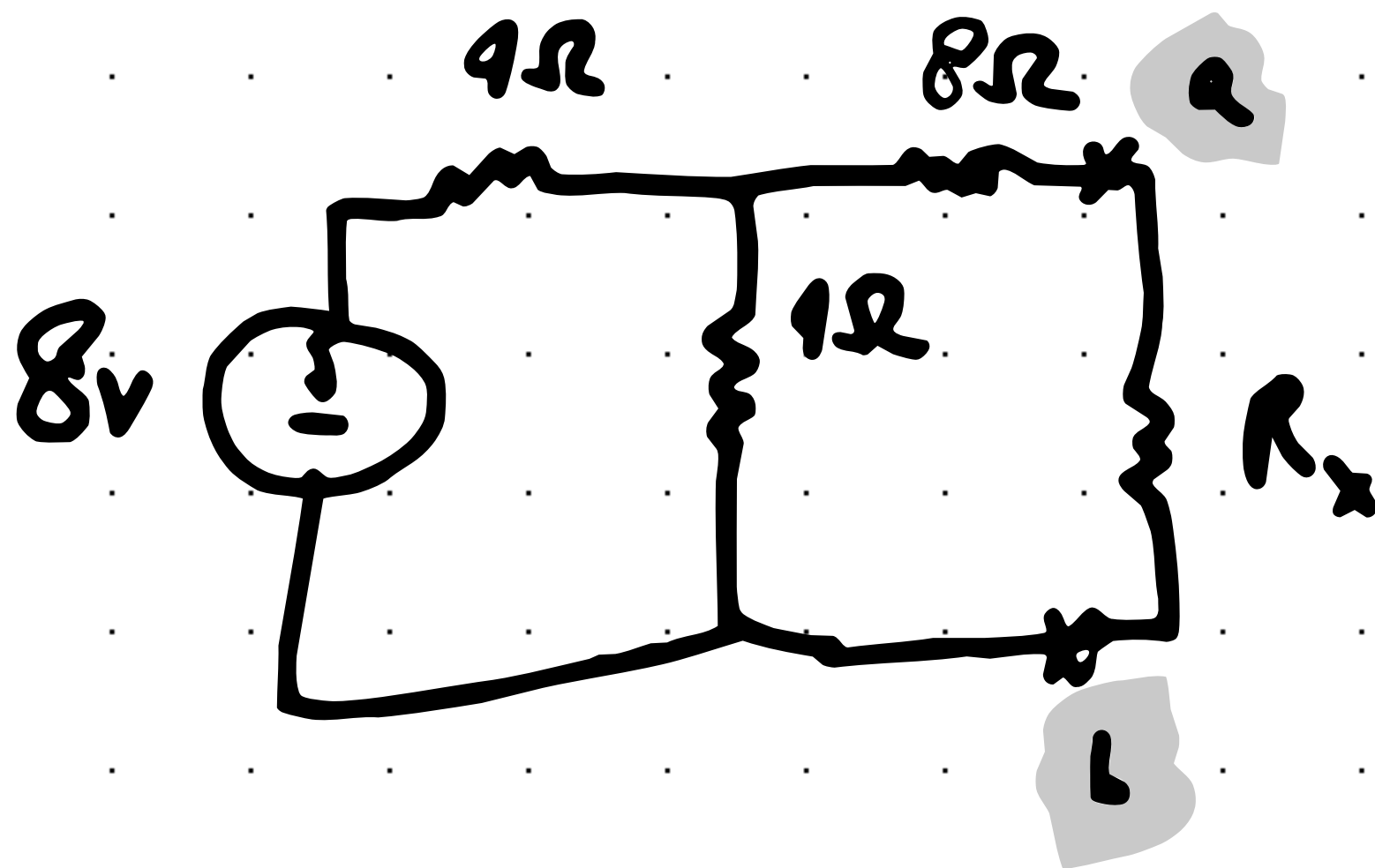


Thevenin and Norton's theorems

Ex



