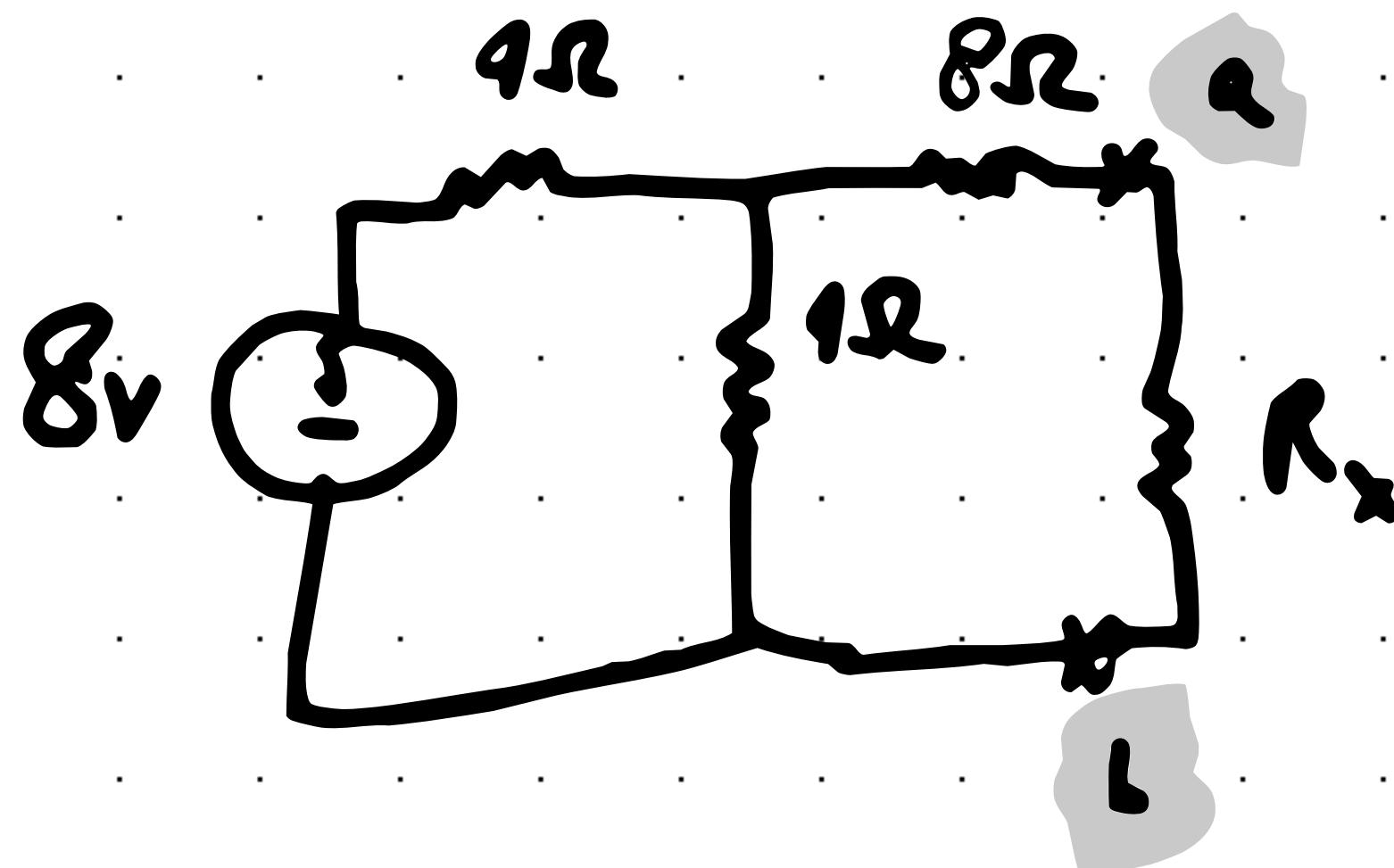


## Thevenin and Norton's theorems

~~Ex~~



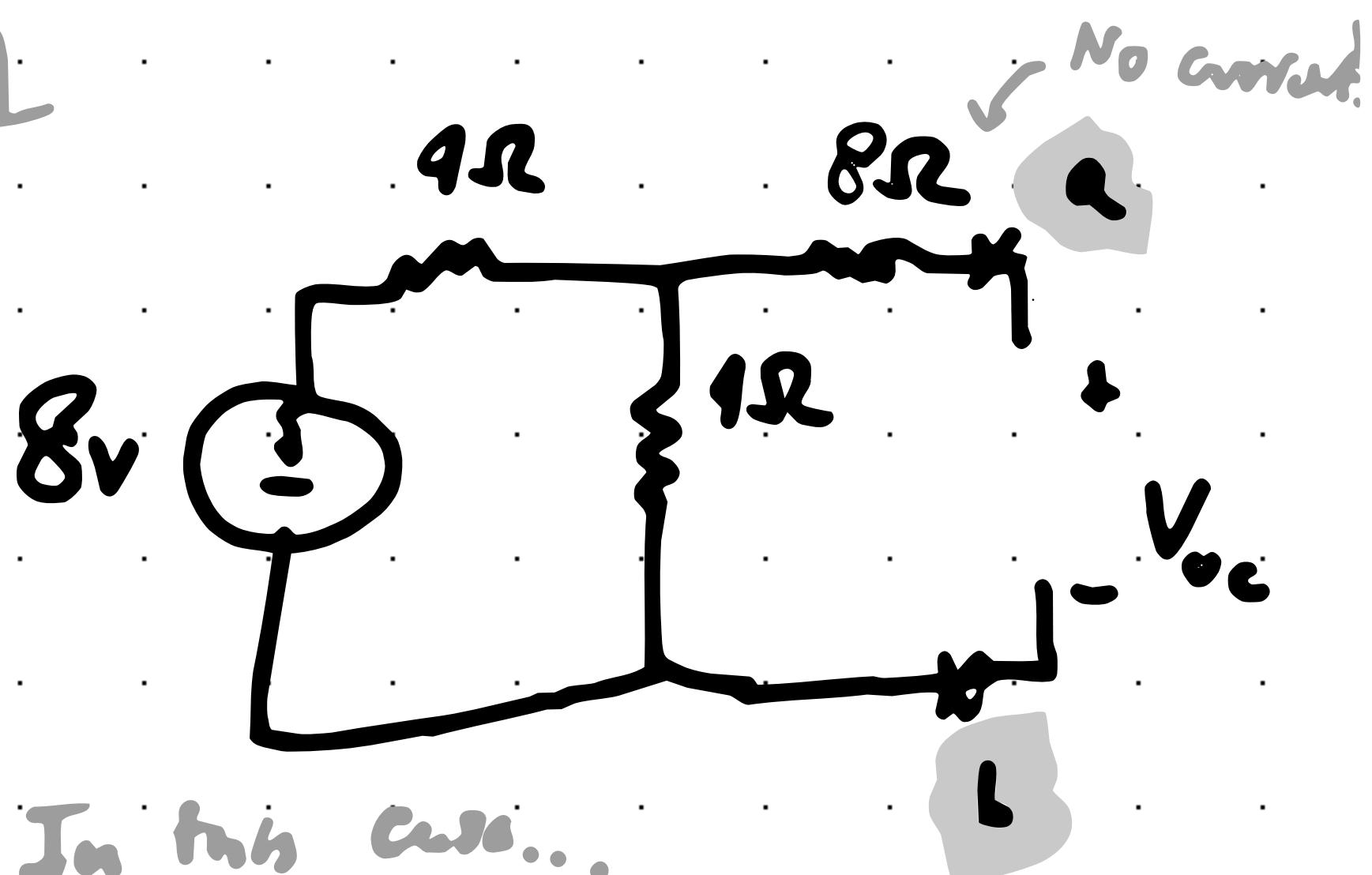
Find Thov and Norton equation between a and b.

Solution

Using Method 1

To calculate  $V_{Th}$

open the circuit



In this case...

