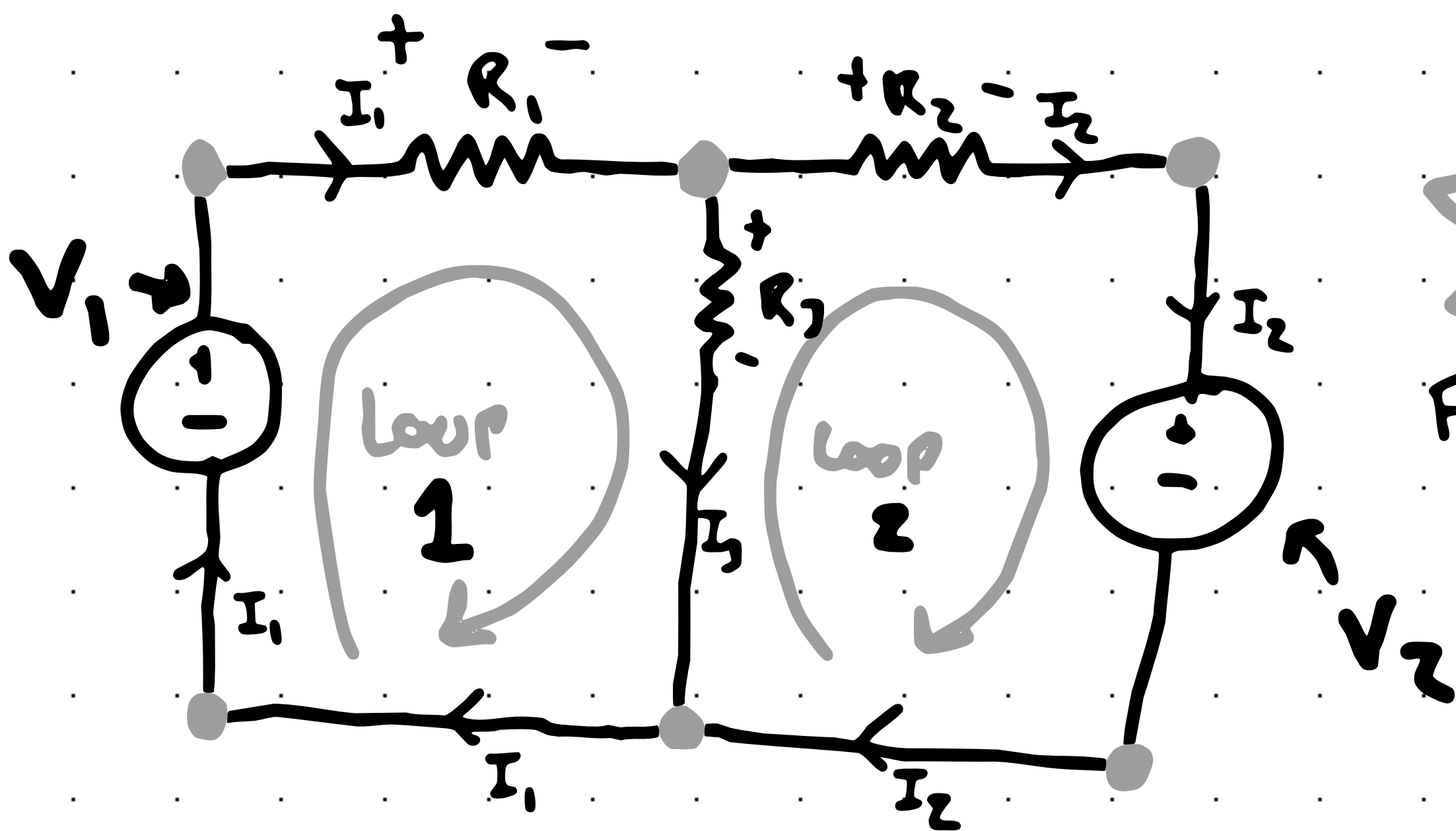|	
——	= Branch
●	= Node

$$\Sigma I = 0$$

At each node!

