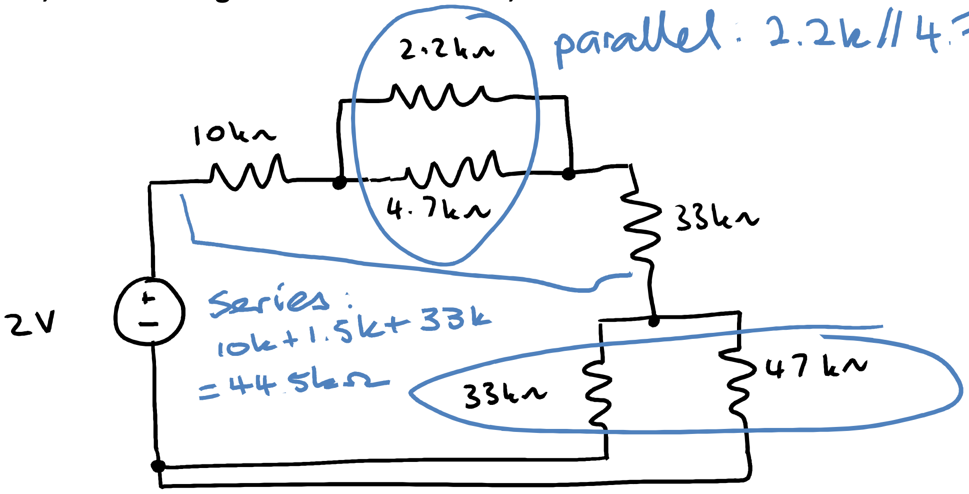
Pre-tutorial 2 Questions

Chapter 3, Ex 67: Voltage and current divider, and resistor combinations

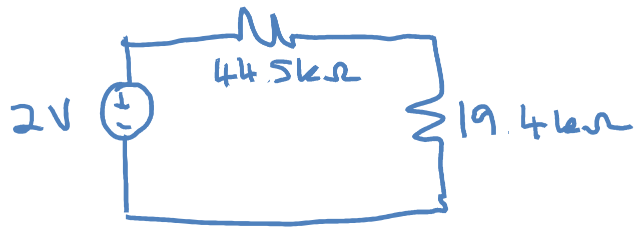


parallel: $2.2k // 4.7k = 1.5k\Omega$

Series: $10k + 1.5k + 33k = 44.5k\Omega$

parallel: $33k // 47k = 19.4k\Omega$

a) Use voltage division to calculate the voltage across the 47 kΩ resistor in the circuit above.

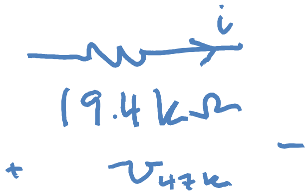


$$v_{47k} = 2 \times \frac{19.4k}{19.4k + 44.5k}$$

$$= 607\,mV$$

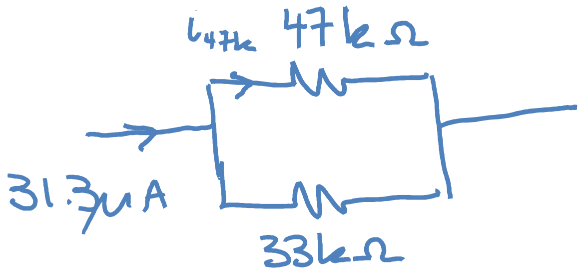
b) Find the current down the 47 kΩ resistor using current divider.

Current through main loop:



$$i = \frac{v}{R} = \frac{607 \times 10^{-3}}{19.4 \times 10^{3}}$$

$$= 31.3\,\mu A$$

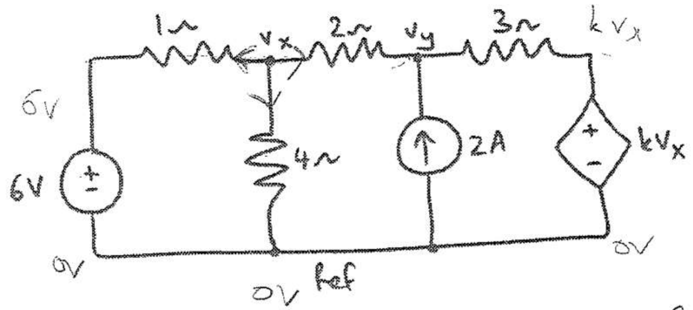


$$i_{47k} = \frac{31.3\mu \times 33k}{47k + 33k}$$

$$= 12.9\,\mu A$$

Chapter 4, Ex 19: Nodal analysis

Using nodal analysis, find the value of k that will result in $v_y = 0$ in the circuit below.