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

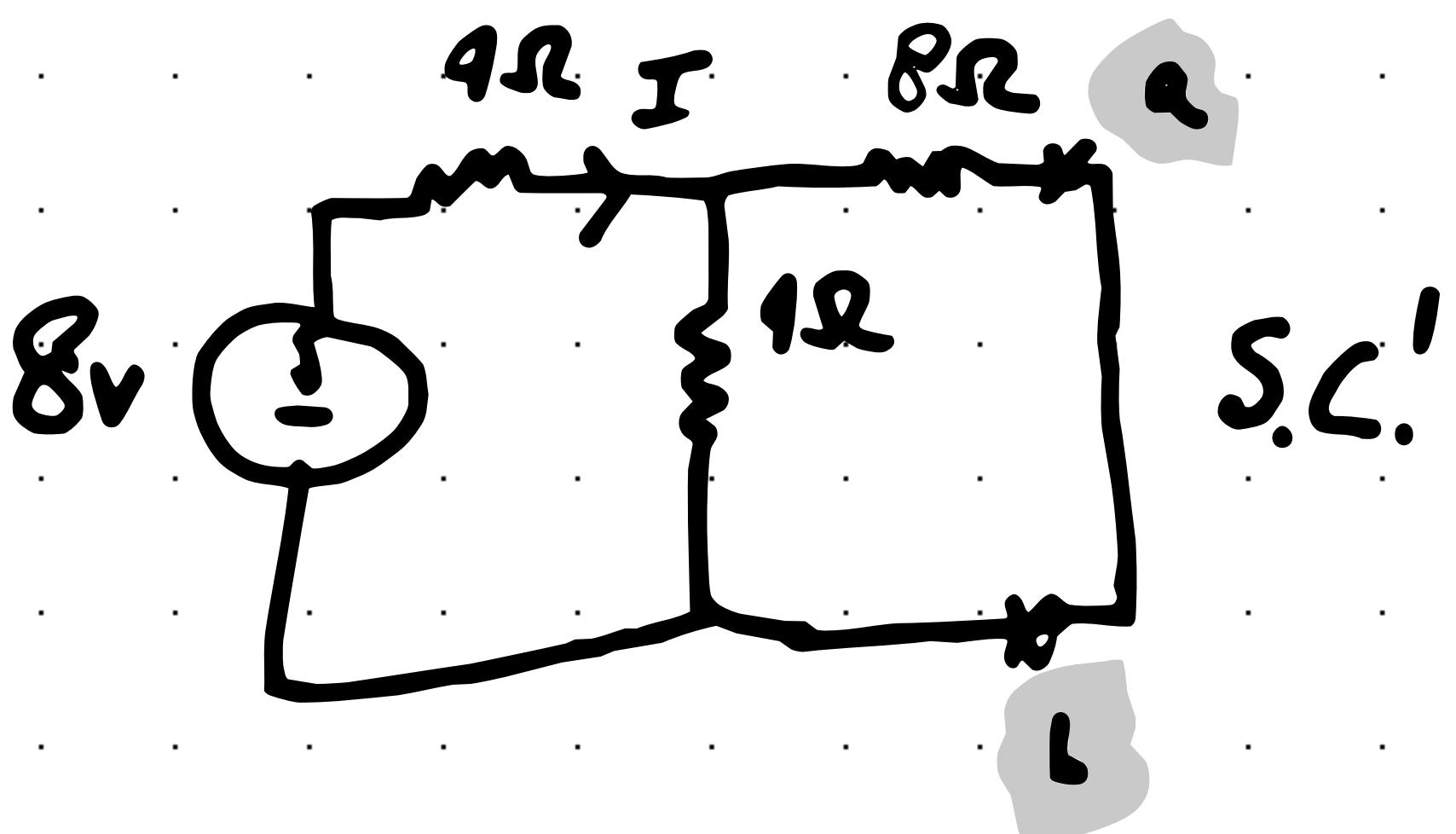
$$V_{oc} = V_{1\Omega}$$

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

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

To Calculate  $I_{Norton}$

Show Two Resistors!



$$R_{eq} = 8/14 + 4$$

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

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

Using Current divider...

