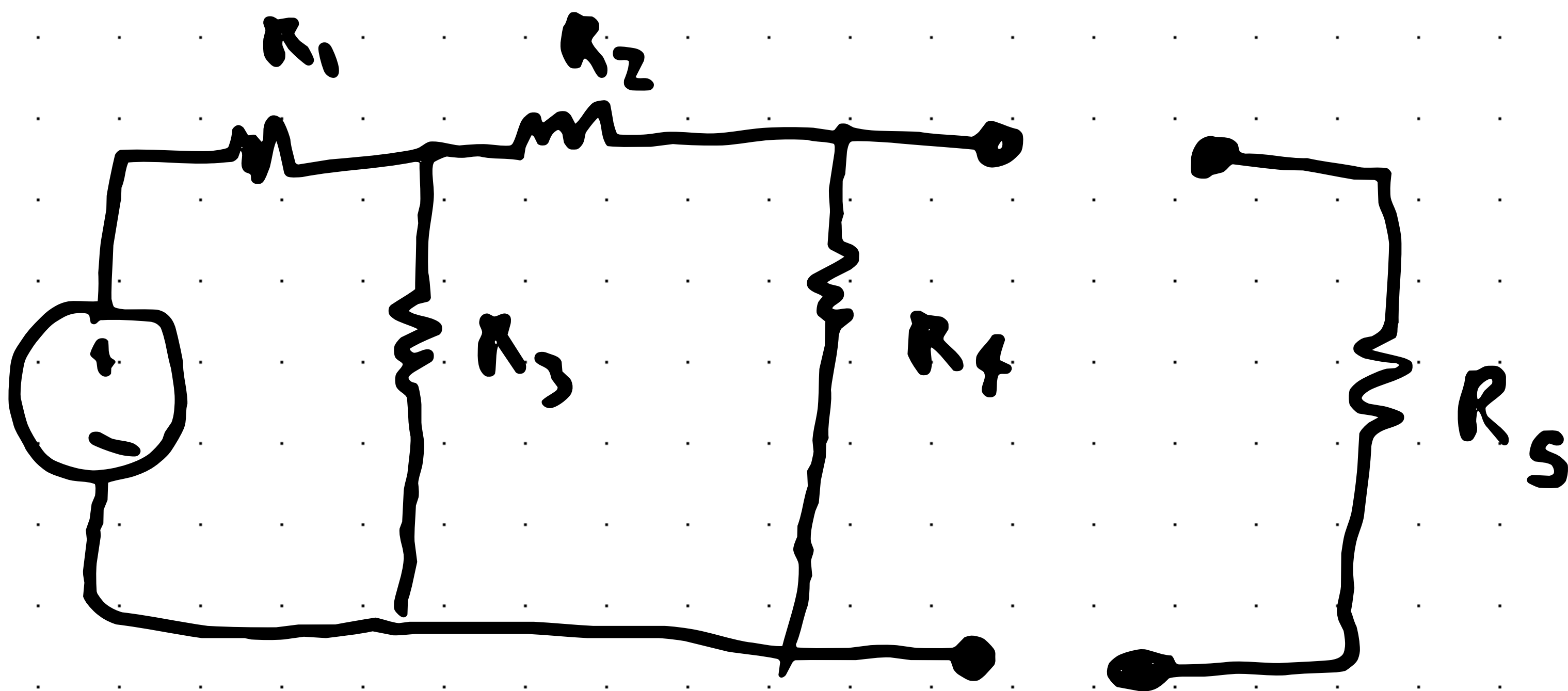


Open Circuit (O.C)



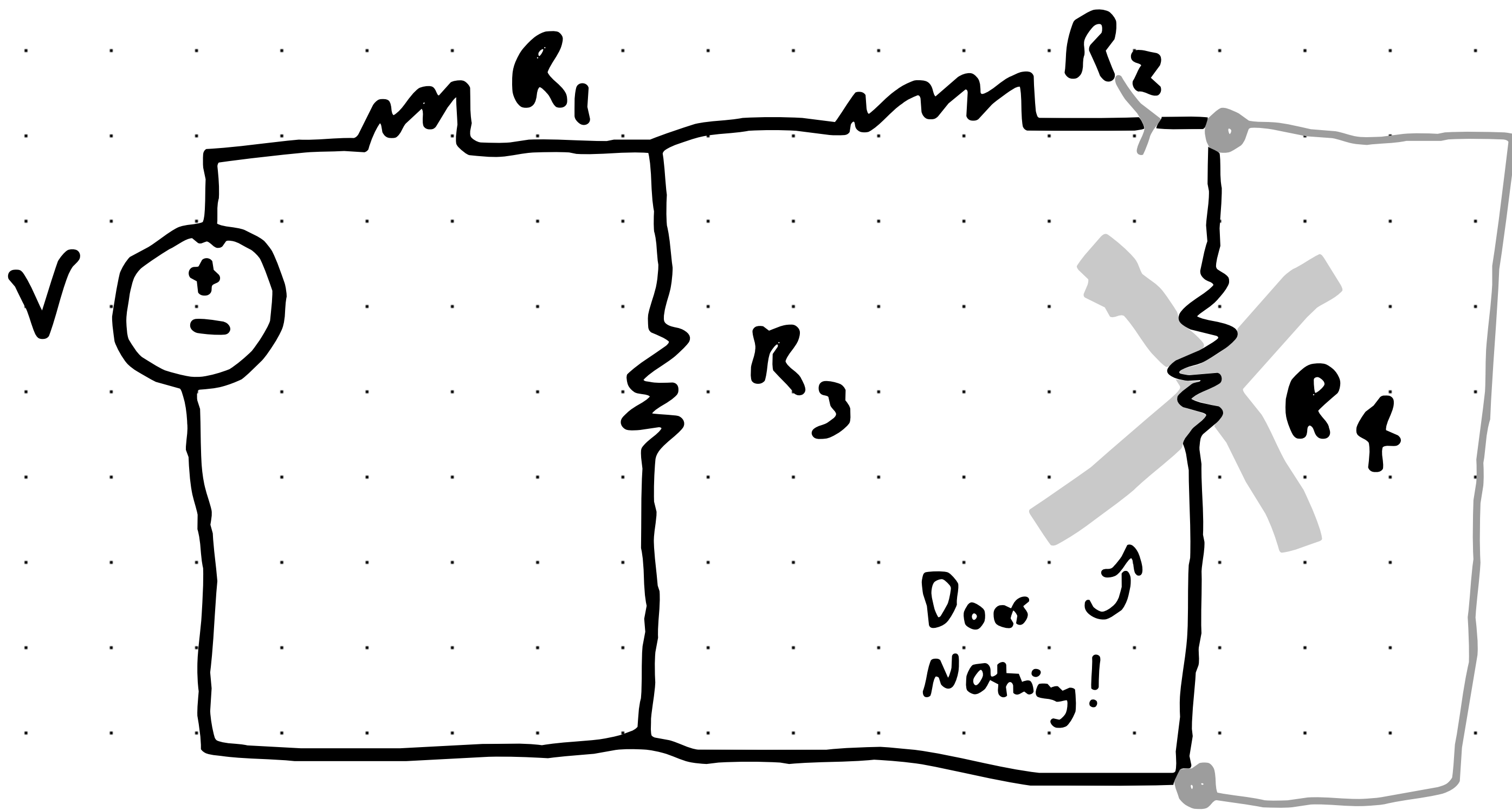
For an open circuit:

$$I = 0$$

But There is voltage!

would you stick your finger in
an outlet?

Short circuit (S.C)



