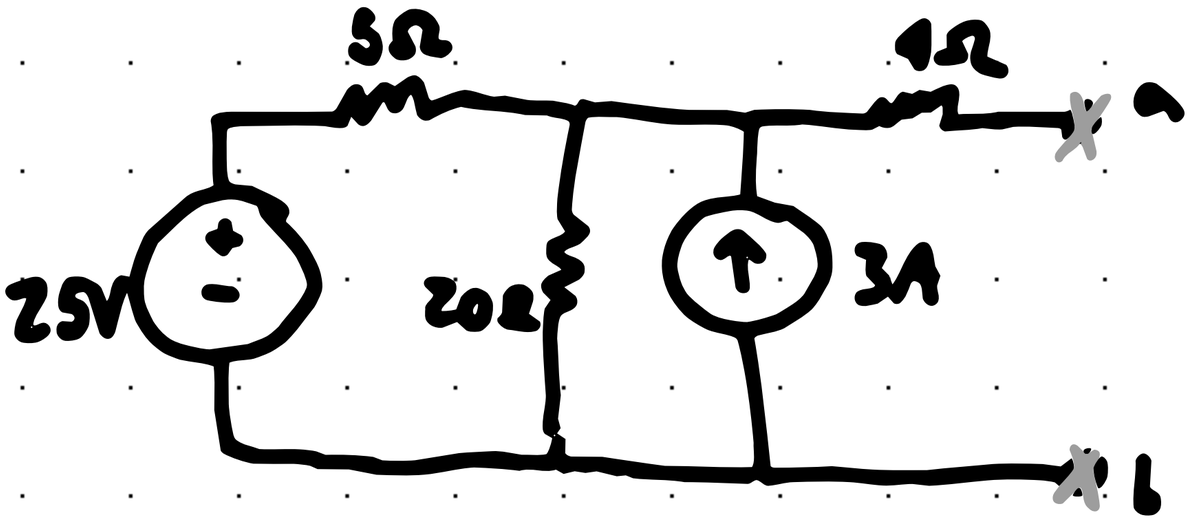
Lecture 11 ECED 2000

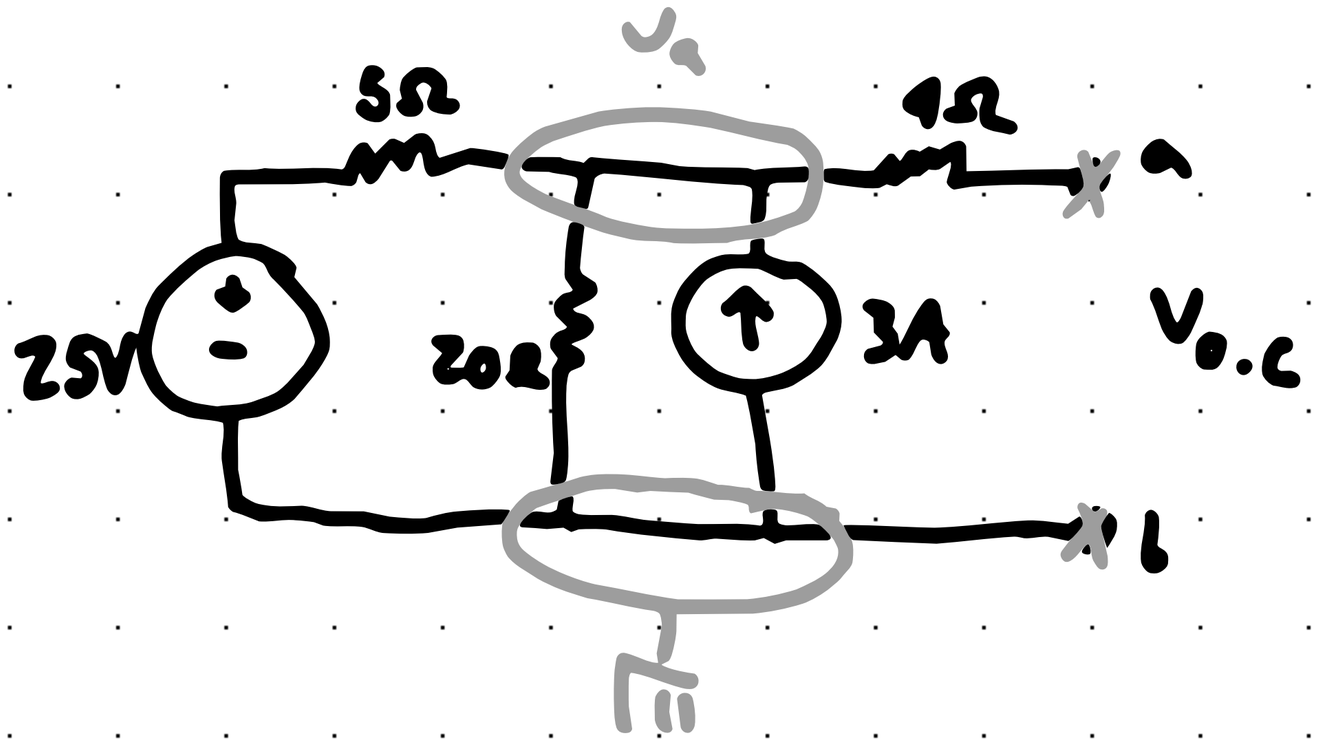
Thev and Norton's equivalents Problem

Ex. Find Thev and Norton equivalent between a and b for the following circuits



Calculate the Value of R_L for max Power and max Power