$$I_N = I \frac{4}{4+8} = 0.398A$$

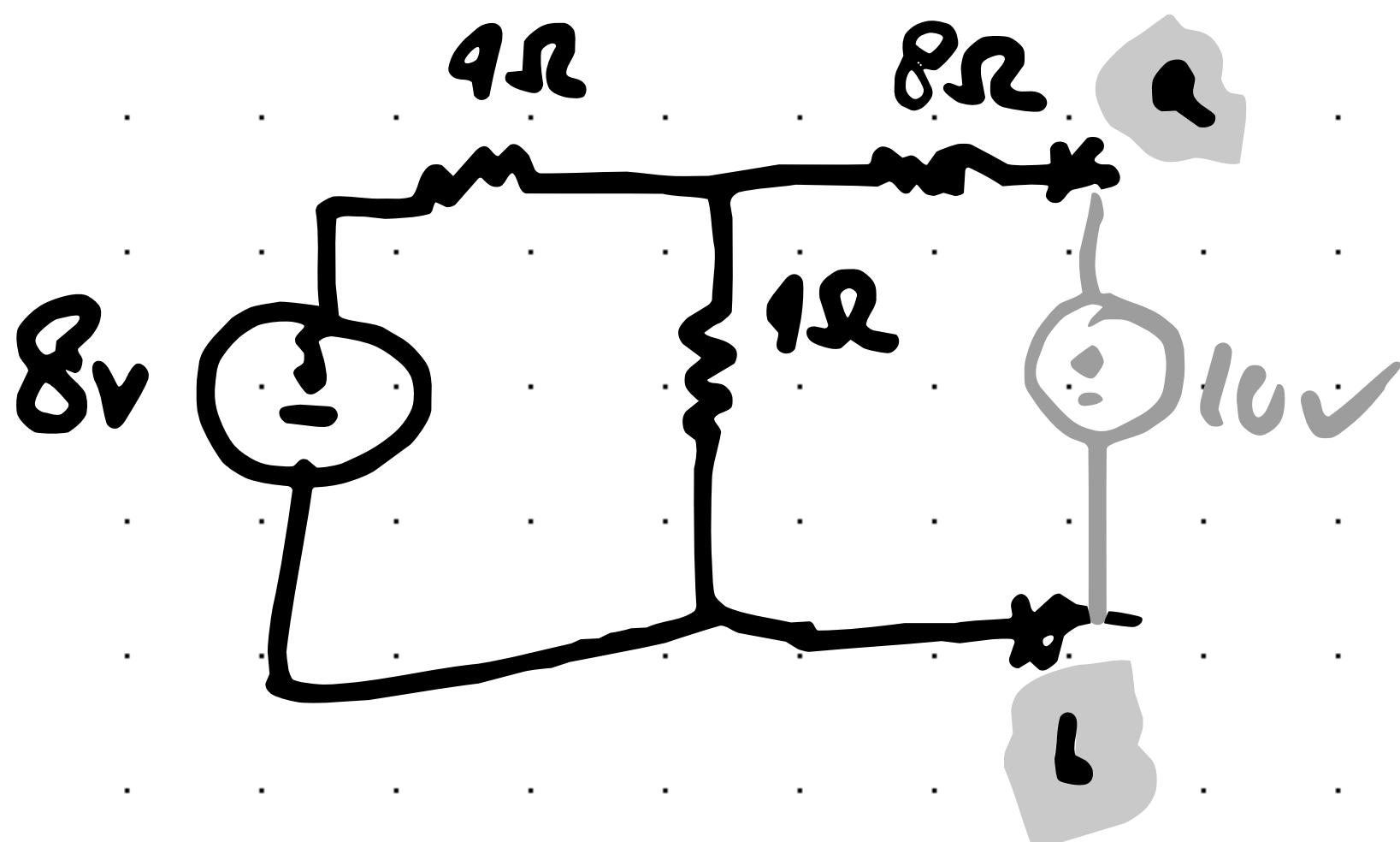
$$I_N = I_{SC} = 0.398A$$

Calculate  $R_{Thv}$

Using Method 1

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

## Using Method Two:



Remove all independent Voltage Sources

Inject ANY voltage source into the input of  $R_N$ . All we care about is the ratio