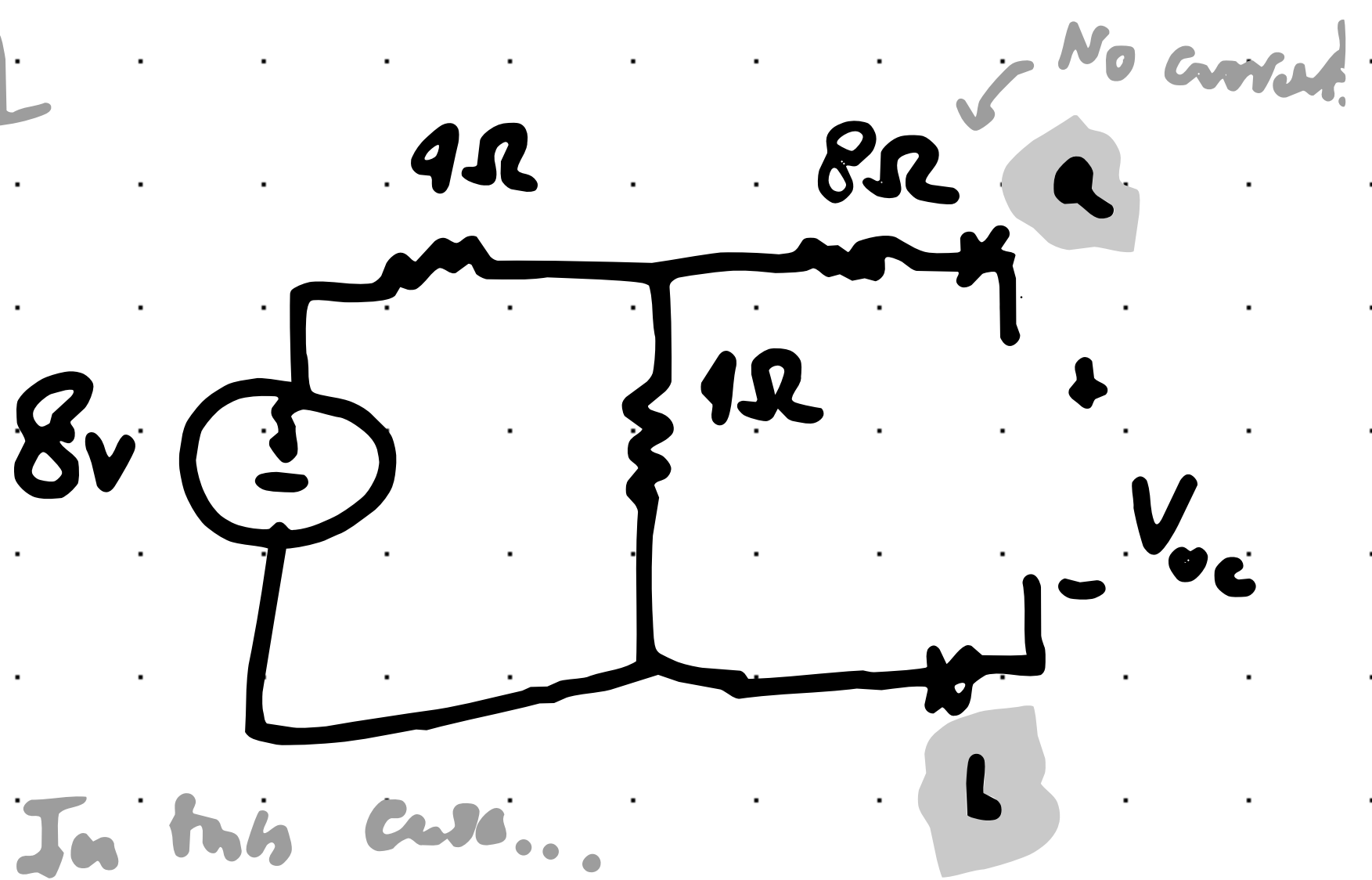
Find Thev and Norton equations between a and b.