Soln Vth

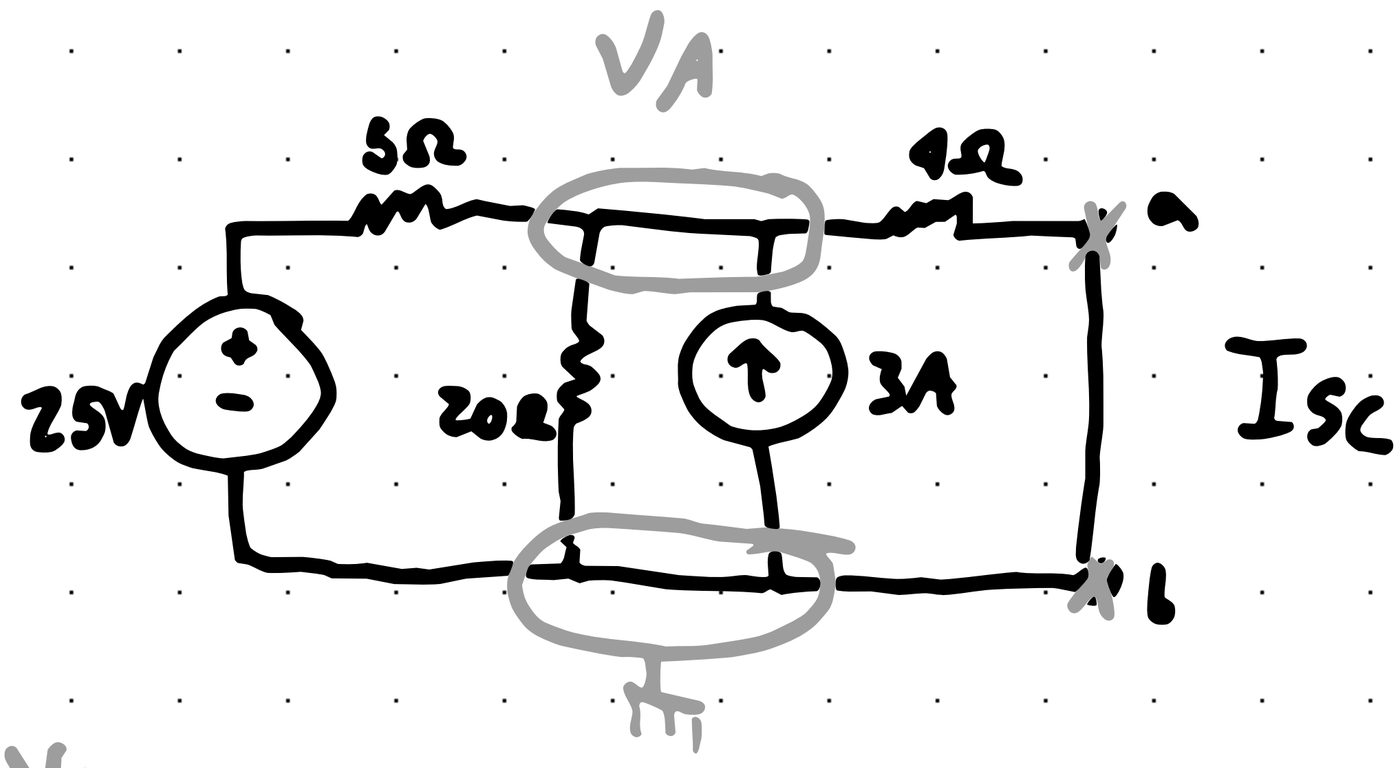


$$\frac{V_a - 25}{5} + \frac{V_a}{20} - 3 = 0$$

$$V_a = 32\,V$$

$$V_{o.c} = V_a = V_{TH} = 32V$$

To Calculate I_N



$$I_{sc} = \frac{V_a}{4}$$

$$\frac{V_a - 25}{5} + \frac{V_a}{20} + (-3) + \frac{V_a}{4} = 0 \qquad V_a = 16V$$