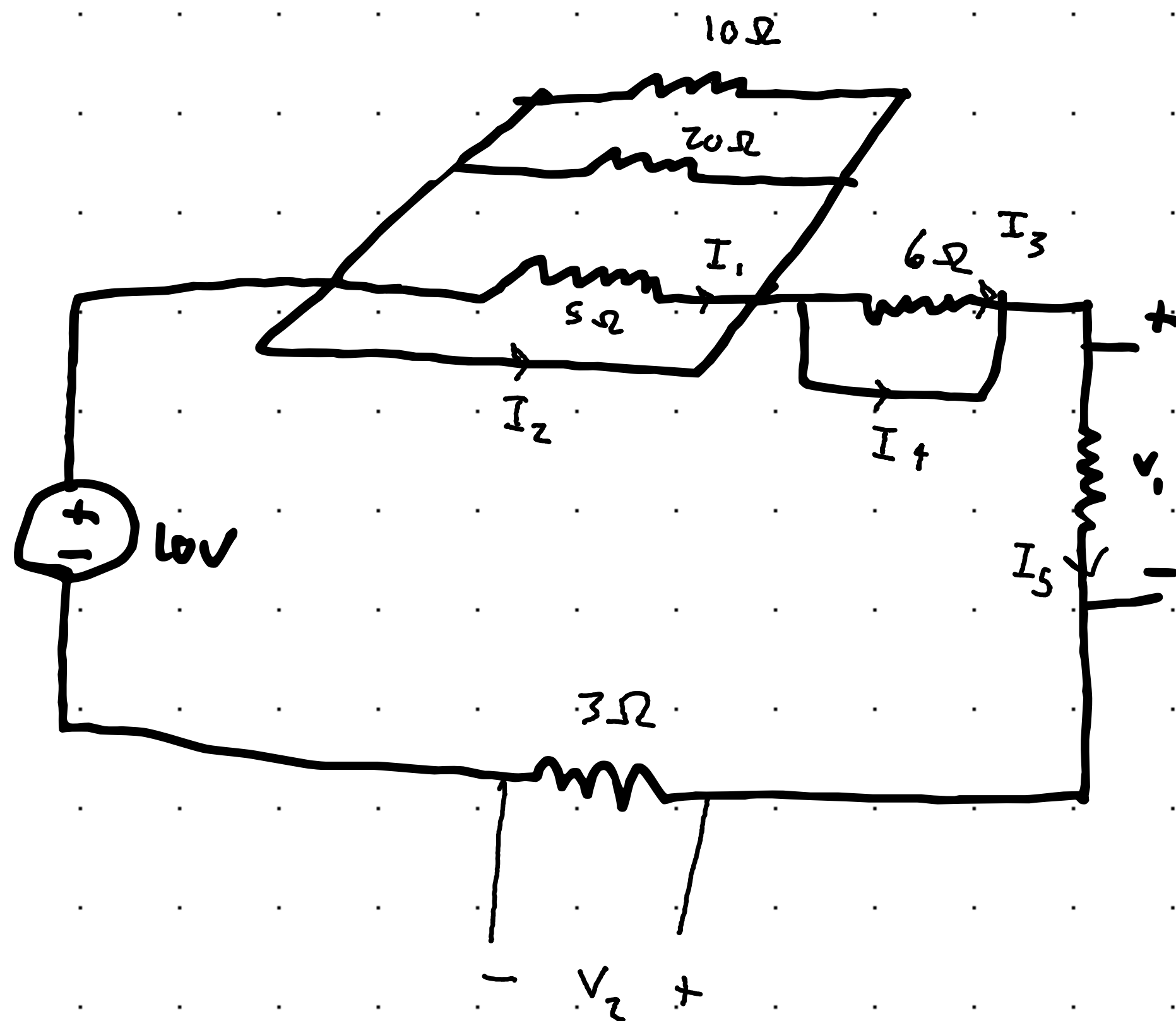
Why would I go through a resistor when it doesn't have to?

Currents prefer lower resistance values.

There is a current in the short circuit branch, but the voltage is equal to zero.

$$V = I(0)$$

Example 1



Sol.