Solution

Using Method 1

To calculate V_{Th}

Open the circuit



In this case...

$$V_{oc} = V_{1\Omega}$$

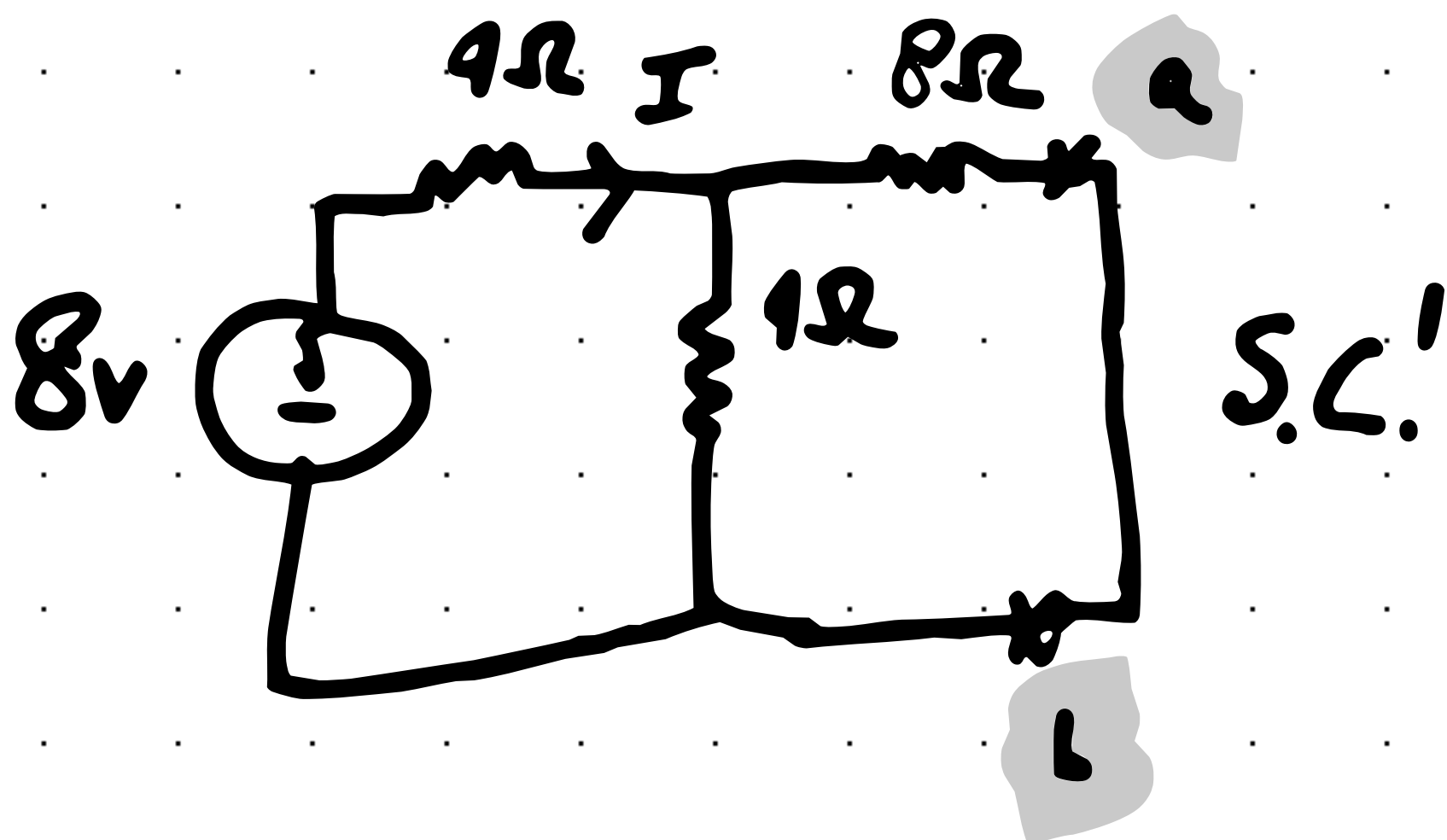
$$i = \frac{8}{4+4} = 1A$$

$$V_{oc} = 1(4) = 4V$$

$$V_{Th} = V_{oc} = 4V$$

To Calculate I_{Norton}

Short Two Resistors!