$$I_{sc} = \frac{16}{4} = 4A$$

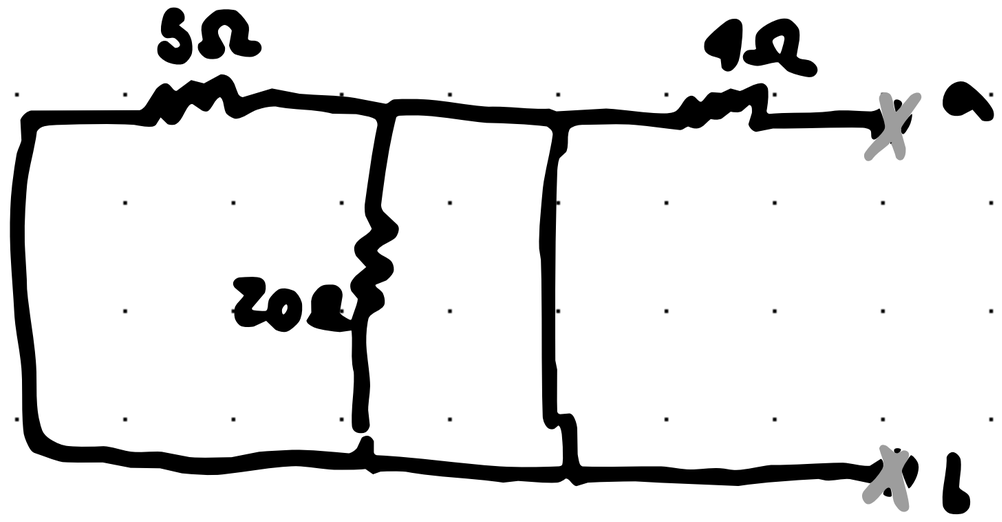
$$I_N = I_{SC} = 4A$$

Calculating R_{TH}

$$R_{TH} = \frac{V_{TH}}{I_N} = \frac{32}{4} = 8\Omega$$

Another Method for R_{TH}

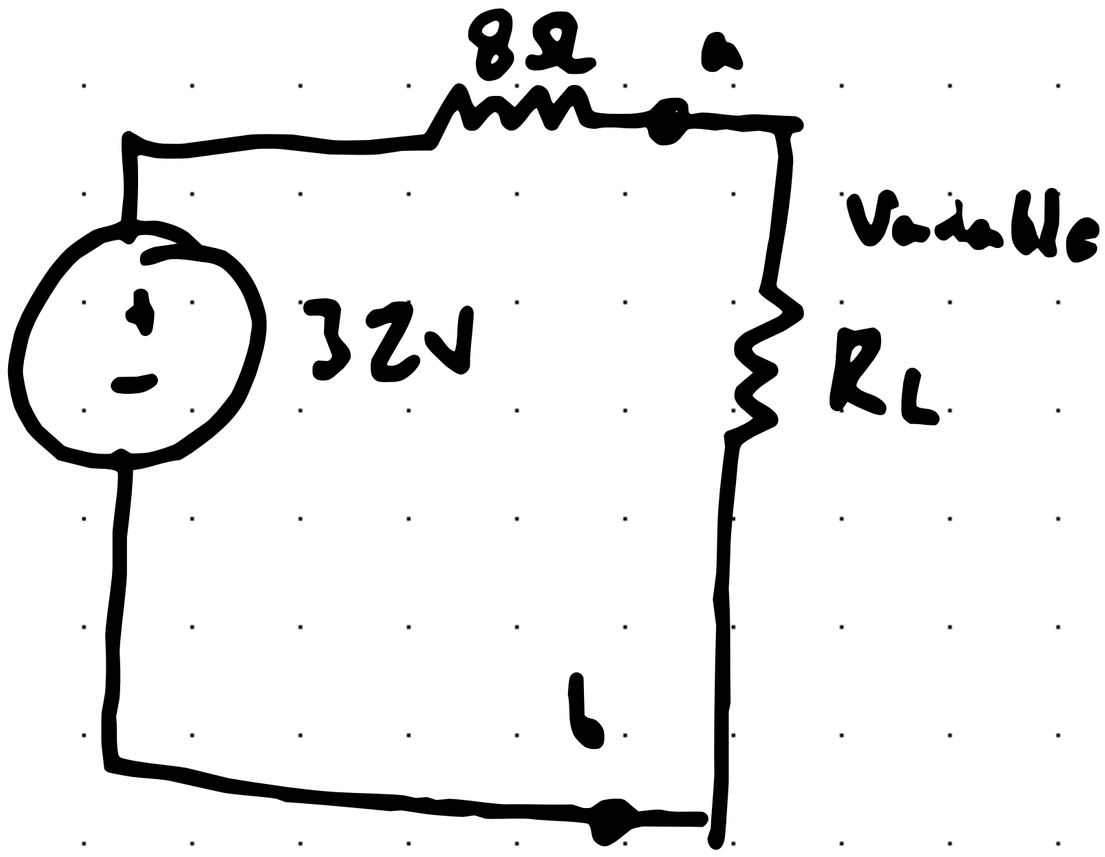
Remove Independent Sources