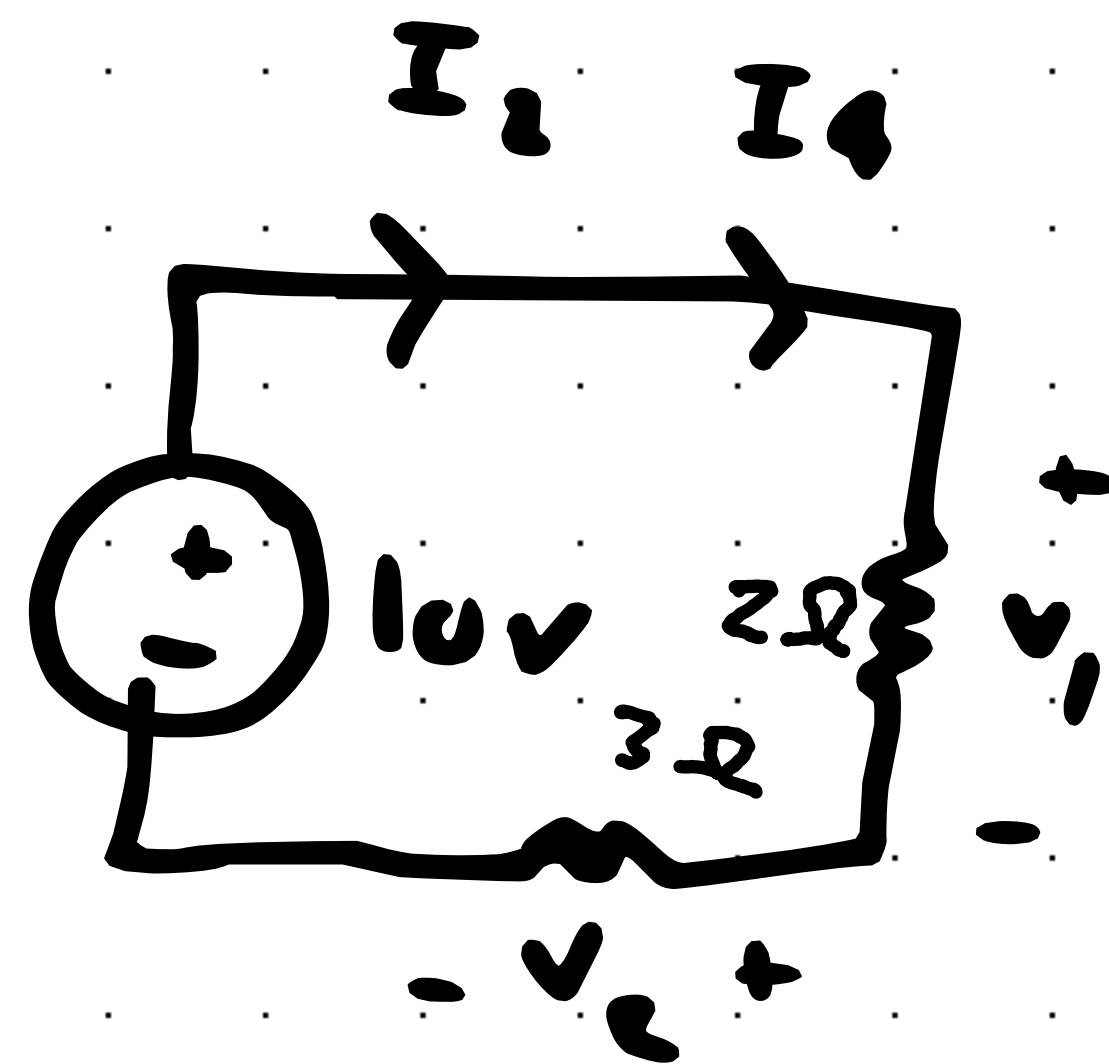
$I_3 = 0$ Because of S.C

$I_1 = 0$ Because of S.C

$$I_2 = I_4 = \frac{10}{5} = \underline{2A}$$

$$V_1 = IR$$

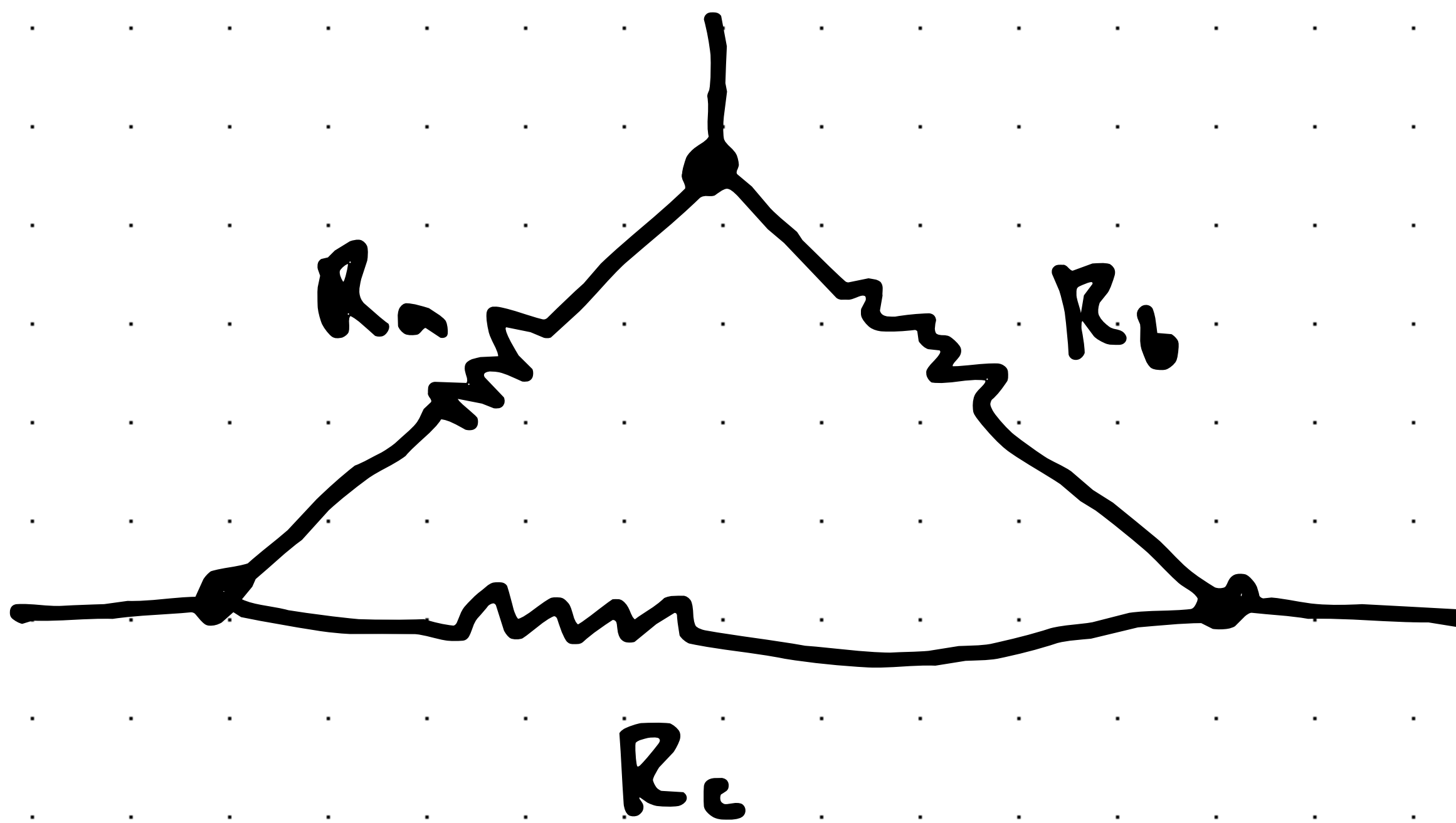
$$(2)(2) = \underline{4V}$$



$$V_2 = (2)(3) = \underline{6V}$$

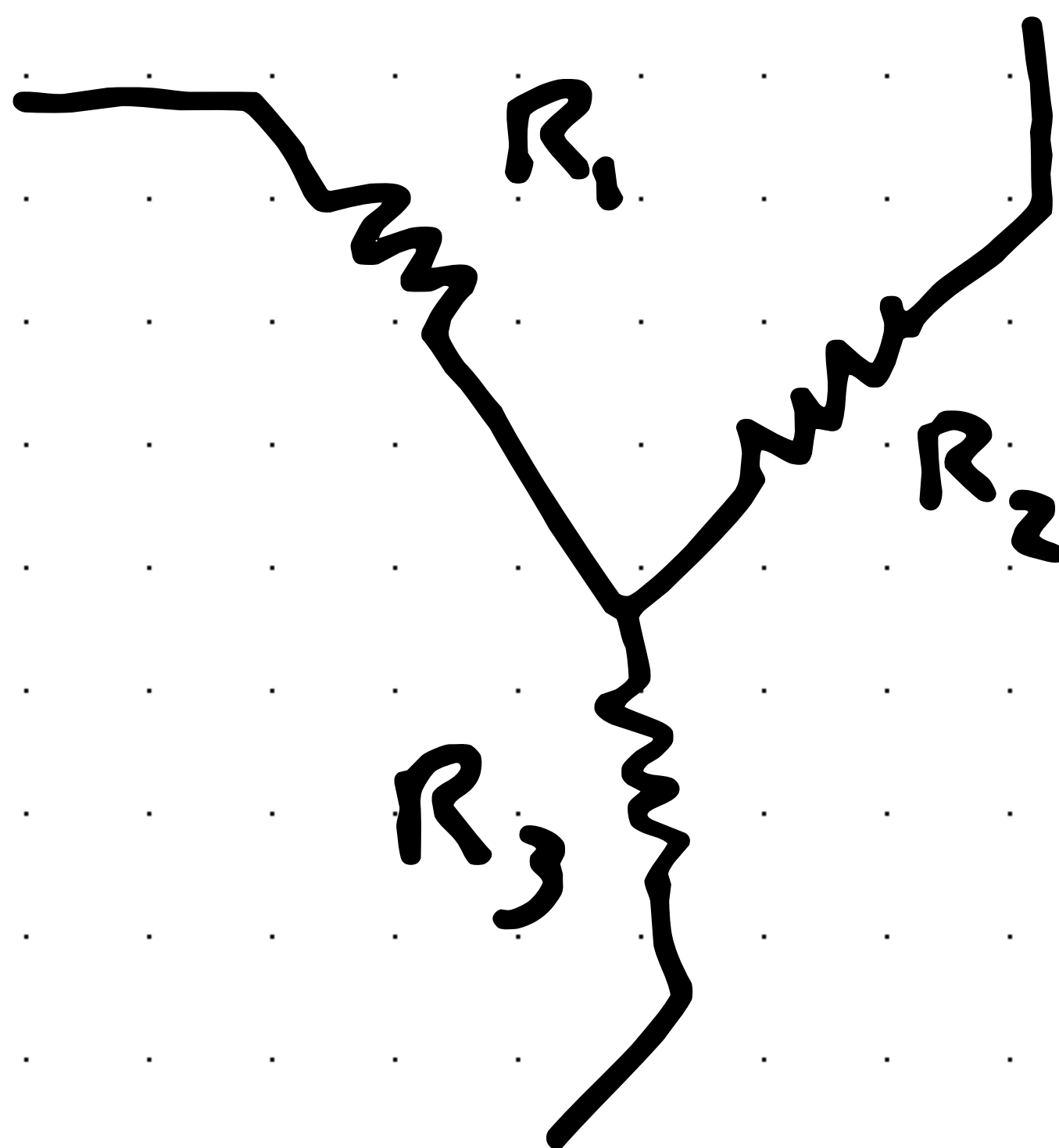
$$R_{total} = 3\Omega + 2\Omega = 5\Omega$$

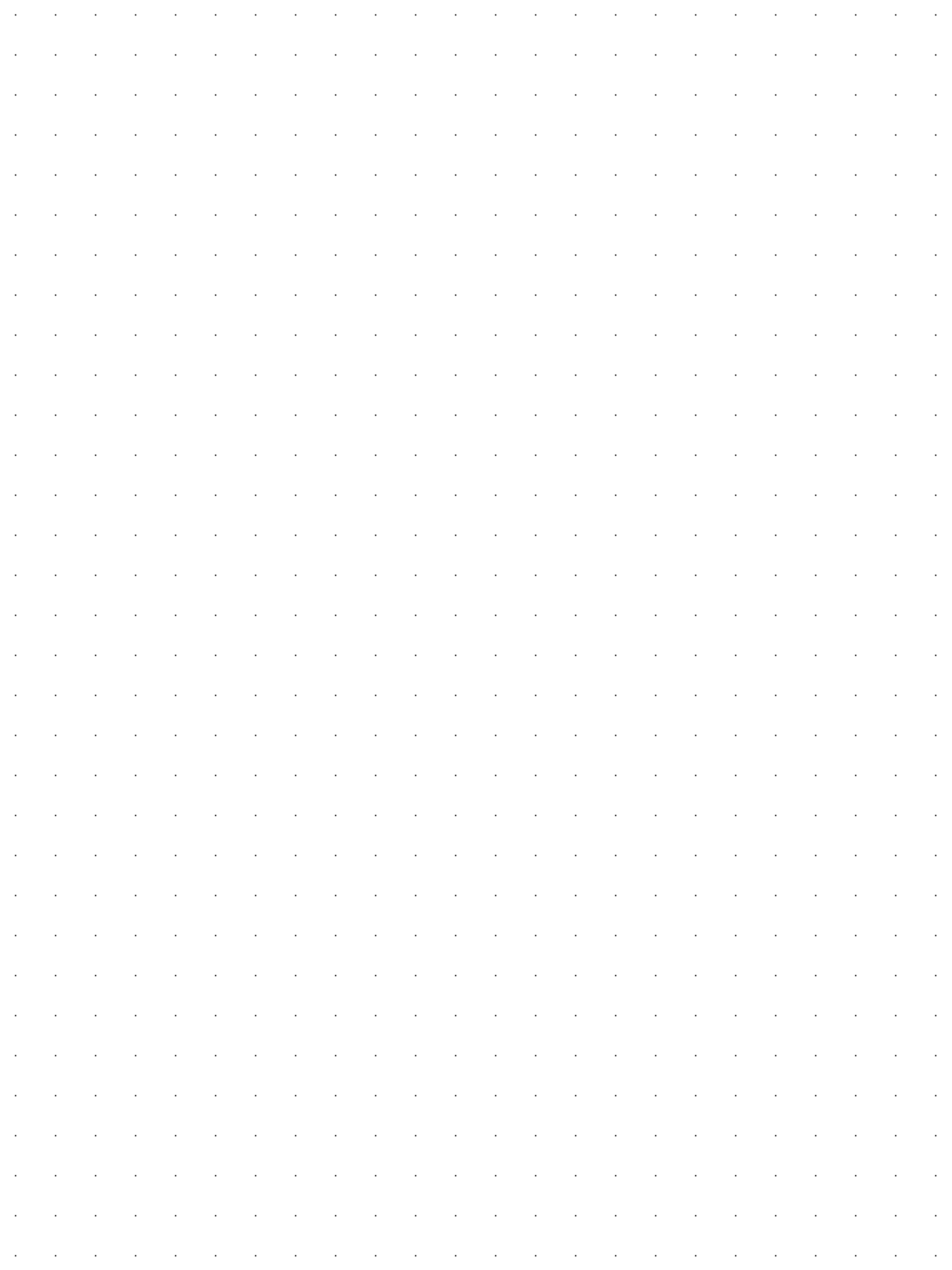
Delta Connections



Three Branches, connected by three nodes,
in a closed loop.