$$R_{eq} = 8/4 + 4$$

$$\frac{(8)(1)}{8+4} + 4 = 6.7\Omega$$

$$I = \frac{8}{6.7} = 1.19A$$

Using Current divider.. $I_N = I \frac{4}{4+8} = 0.398A$

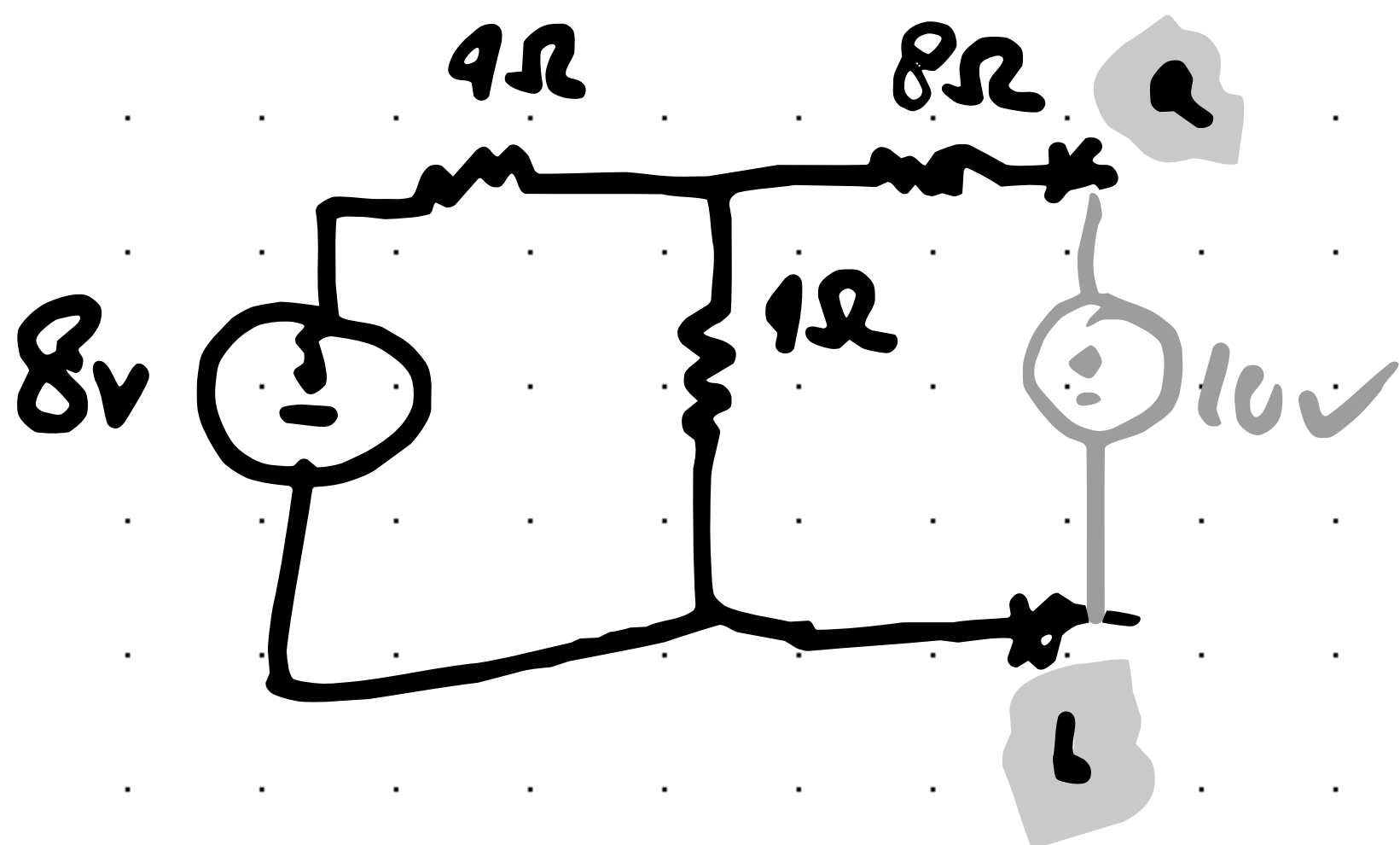
$$I_N = I_{sc} = 0.398A$$

Calculate R_{Thev}

Use Method 1

$$R_{Thev} = \frac{V_{Th}}{I_N} = \frac{4}{(0.398)} = 10\Omega$$

Using Method Two:



Remove all independent
Voltage Sources

Inject ANY voltage
Source into the
Spot of R_N . All
We care about is
the ratio

Let's say 10V

$$R_{TH} = R_N = \frac{V_{injected}}{I} = \frac{10}{I}$$

$$R_{eq} = (4 // 4) + 8 = \frac{4(4)}{4+4} + 8 = \underline{10\Omega}$$

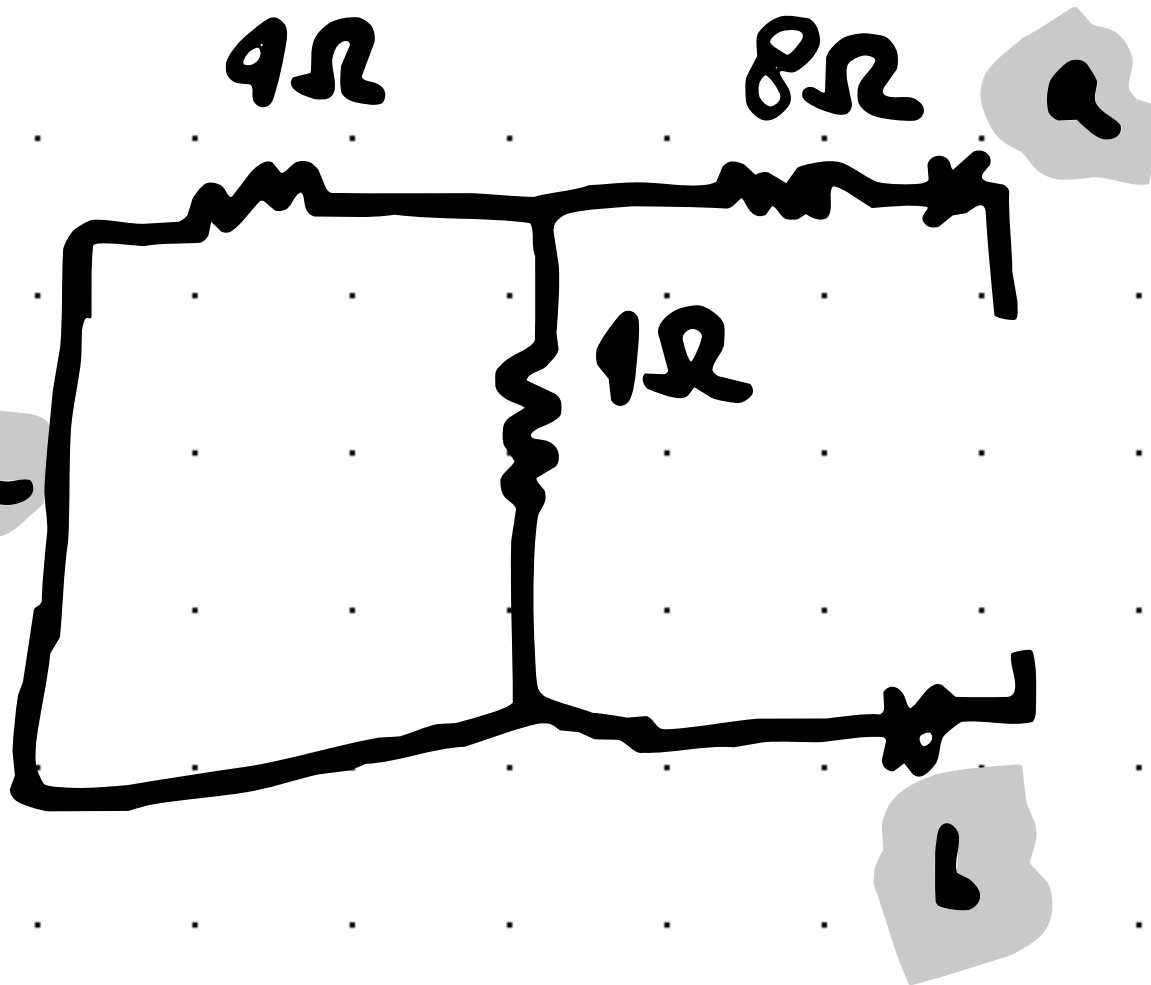
$$I = \frac{V}{R} = \frac{10}{10} = \underline{1\text{Amp}}$$