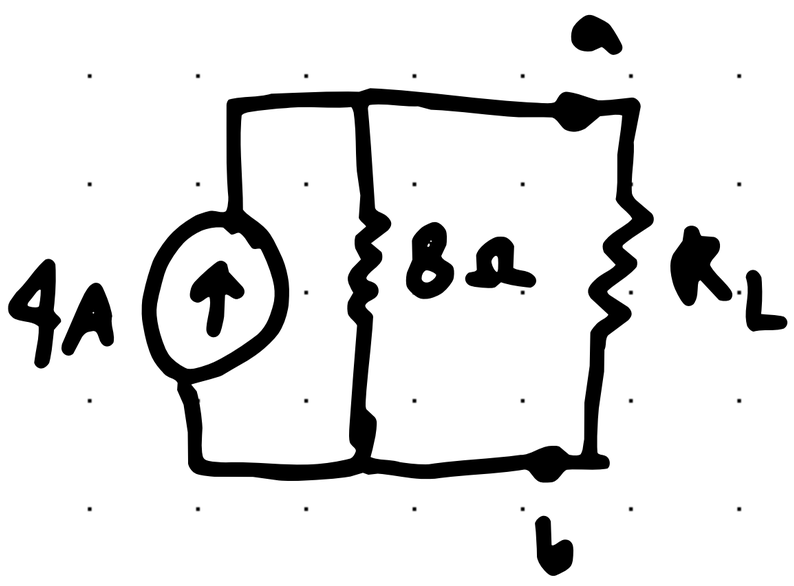
$R_{eq} = 5 // 20 + 4$

$R_{eq} = 8\,\Omega$

Thevenin Equivalent



Norton Equivalent

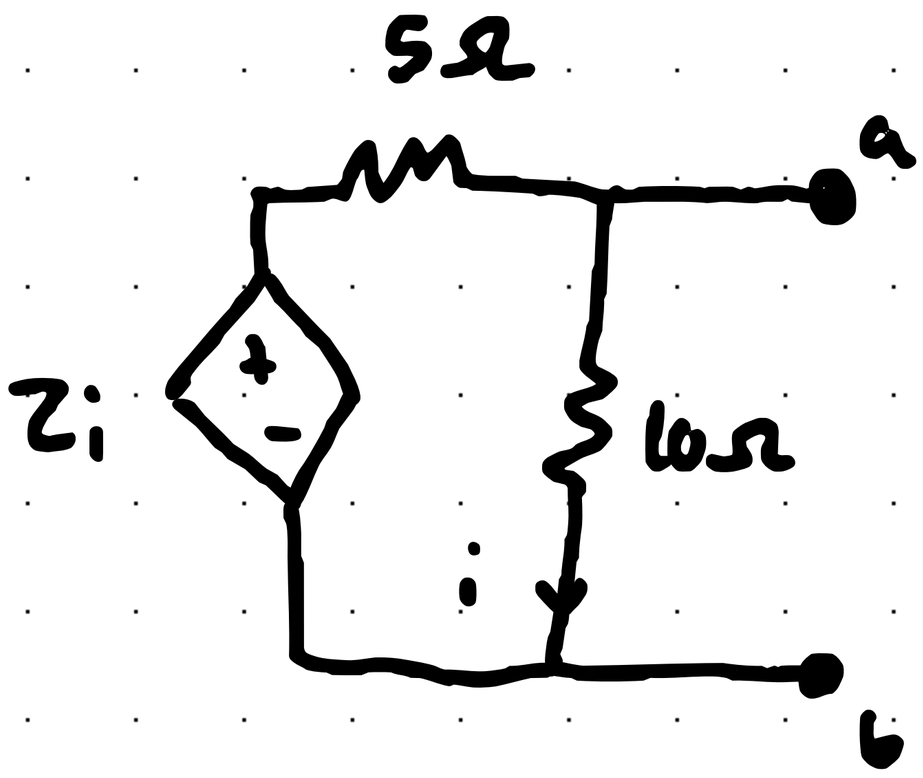


For Max Power

$$R_L = R_{TH} = 8\,\Omega$$

$$P_{RL} = I^2 R = \left(\frac{3^2}{8+8}\right)^2 8 \quad \text{Watts}$$