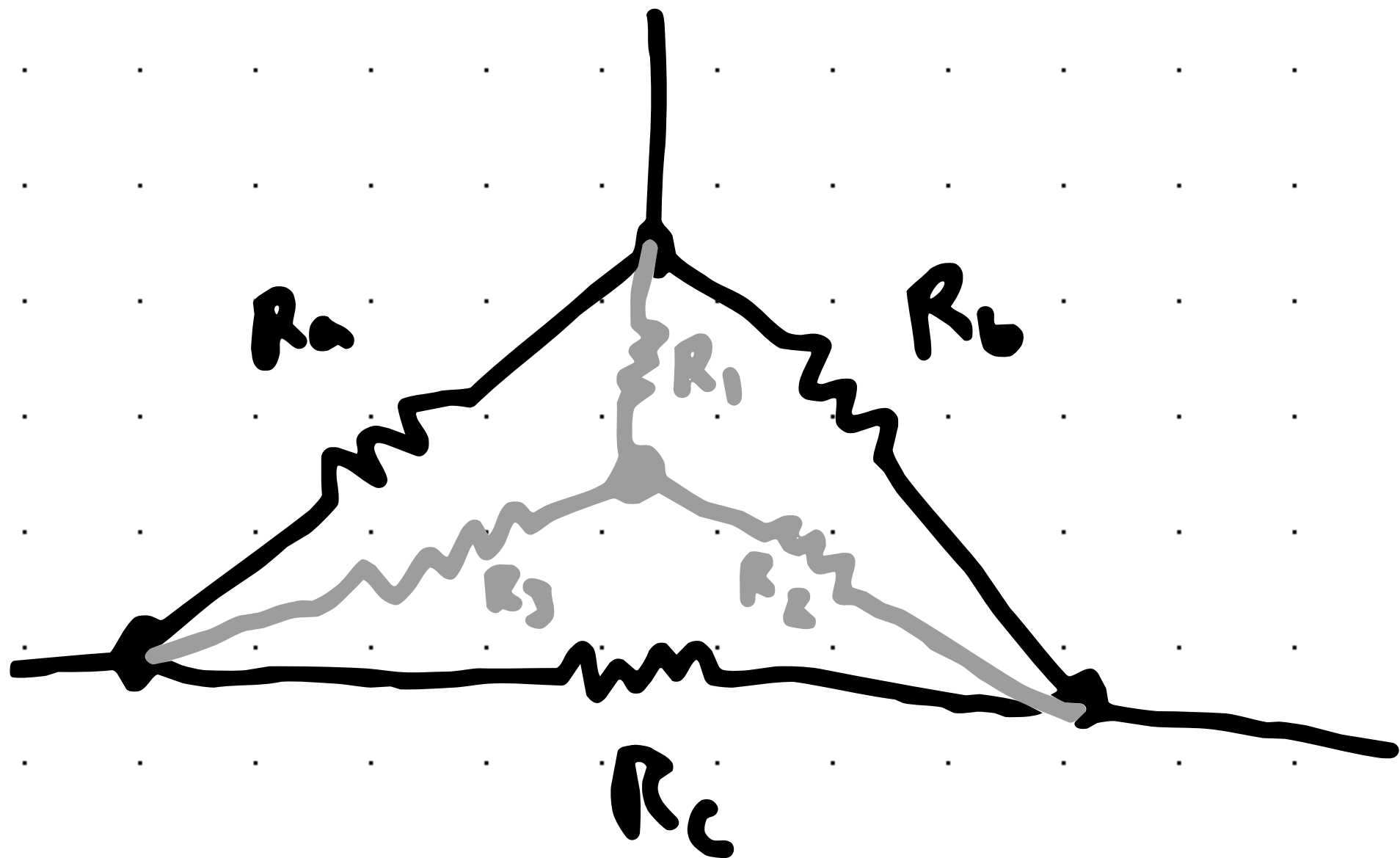
Wye (Star) Connection





Conversion from Delta to Wye Connection

1) From each node, draw a resistor.

