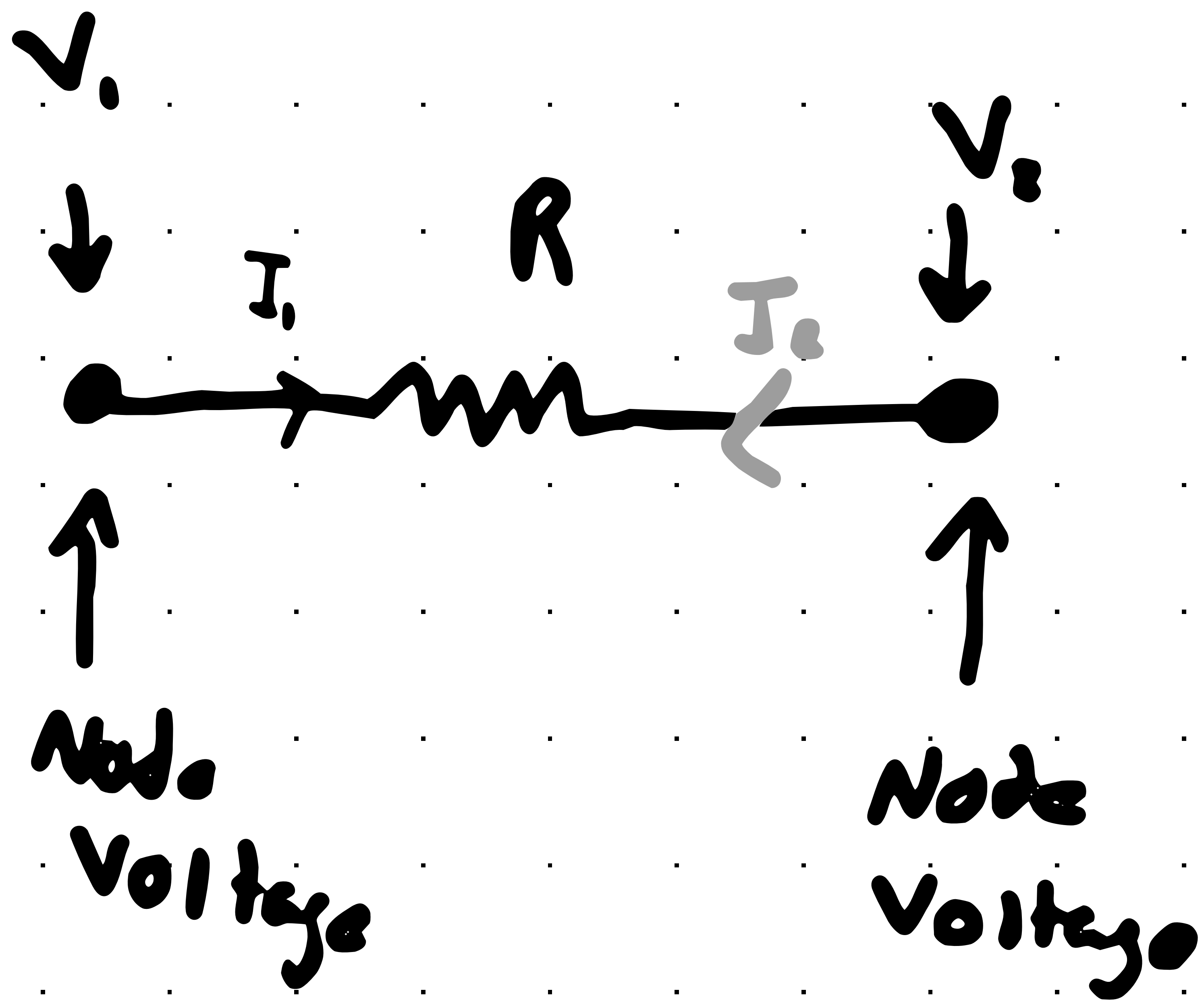
For any Resistor...