$$R_{TH} = R_N = \frac{10}{1} = \frac{10}{1} = \boxed{10\Omega}$$

Using

Method 3

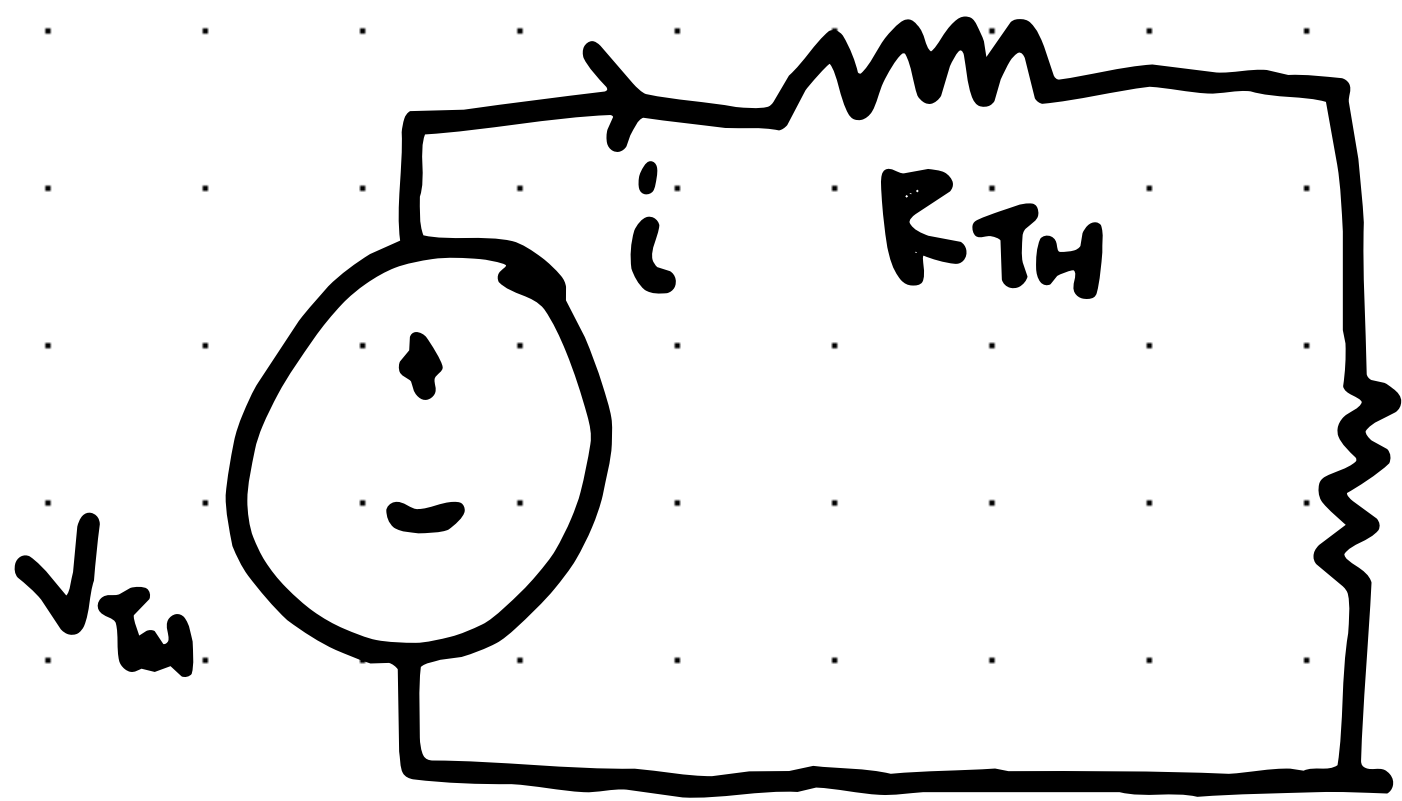
$$R_T = 4 // 4 + 8 = \frac{4 \times 4}{4 + 4} + 8 = 6 \Omega$$



$$R_{TH} = R_N = R_T = 10 \Omega$$

Now, This method ONLY WORKS if you have an independent source. It is very similar to Method 2, but without the voltage injection.