Let's say  $10V$

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

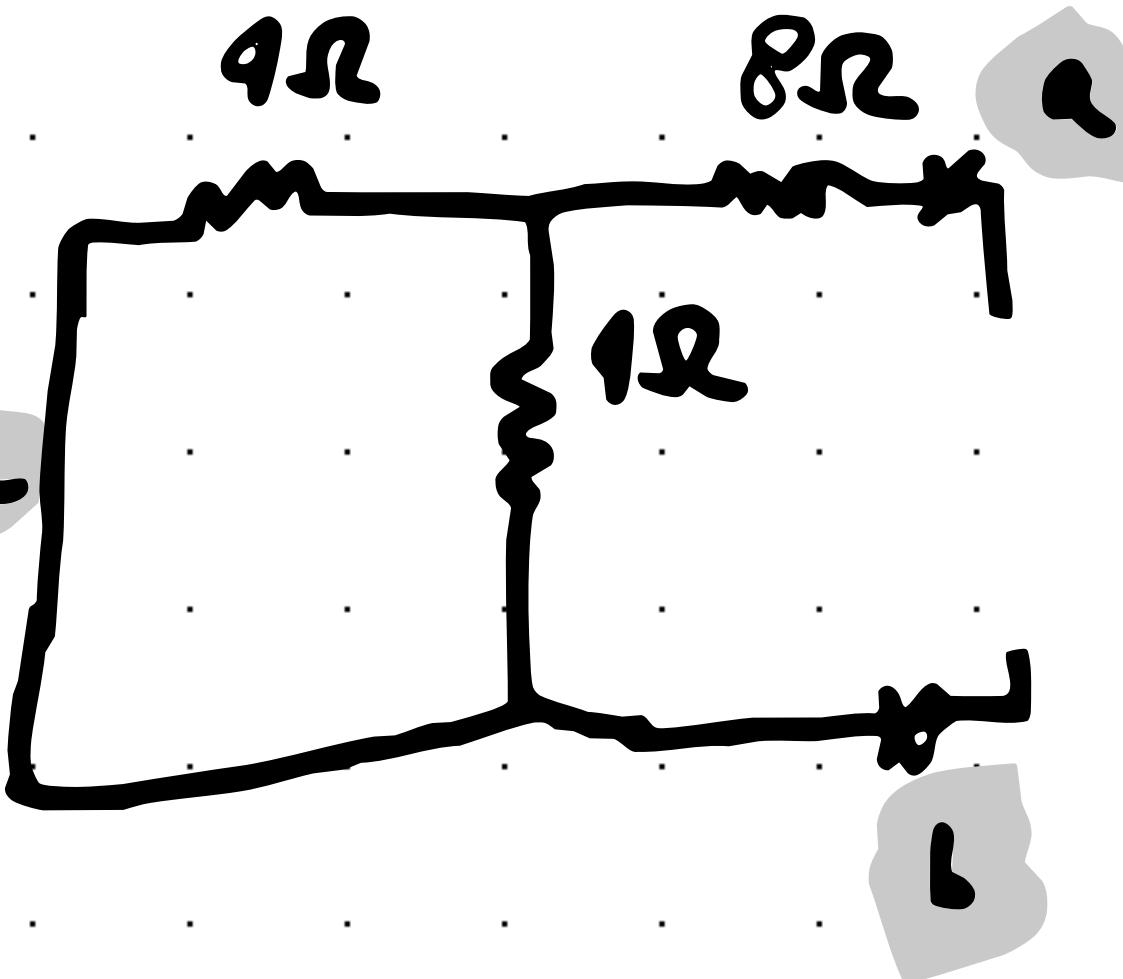
$$R_{eq} = (4 // 1) + 8 = \frac{4(1)}{4+1} + 8 = \underline{10\Omega}$$