$$\boxed{I_1 = \frac{V_1 - V_2}{R}}$$



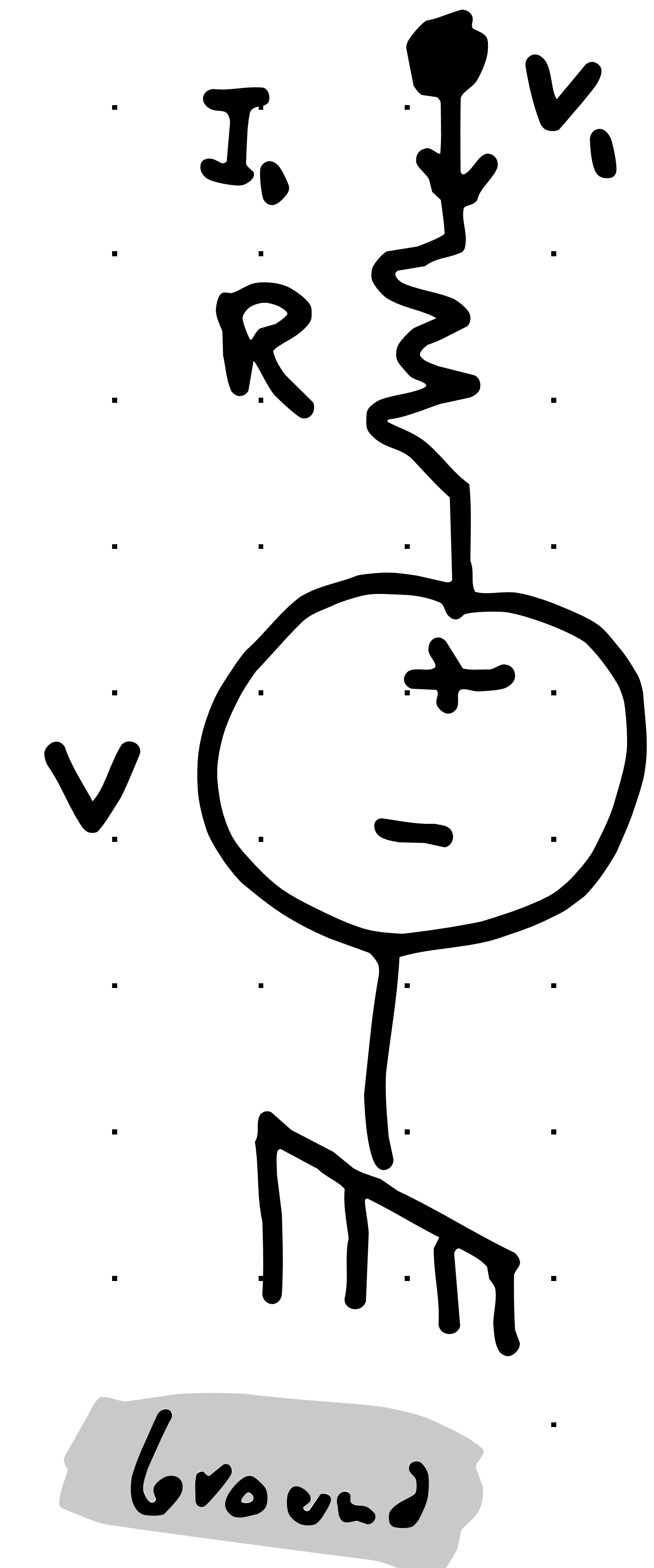
$$\boxed{I_2 = \frac{V_2 - V_1}{R}}$$

I_2 is going in the opposite direction

- I_1 and I_2 do NOT cancel each other out!
- They are the same current.