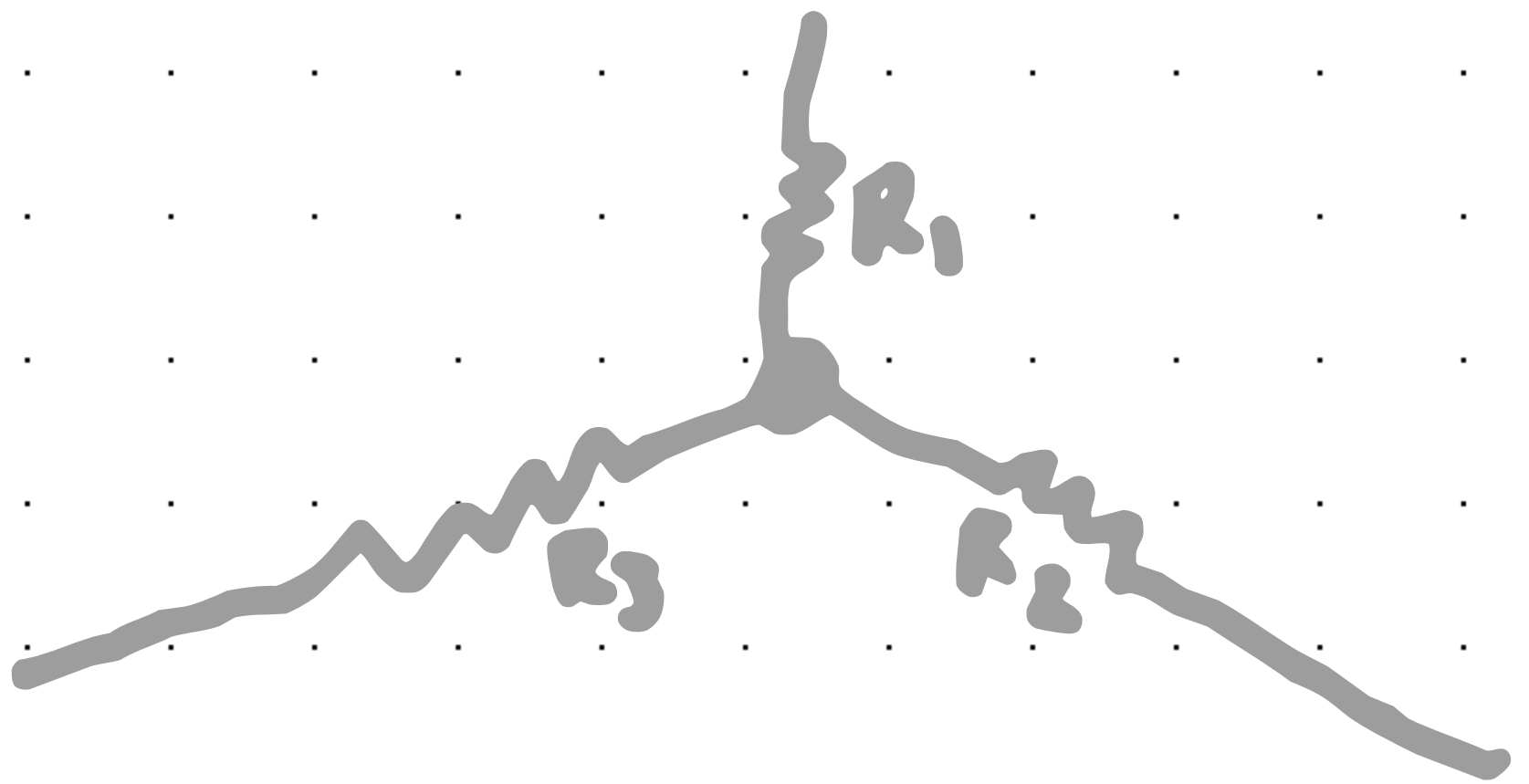


$$R_1 = \frac{R_a R_b}{R_a + R_b + R_c}$$

$$R_1 = \frac{R_a R_b}{R_a + R_b + R_c}$$

$$R_2 = \frac{R_b R_c}{R_a + R_b + R_c}$$

$$R_3 = \frac{R_a R_c}{R_a + R_b + R_c}$$

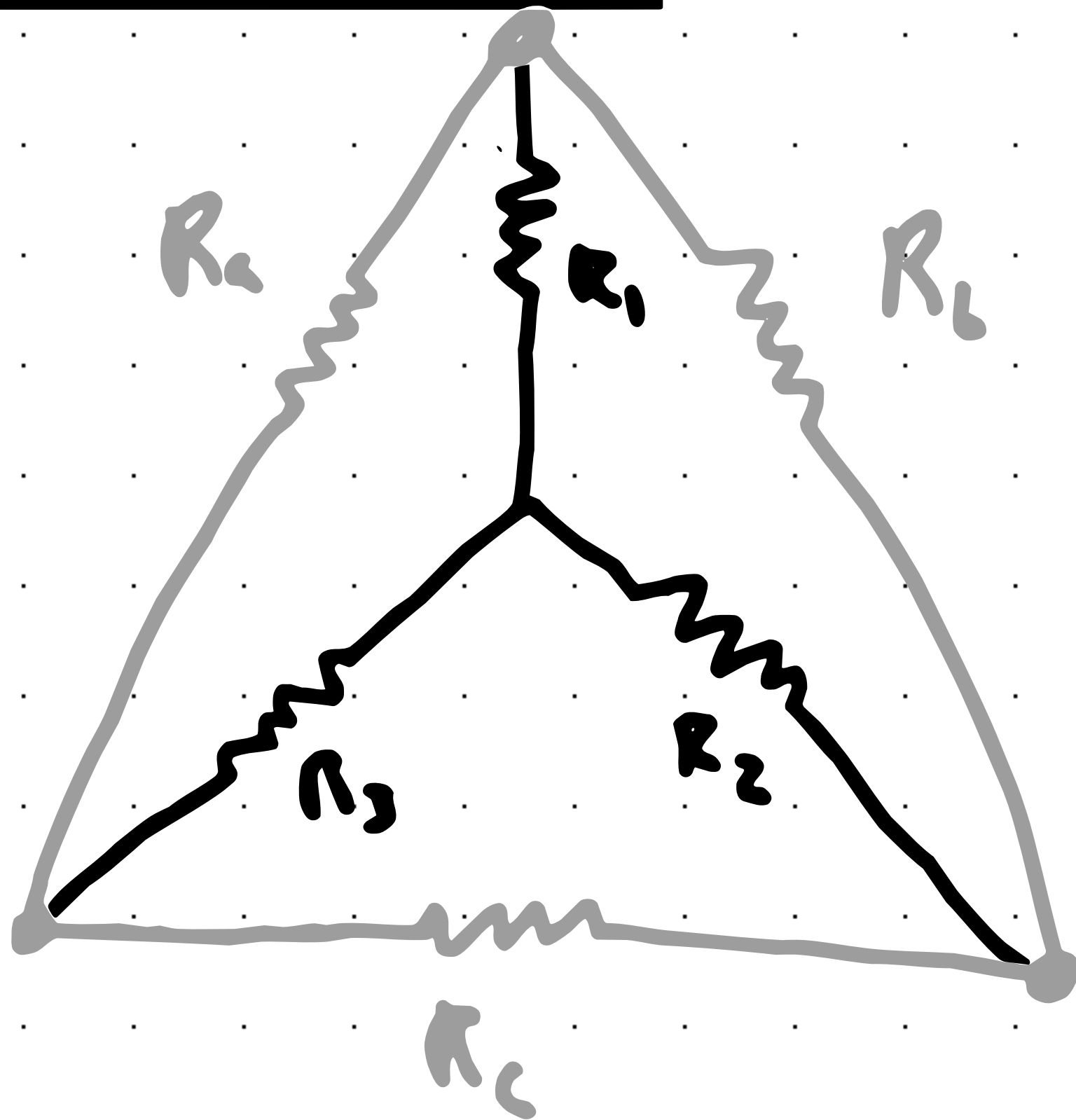


Conversion from Wye to Delta Connection

$$R_a = R_1 + R_3 + \frac{R_1 R_3}{R_2}$$

$$R_b = R_1 + R_2 + \frac{R_1 R_2}{R_3}$$

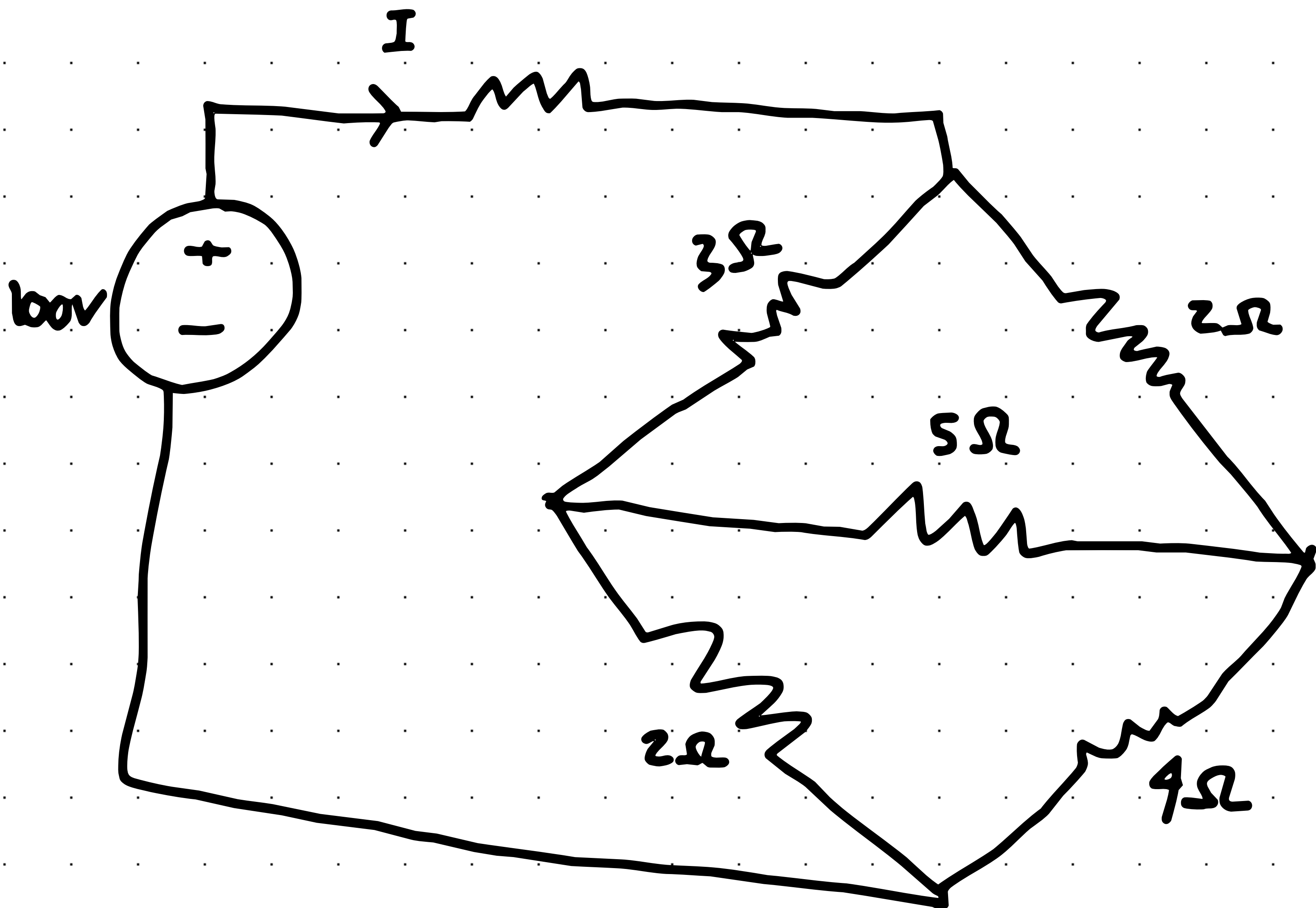
$$R_c = R_2 + R_3 + \frac{R_2 R_3}{R_1}$$