Example 2 Find Thevenin and Norton equivalents between a and b.



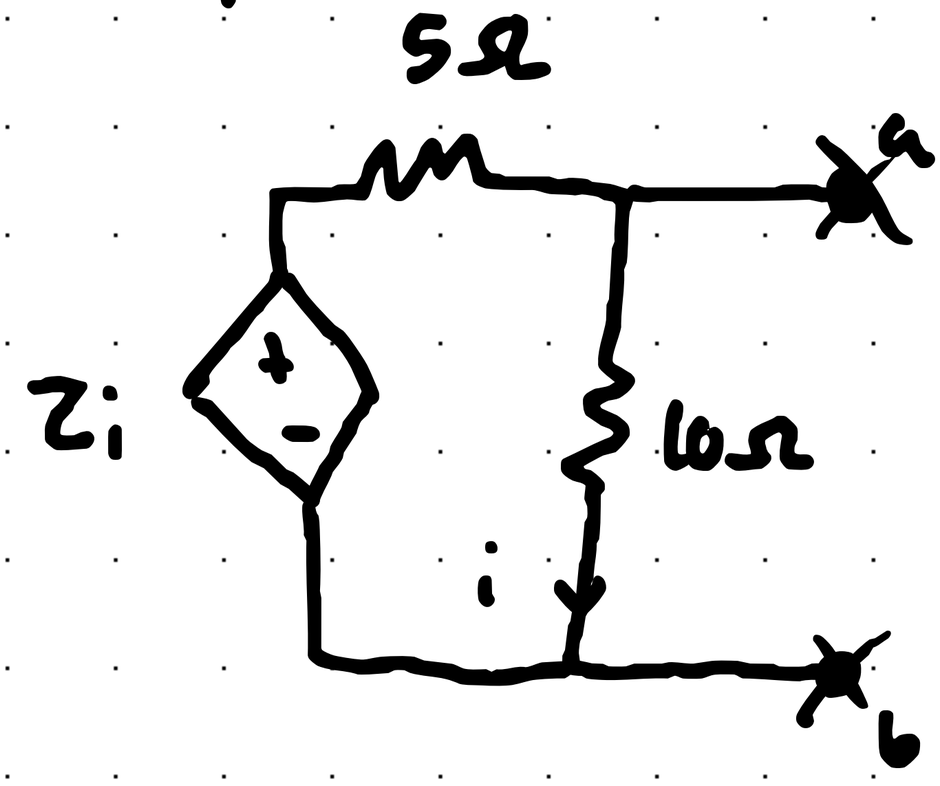
Sol To Calculate V_{TH}

$V_{o.c} = 10i$

$\sum V = 0$ $\quad 2i - 5i - 10i = 0$

loop ① $\quad -13i = 0$

$i = 0$?