Let's assume the current entering the node is _positive_, and the current leaving is _negative_

ie, The sum of all currents going in is equal to the sum of all currents going out!

$$I_1 - I_2 - I_3 = 0$$

b) Kirchoff's Voltage laws (KCL)

$$\Sigma V = 0$$

For each loop

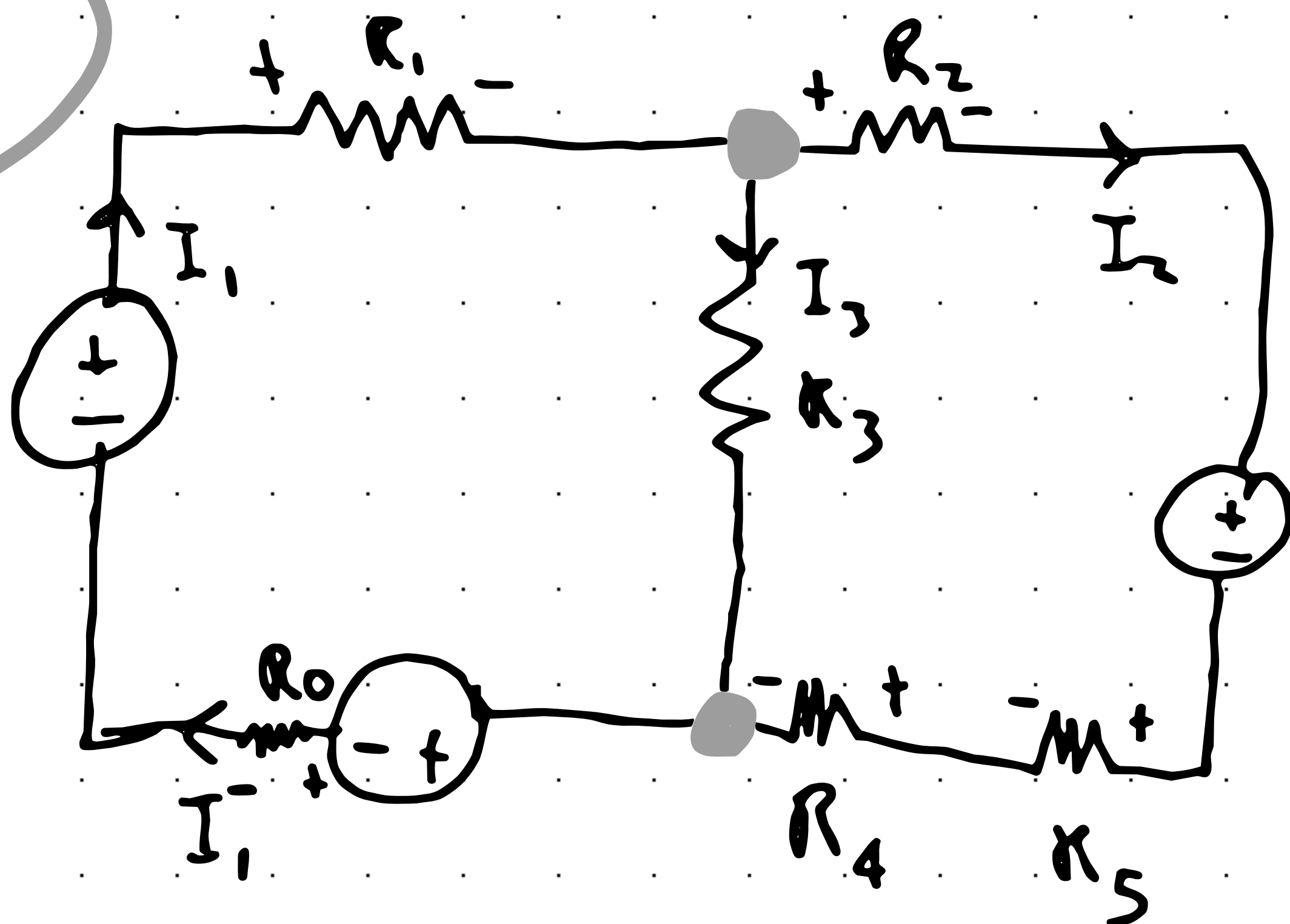It doesn't matter in which direction you travel around the loop, but **be consistent!**

Loop One

$$+V_1 - I_1 R_1 - I_3 R_3 = 0 \quad \circlearrowleft$$

Loop Two

$$-I_2 R_2 + I_3 R_3 - V_2 = 0 \quad \circlearrowleft$$

$$\Sigma I = 0$$

node 1

$$I_1 - I_2 - I_3 = 0$$

$$\Sigma V = 0$$
loop ①

$$-V_3 - I_1 R_0 + V_1 - I_1 R_1 - I_3 R_3 = 0$$

$$\Sigma V = 0$$
loop ②

$$-I_2 R_4 + I_3 R_3 - I_2 R_2 - V_2 - I_2 R_5 = 0$$