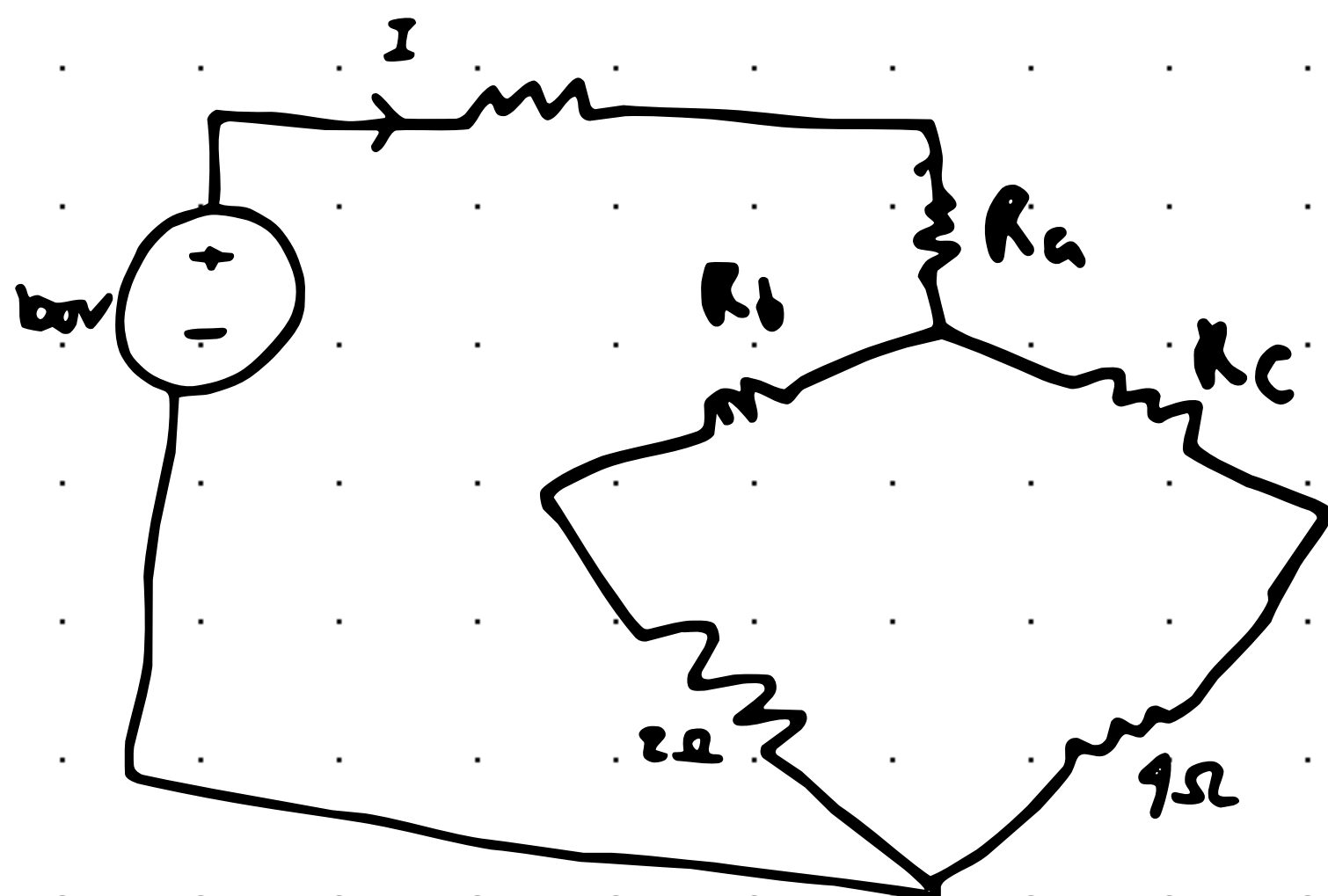
$$R_a = R_1 + R_3 + \frac{R_1 R_3}{R_2}$$