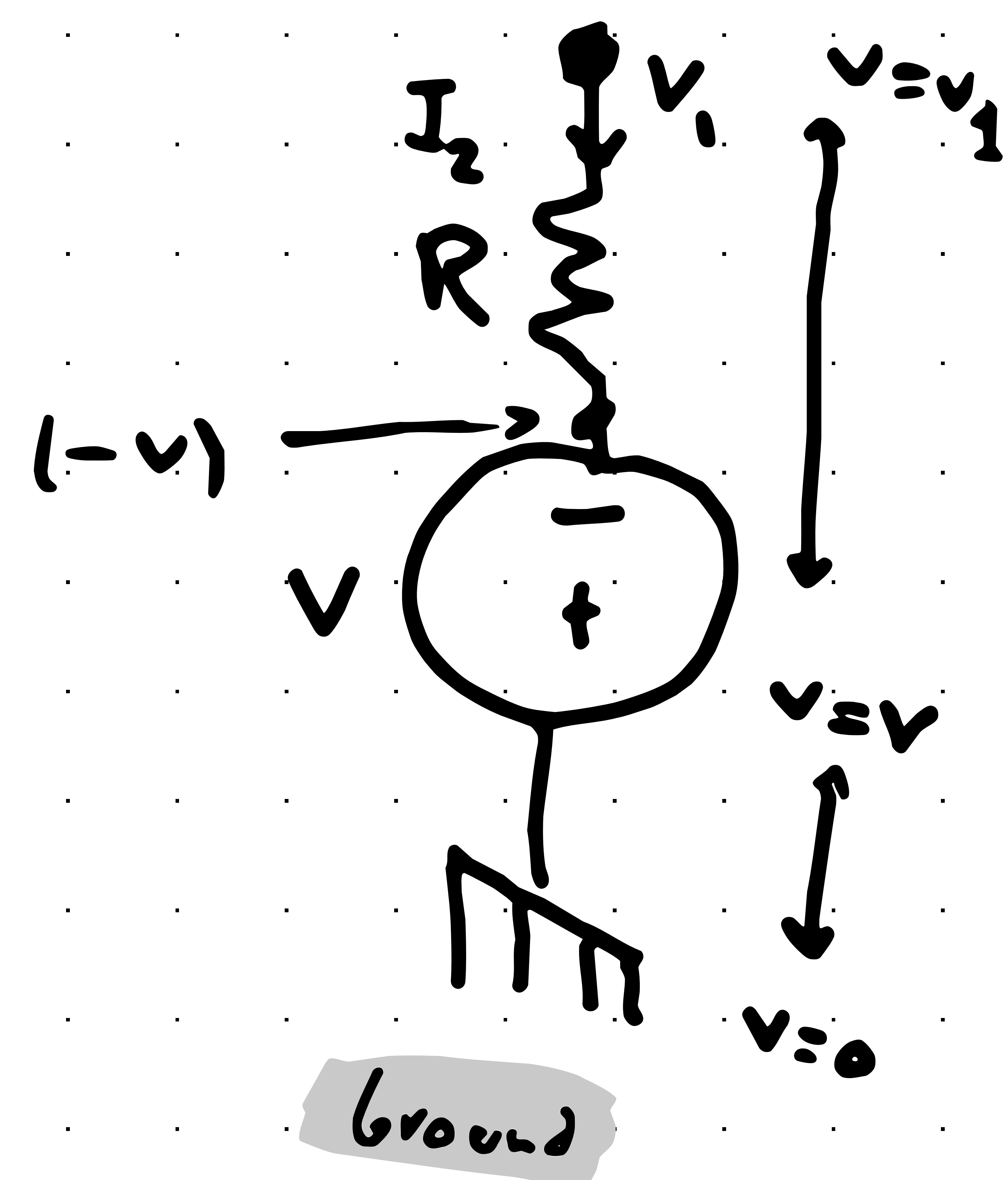
Here...