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

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

## Using Method 3

$$R_T = 4//4 \quad t_8 = \frac{4 \times 4}{4+4} + 8 = 6\Omega$$



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

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

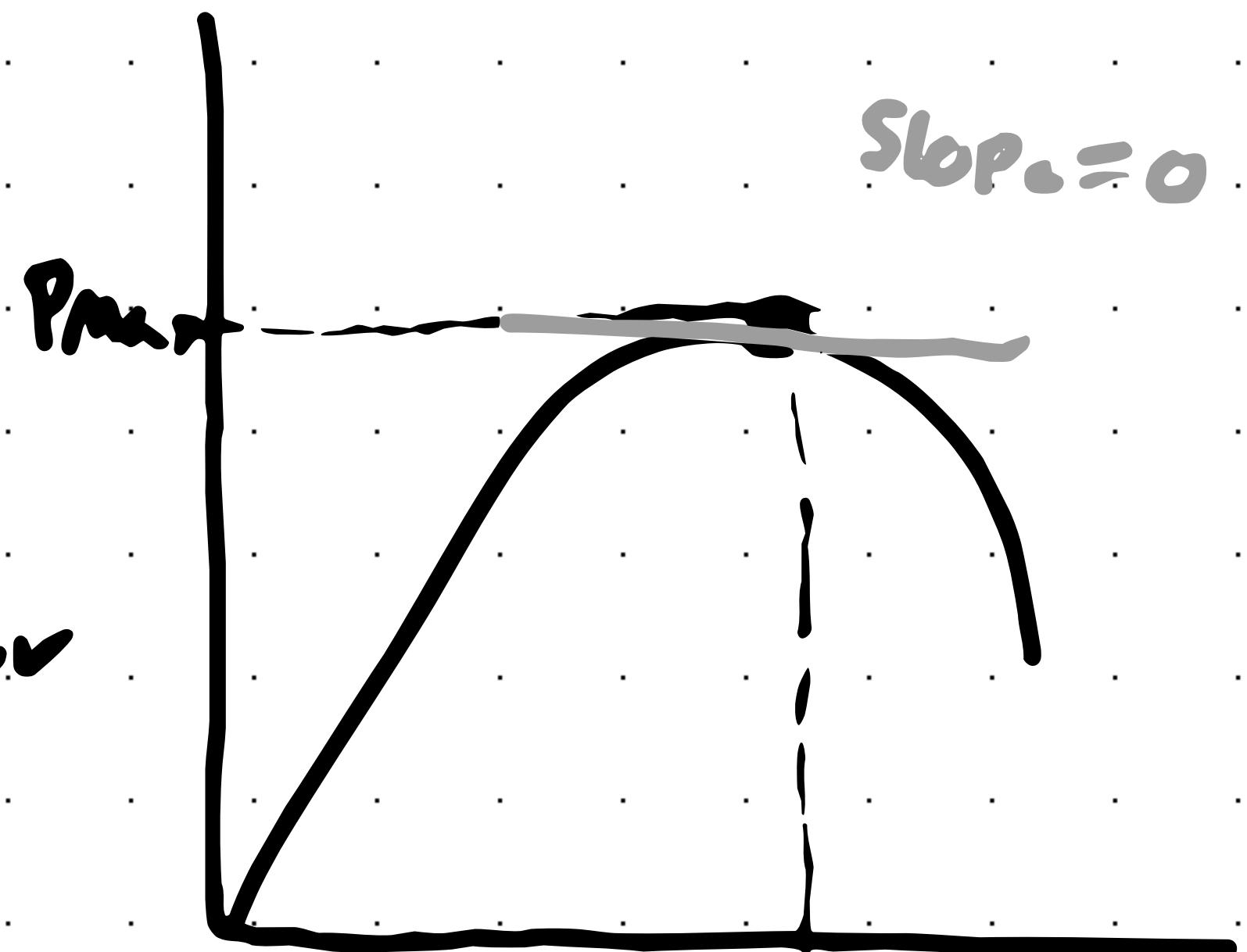


$$i = \frac{\sqrt{V_{TH}}}{R_{TH} + R_L}$$

$$P = i^2 R_L$$

Let's do some substitutions... (Right!)