Example 2

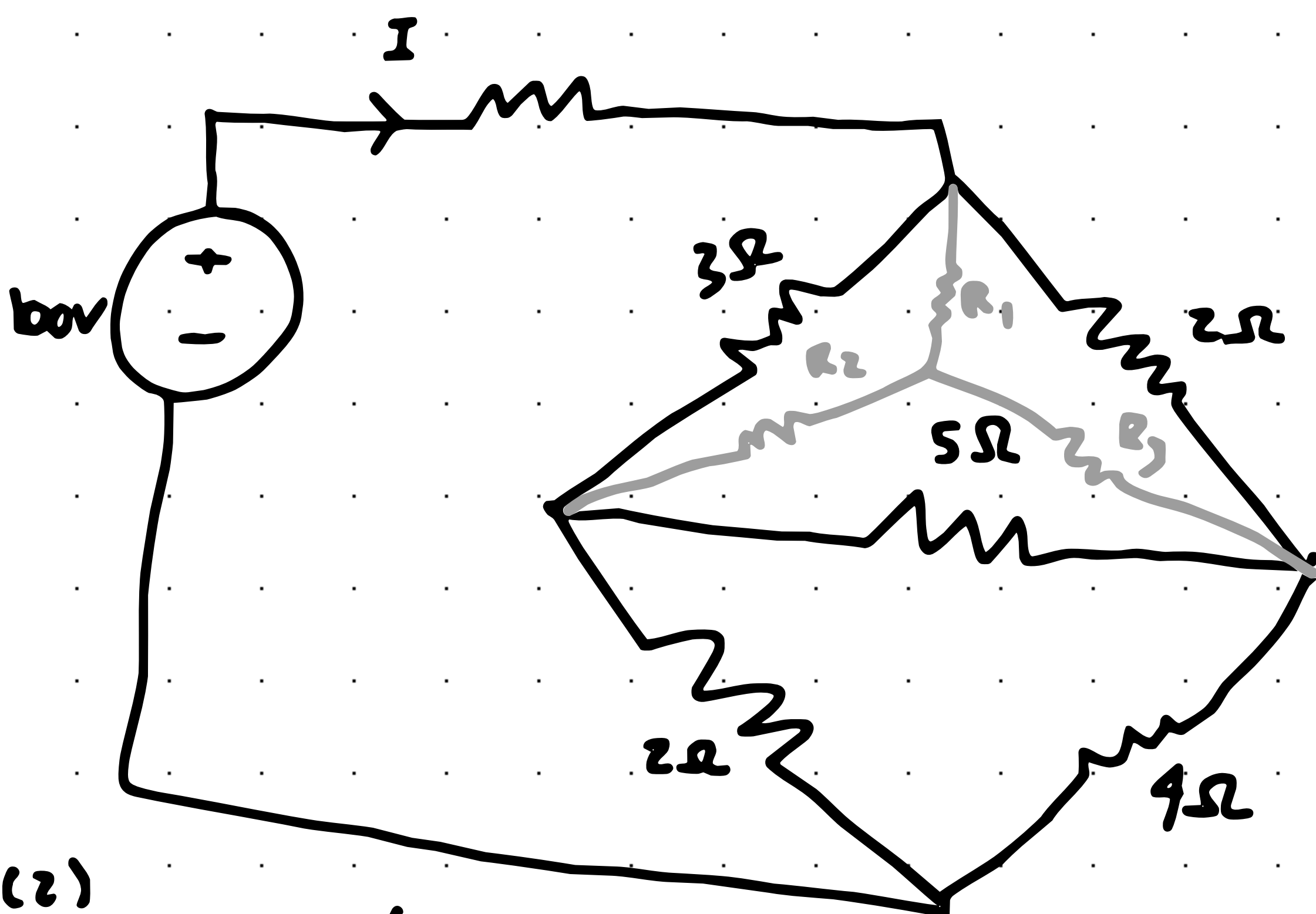
Calculate I



- 1) Identify the delta connection
- 2) Convert it into a Wye connection



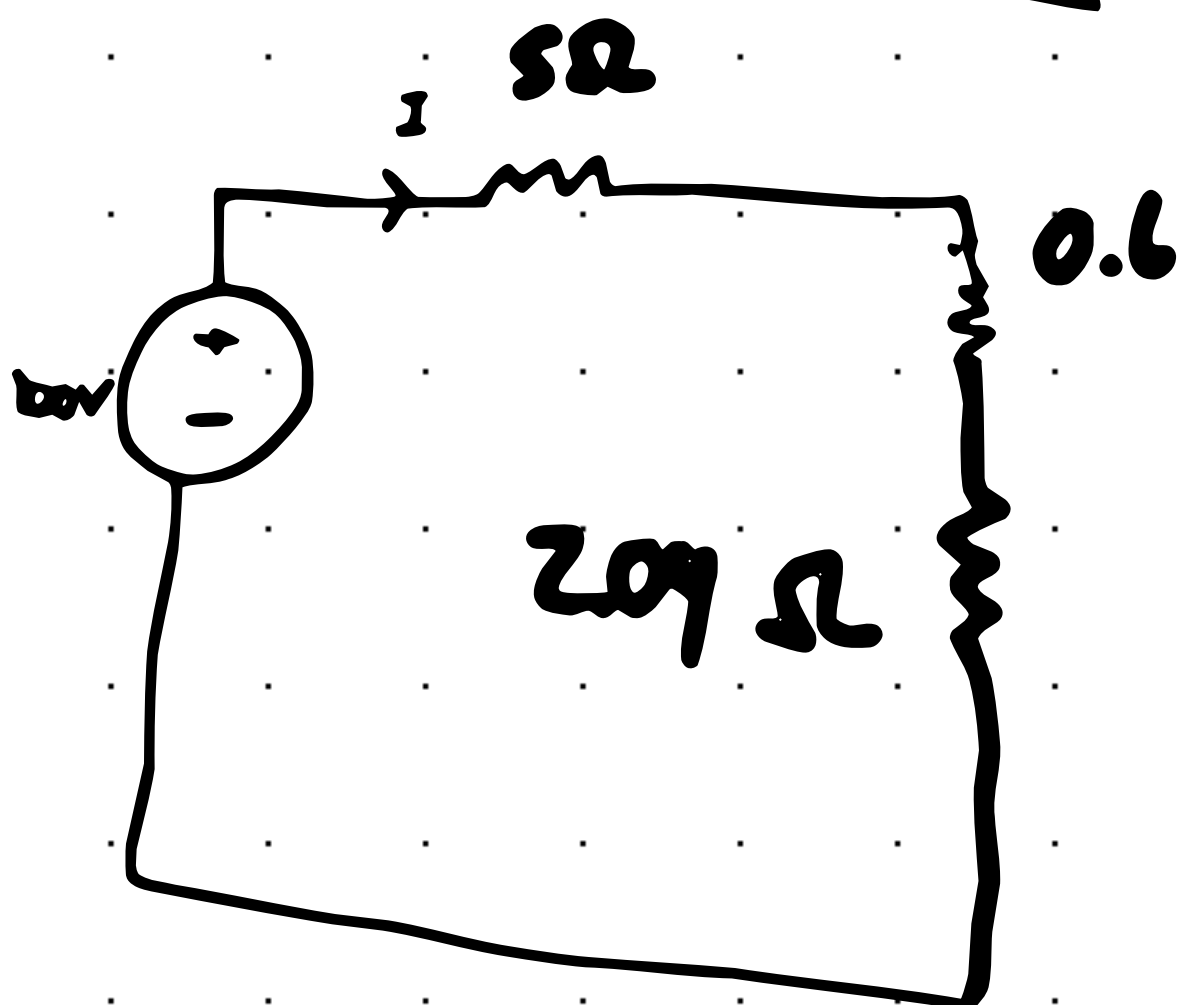
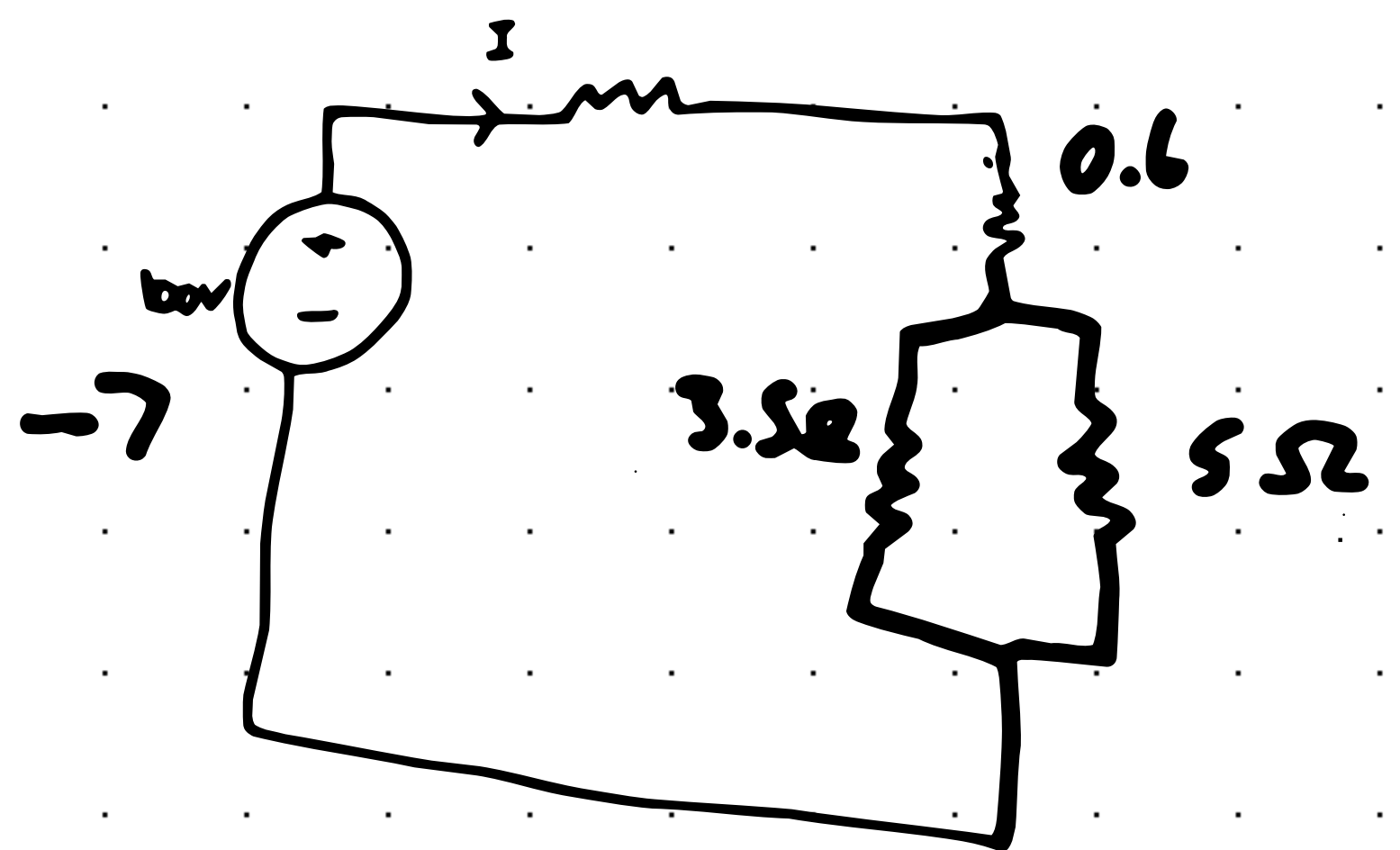
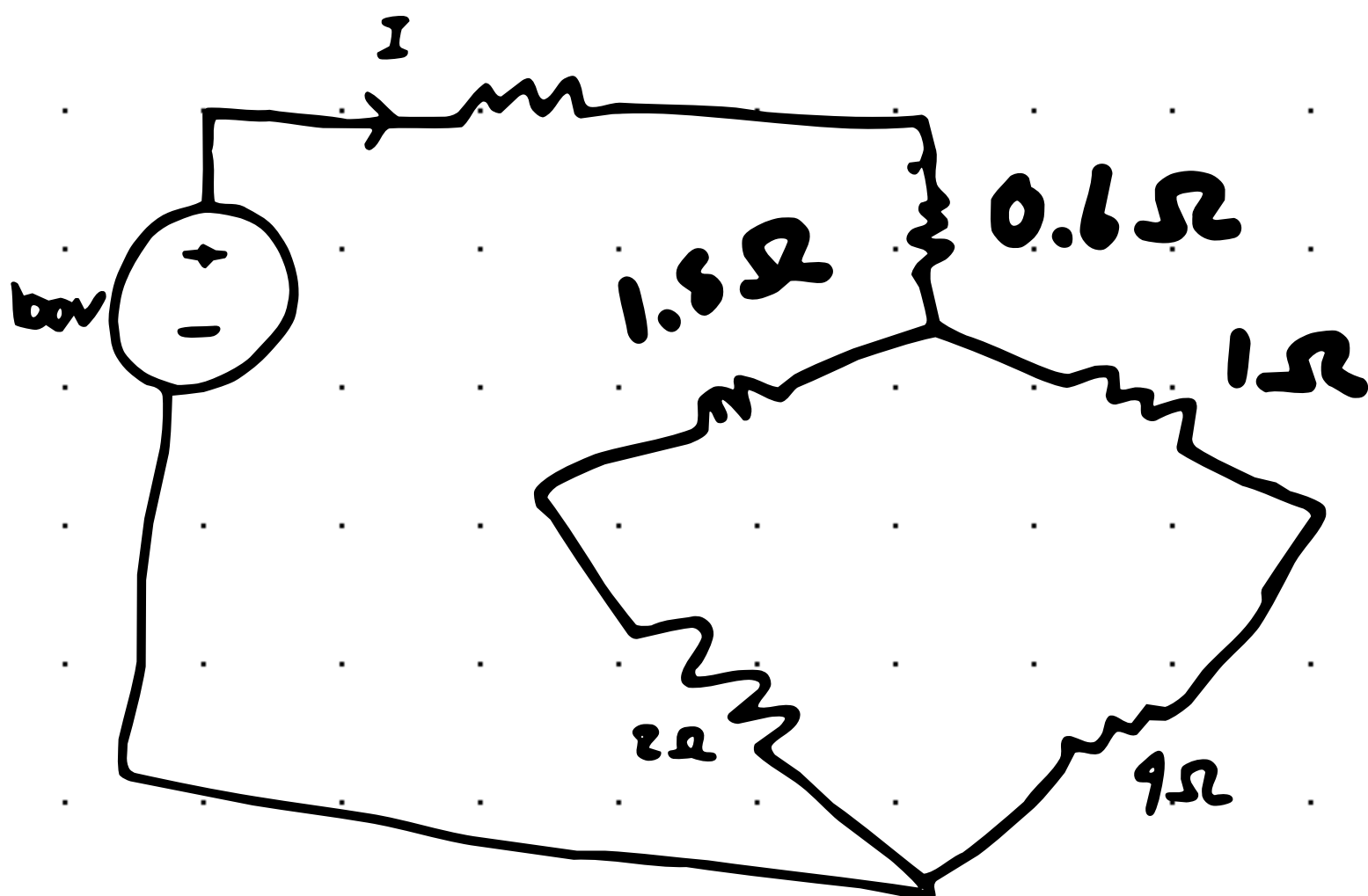
As such 😊