We are measuring the Voltage difference accross the Resistor



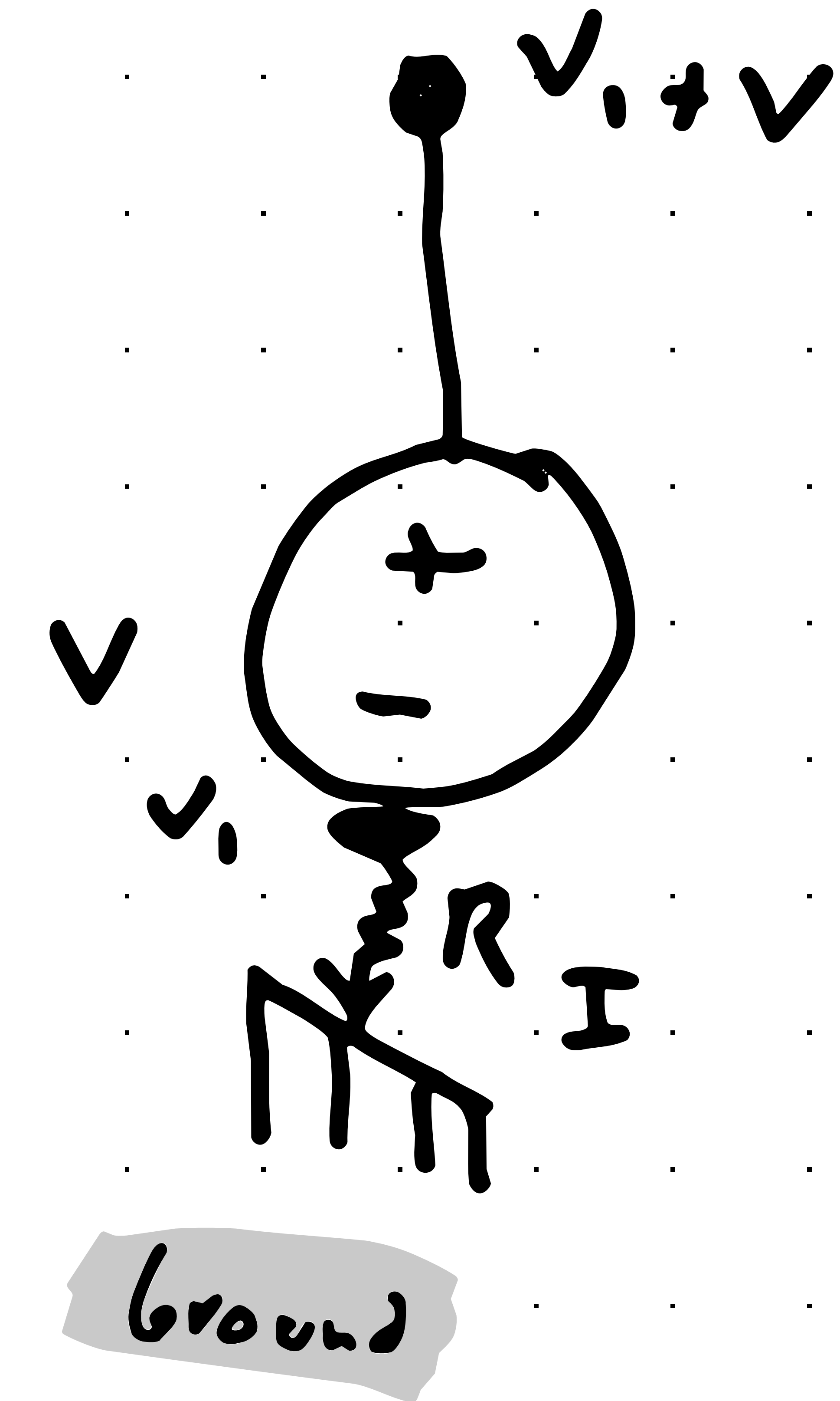
$$I_1 = \frac{V_1 - V}{R}$$

$$I_2 = \frac{V - (-V)}{R}$$



Polarity Flip!

$$I = \frac{V_1 - 0}{R}$$



1 Node-Voltage Method (Nodal Analysis)

1) Choose any node, and connect it to ground (its voltage will be zero.)

2) Define the voltage for all other nodes referred to the reference node.

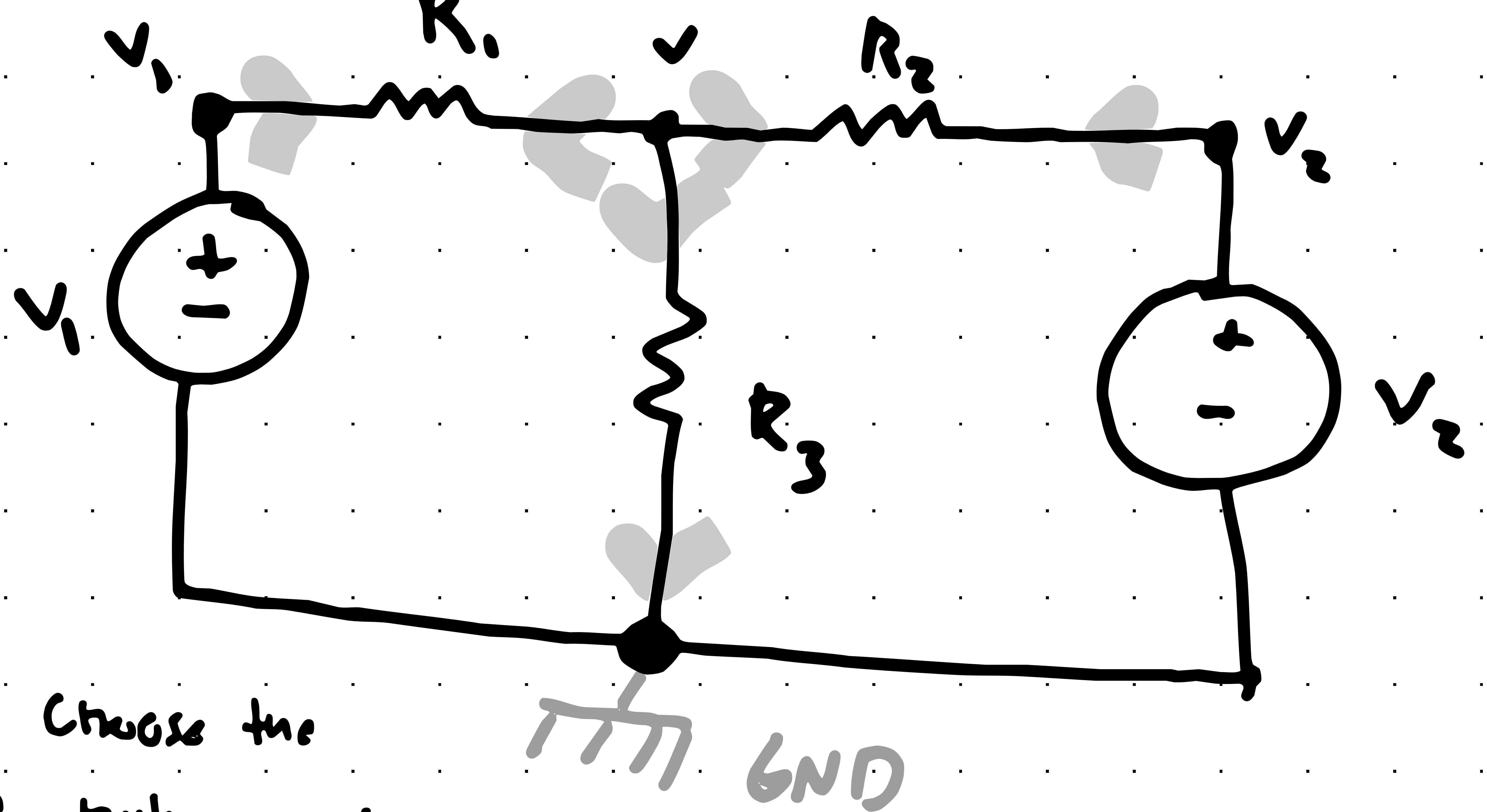
3) Use KCL ($\Sigma I = 0$)