Maximum Power Transfer



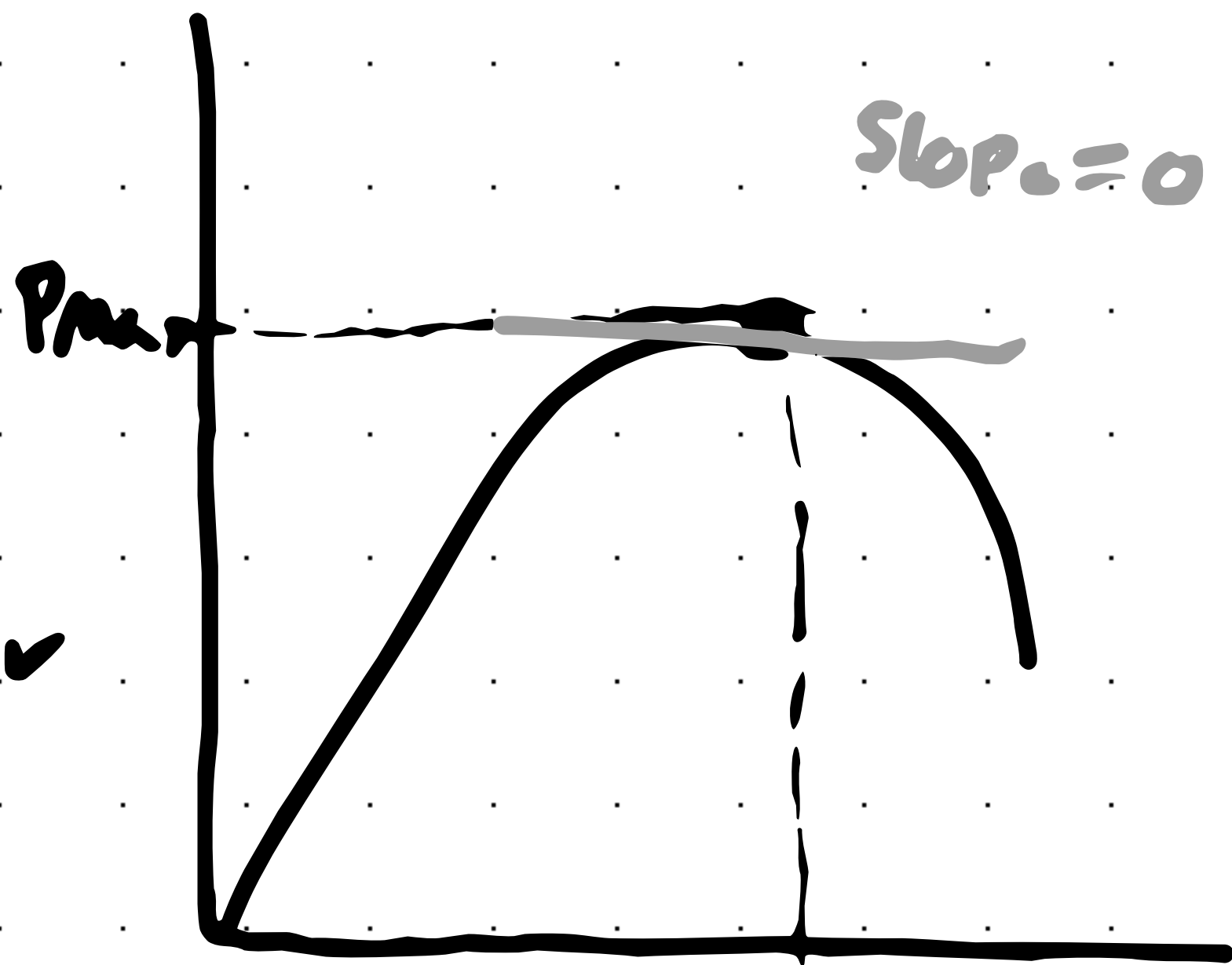
$$i = \frac{V_{TH}}{R_{TH} + R_L}$$

$$P = i^2 R_L$$

Let's do some substitution...