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



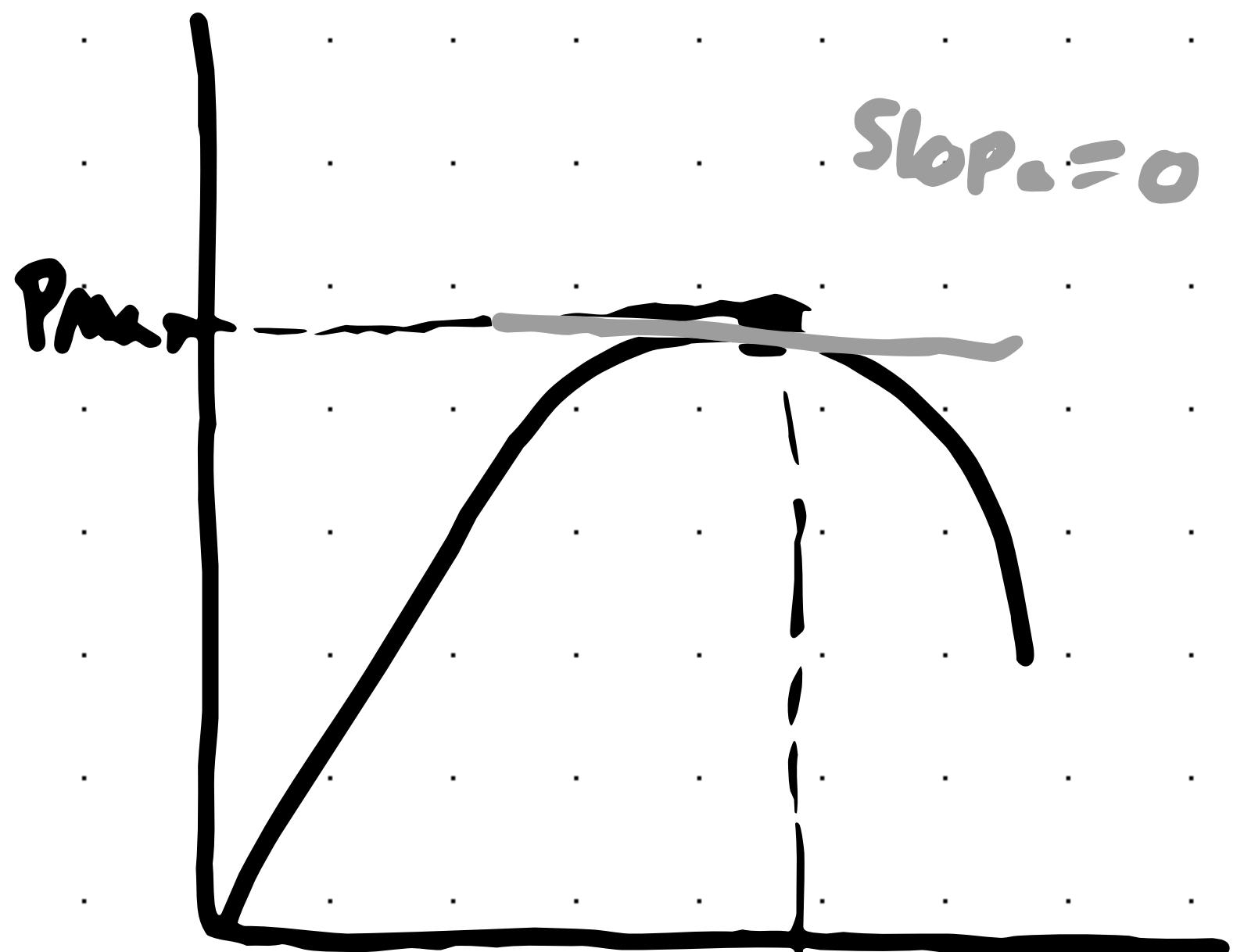
Let's think about this for a second...

If we raise the resistance, the power will drop, but only to a certain point!

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

How do we find the max power Pout?

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



There is a lot of math to say!

For max power:

$$R_L = R_{TH}$$

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

$$\frac{\sqrt{R_{TH}}}{4R_{TH}}$$