all nodes but reference

4) Solve the resulting equations

⇒ For simplicity, assume all currents are leaving the node.

Example



We'll choose the bottom node as the reference, for simplicity, and it is connected to most sources.

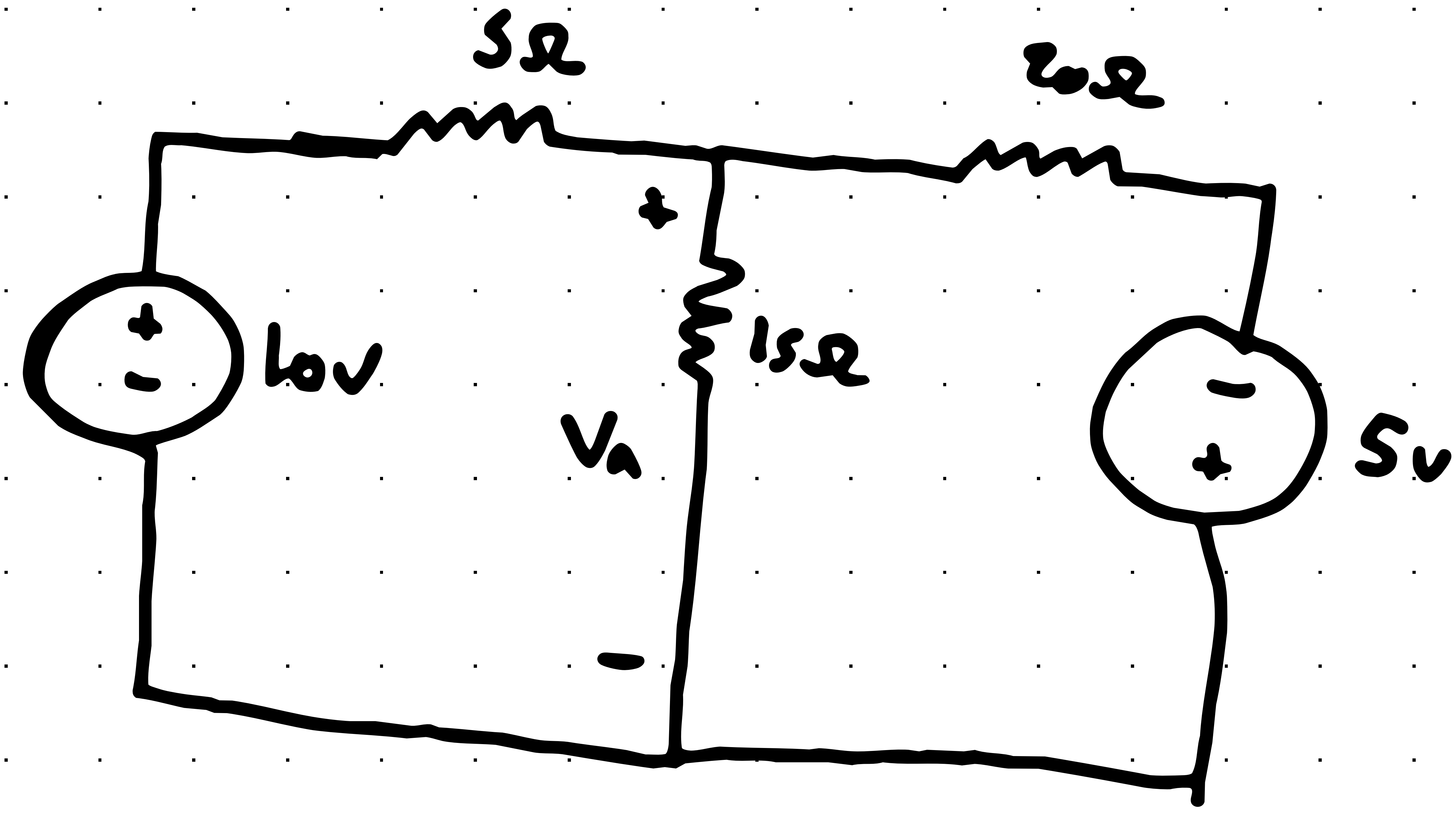
$$\sum I = 0 \qquad \frac{V - V_1}{R_1} + \frac{V - 0}{R_3} + \frac{V - V_2}{R_2} = 0$$