(Right?)

$$P = \left(\frac{V_{TH}}{R_{TH} + R_L} \right)^2 R_L$$



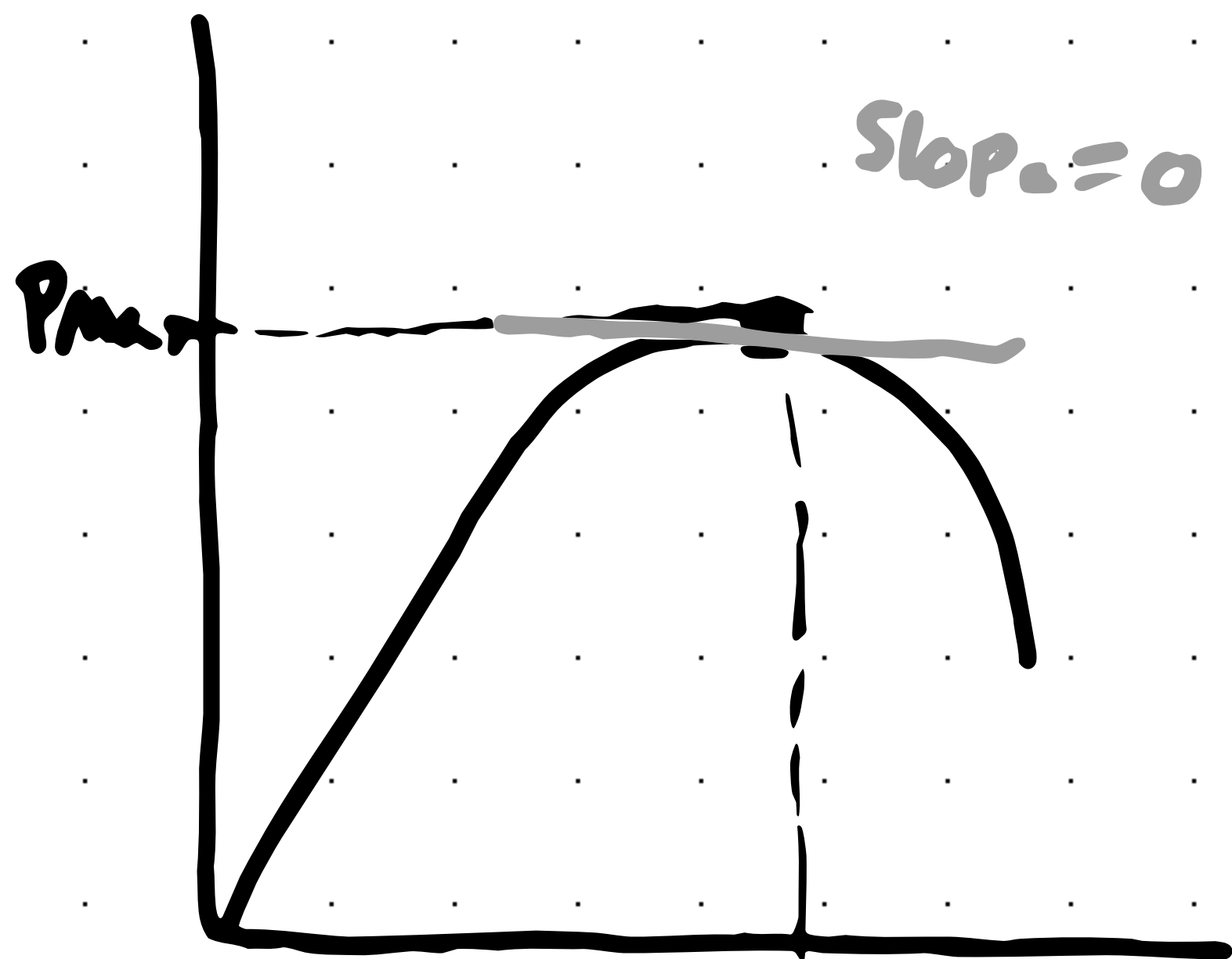
Let's think about this for a second...

If we vary the resistances, the power will increase, but only to a certain point!

This is known as the **Max Power Point**

How do we find the max power point?

We can find the
first derivative, and
set it equal to
zero.



There is a lot of math to say!

For max power:

$$R_L = R_{TH}$$

$$P_{max} = i^2 R_{TH} = \frac{V_{TH}^2}{4R_{TH}^2} R_{TH} = \frac{V_{TH}^2}{4R_{TH}}$$