$$R_1 = \frac{3(2)}{3+2+5} = 0.6\Omega$$

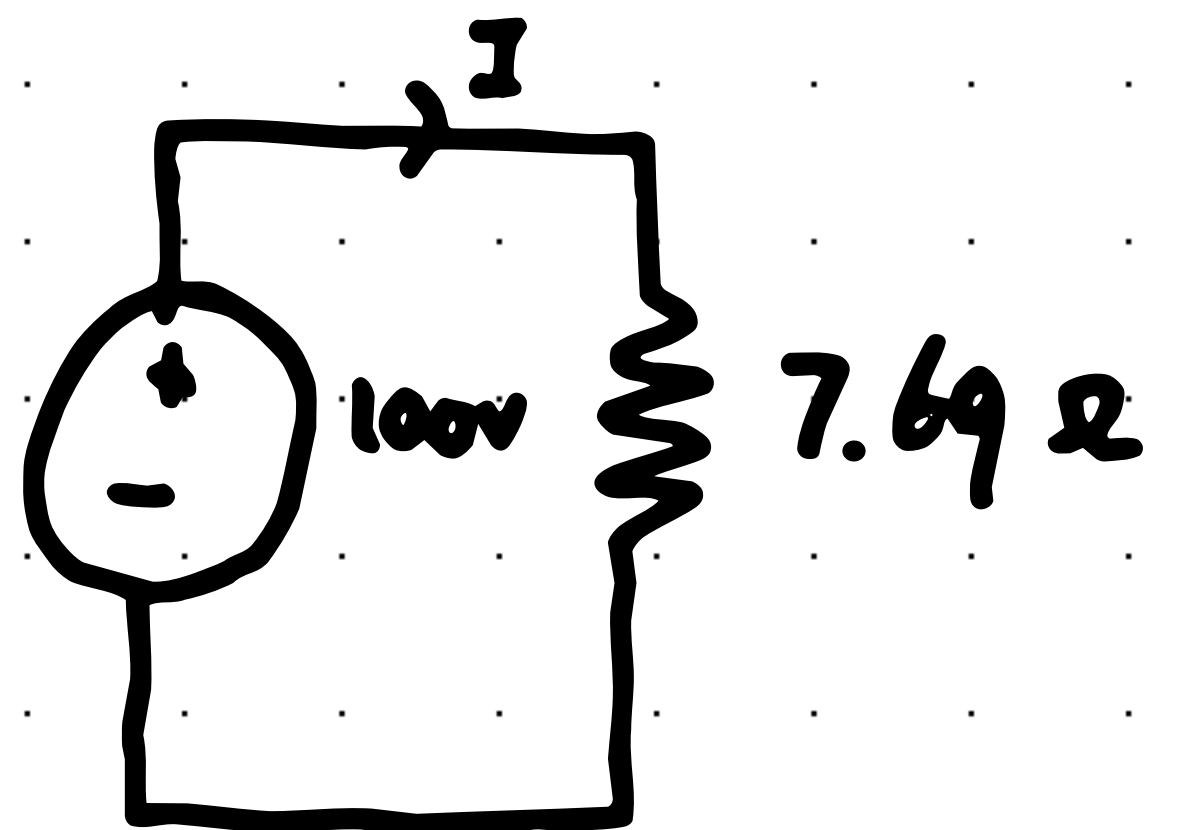
$$R_2 = \frac{3(5)}{3+2+5} = 1.5\Omega$$

$$R_3 = \frac{2(5)}{3+2+5} = 1\Omega$$



$$\frac{(3.5)(7)}{3.5+7} = 2.09\Omega$$

→



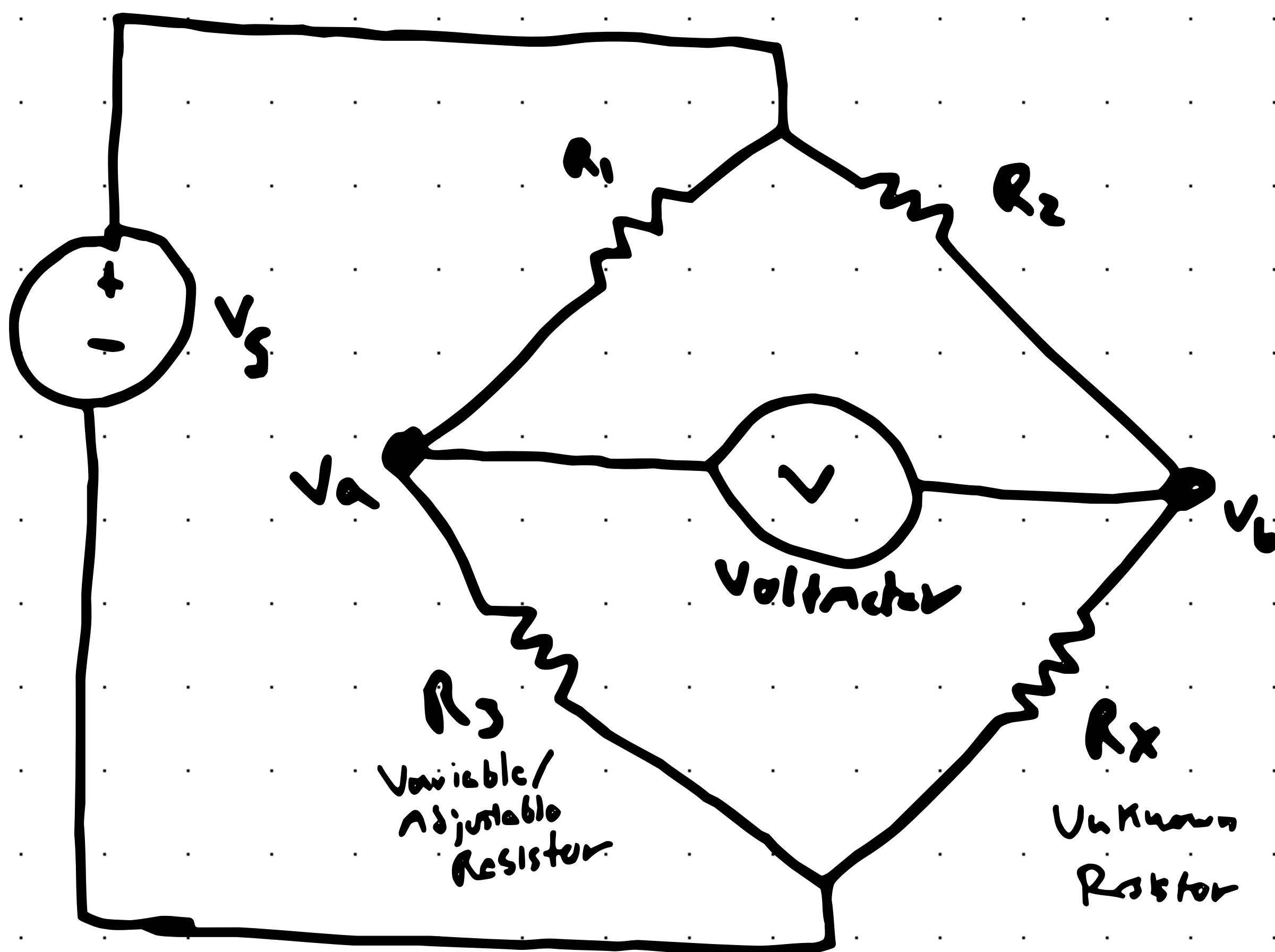
$$V = IR$$

$$100 = I(7.69)$$

$$I = 13A$$

Practical Example of Voltage Divider

- Resistance Measurement using a Wheatstone



If the voltmeter reads 0 volts in the middle trace, that means that V_a and V_b are equal!

$$V_a - V_b = 0 \longrightarrow V_a = V_b$$

Voltage Divider

$$V_a = V_S \left(\frac{R_3}{R_1 + R_3} \right), \quad V_b = V_S \left(\frac{R_x}{R_2 + R_x} \right)$$

and since $V_a = V_b \dots$

$$V_s \left(\frac{R_3}{R_1 + R_3} \right) = V_s \left(\frac{R_x}{R_2 + R_x} \right)$$

(Va)

(Vb)

$$R_3 R_2 + R_3 R_x = R_1 R_x + R_x R_3$$

$$R_x = \frac{R_2}{R_1} R_3$$

Wheatston Bridge

Resistance

Measurement

→ used to measure
an unknown electrical
resistance by balancing
two legs of a
bridge circuit, one
leg including R_x