Node (1)

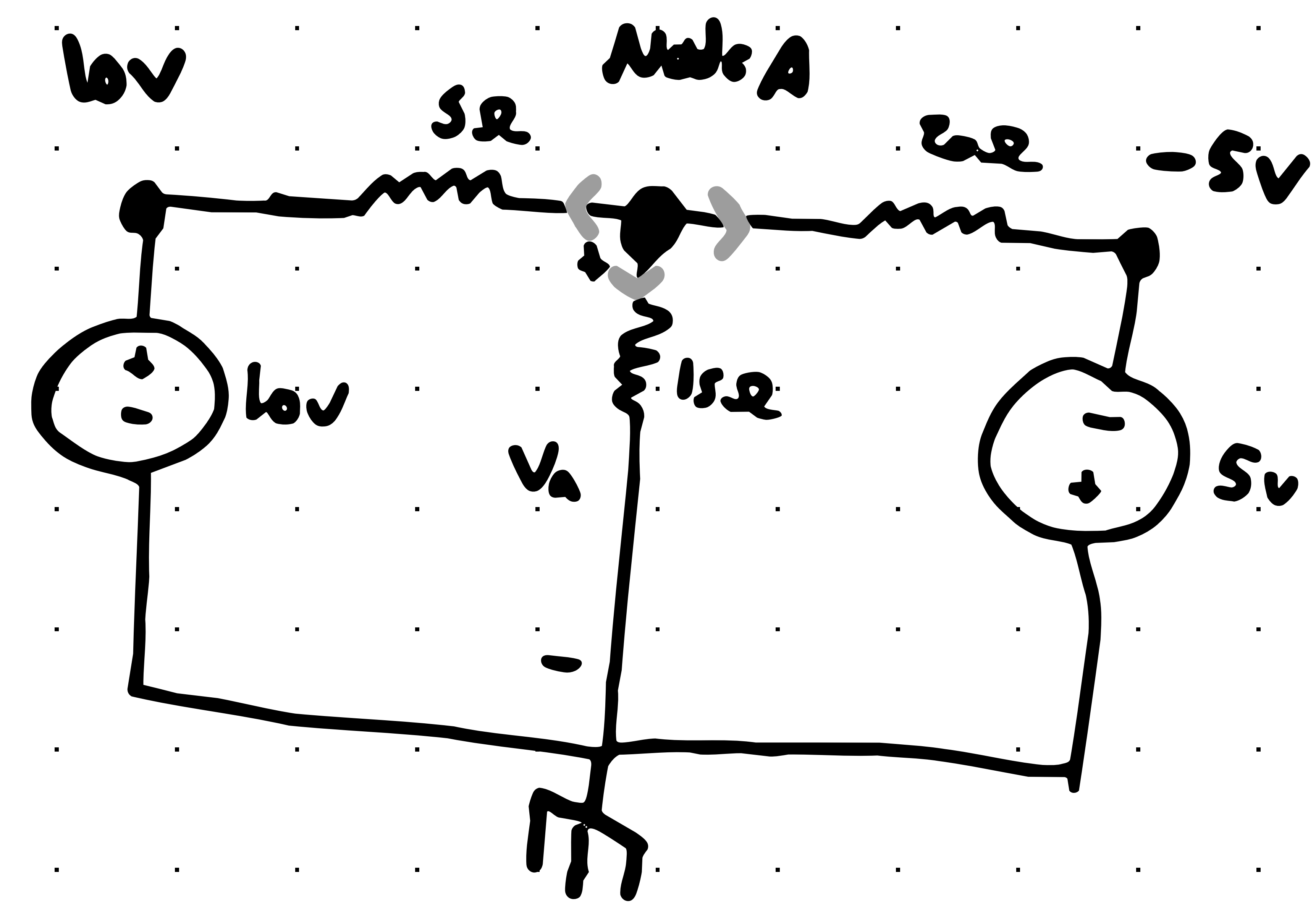
We only have one unknown now!
Pretty Sweet!