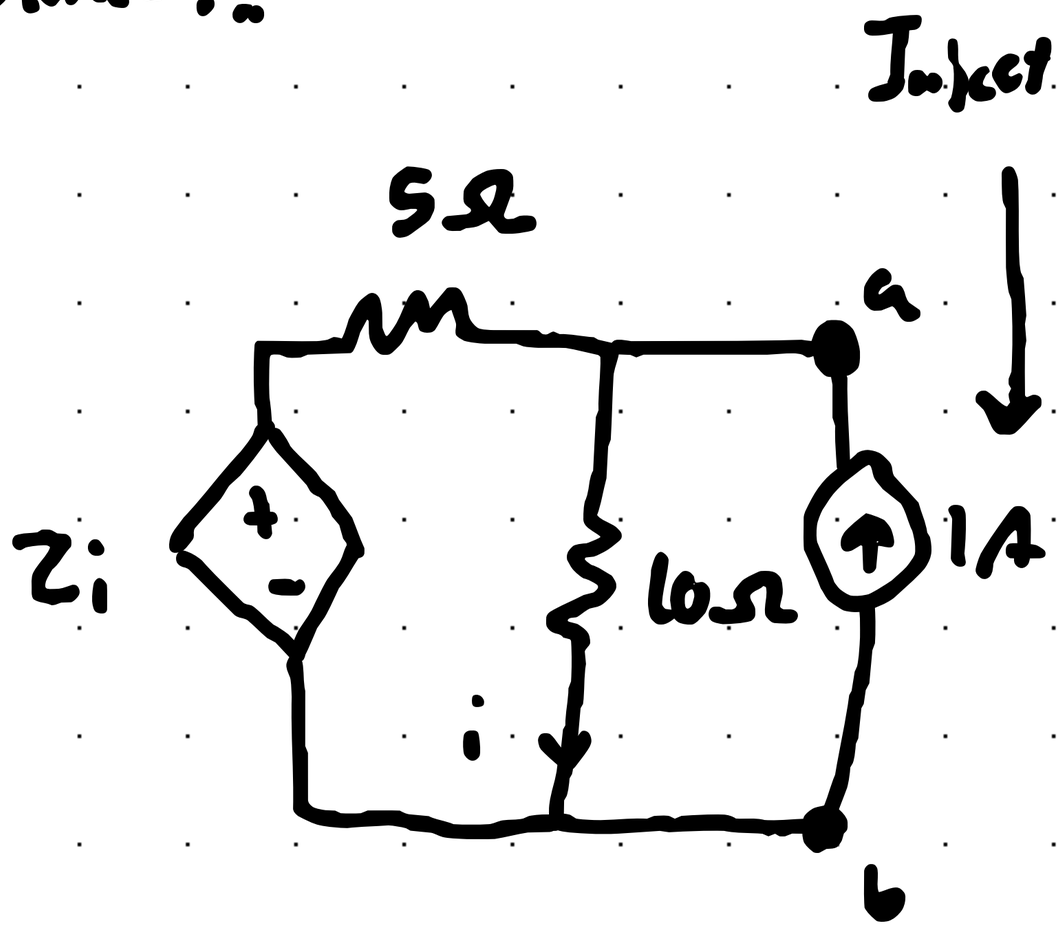
What? How does this make sense?

Well, There are two independent Sources here...

Since there are two independent Sources, I should be expecting that Current is equal to $I_{s.c}$...

So, Method one doesn't really work does it?

$$R_{TH} = \frac{0}{0} = \text{undefined..}$$



To Calculate $R_N = R_{TH}$

$$\sum I = 0$$

Node ①

$$\frac{v_1 - 2i}{5} + \frac{v_1}{10} + (-1) = 0$$

$$i = \frac{v_1}{10}$$

$$\frac{v_1 - 2\left(\frac{v_1}{10}\right)}{5} + \frac{v_1}{10} + (-1) = 0$$

$$v_1 = 3.85$$

$$R_{TH} = R_N = \frac{v_1}{1} = \boxed{3.85\,\Omega}$$