Example 2

- Use Node Voltage method to calculate V_a



Solution



$\sum I = 0$

Node A $\quad \dfrac{V_a - 10}{5} + \dfrac{V_a - 0}{15} + \dfrac{V_a - (-5)}{20} = 0$

Common denominator, 60, multiply all terms by 60 and divide.

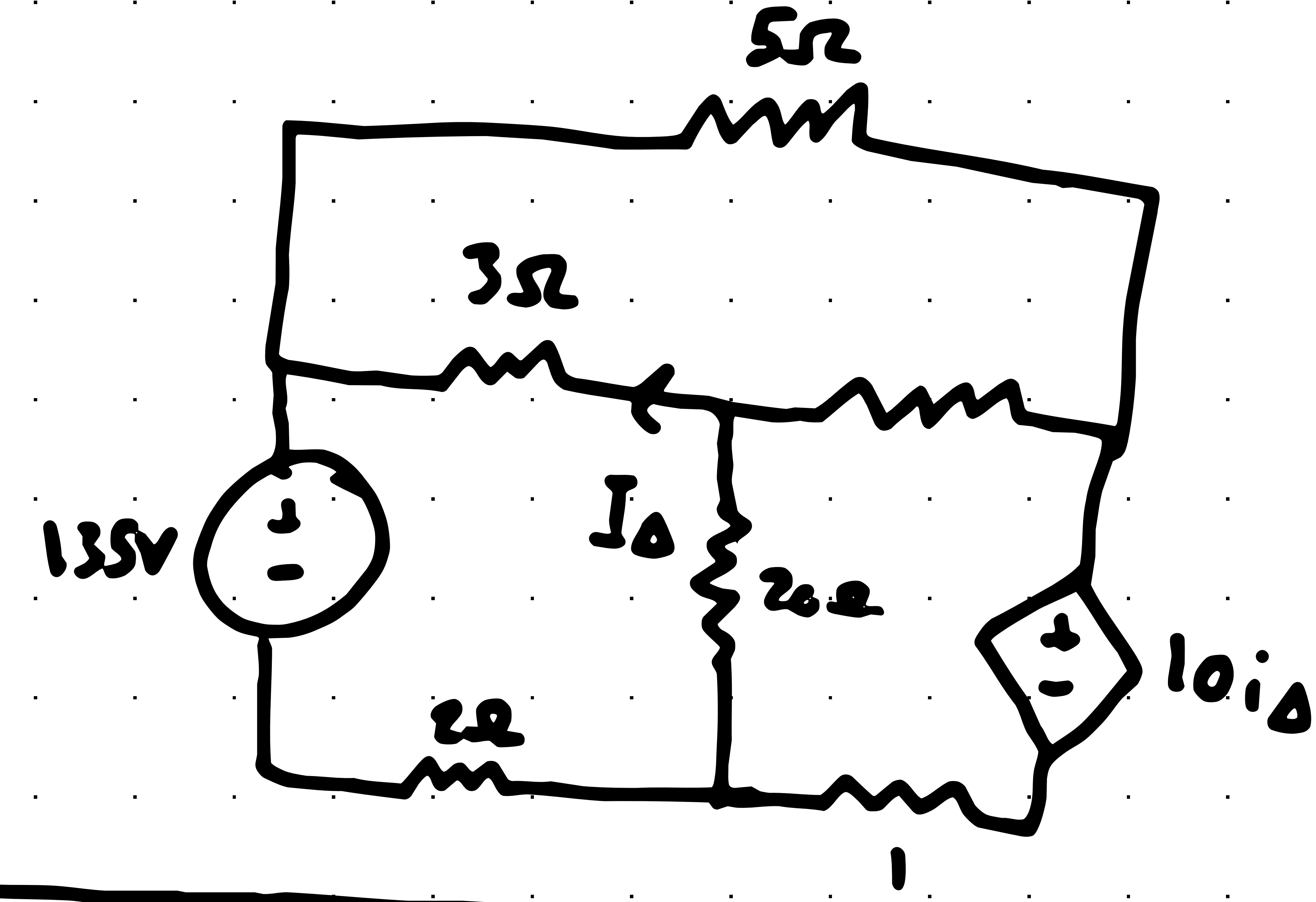
$$12(V_a - 10) + 4(V_a - 0) + 3(V_a + 5) = 0$$

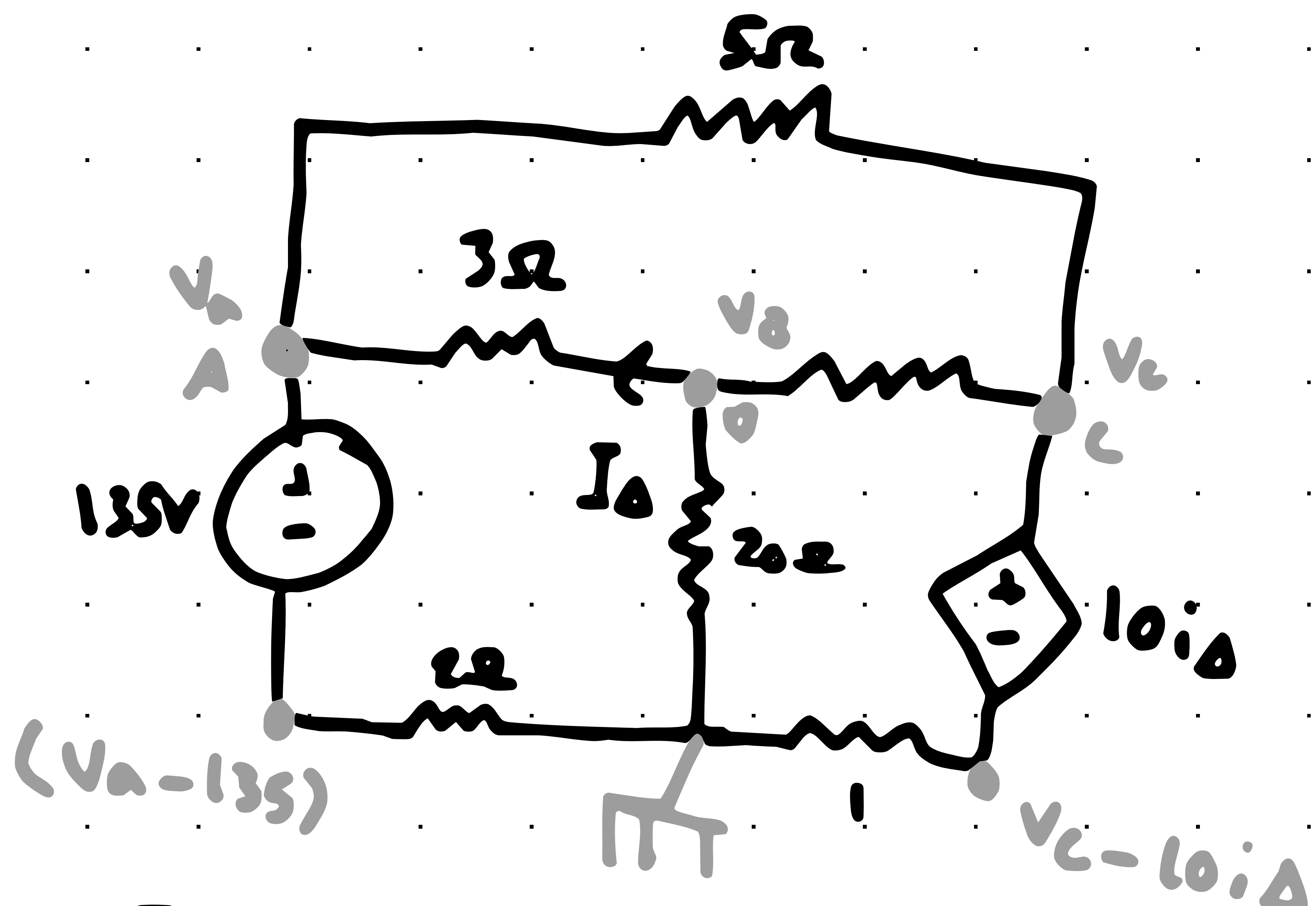
$$12V_a - 120 + 4V_a + 3V_a + 15 = 0$$

$$19V_a = 105$$

$$V = \frac{105}{19} = 5.53V$$

Example 3





[redacted]

$$i_\Delta = \frac{VB - VA}{3}$$

$\sum I = 0$ @Node A

$$\frac{Va - 135}{2} + \frac{Va - vc}{5} + \frac{Va - VB}{3} = 0$$

$\sum I = 0$ @Node B

$$\frac{Vb - Va}{3} + \frac{Vb - 0}{20} + \frac{vb - vc}{1} = 0$$

$\sum I = 0$ @Node C

$$\frac{VC - Va}{5} + \frac{VC - VB}{4} + \frac{Vc - 10i_\Delta}{1} = 0$$