$\underline{\underline{V_x}}$

$\sum I_{out} = 0$

$$\frac{V_x - 6}{1} + \frac{V_x}{4} + \frac{V_x - V_y}{2} = 0$$

$$7v_x - 2v_y = 24 \xrightarrow{v_y = 0} 7v_x = 24 \qquad (1)$$

$\underline{\underline{V_y}}$ $\quad \sum I_{out} = 0$

$$\frac{V_y - v_x}{2} - 2 + \frac{v_y - kv_x}{3} = 0 \qquad (2)$$

$$5v_y - v_x(3 + 2k) = 12 \xrightarrow{v_y = 0} -3v_x - 2kv_x = 12$$

From (1)

$$V_x = 24/7 = 3.429V$$

From (2)

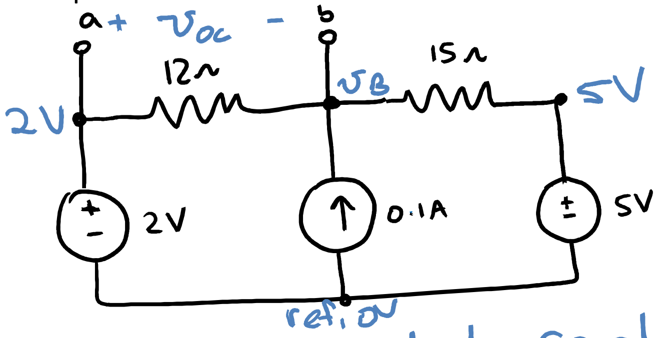
$$k = \frac{-12 - 3v_x}{2v_x} = -3.250$$

At Tutorial 2 – Marked Question

Chapter 5, Ex 45: Thévenin equivalent (use nodal analysis)

For the network below:

a) find the Thévenin equivalent seen at terminals a and b.



Find v_{oc} using nodal analysis

$\Sigma I_{out} = 0$ at node B

$$\frac{v_B - 2}{12} - 0.1 + \frac{v_B - 5}{15} = 0$$

$$\frac{5v_B - 10 + 4v_B - 20}{60} = 0.1$$

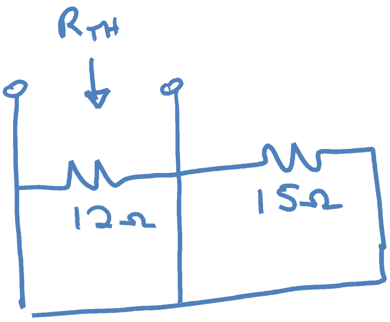
$$9v_B - 30 = 6$$

$$9v_B = 36$$

$$v_B = 4\,V$$

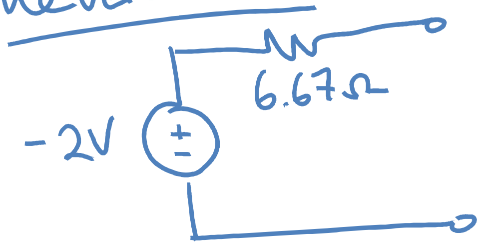
$$v_{oc} = 2 - v_B$$
$$= -2V$$

R_{TH}

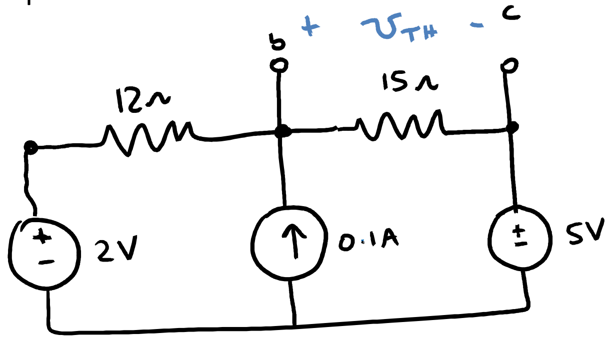


$$R_{TH} = 12 /\!/ 15$$
$$= 6.67\,\Omega$$

Thévenin cct:

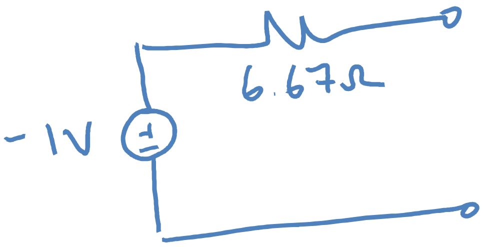


b) find the Thévenin equivalent seen at terminals b and c.



$\Rightarrow v_B$ is the same as before. $\therefore v_B = 4V$

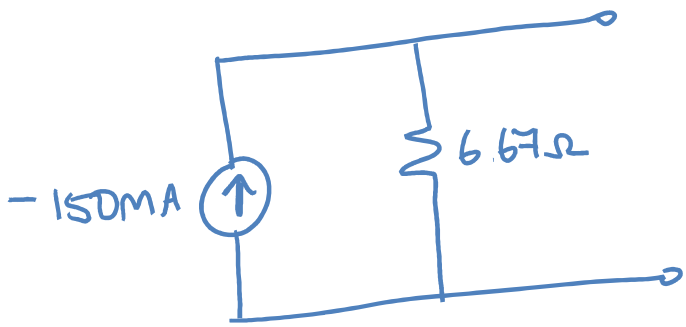
$v_{TH} = 4 - 5 = -1V$ $\quad R_{TH} = 15 // 12 = 6.67\Omega$



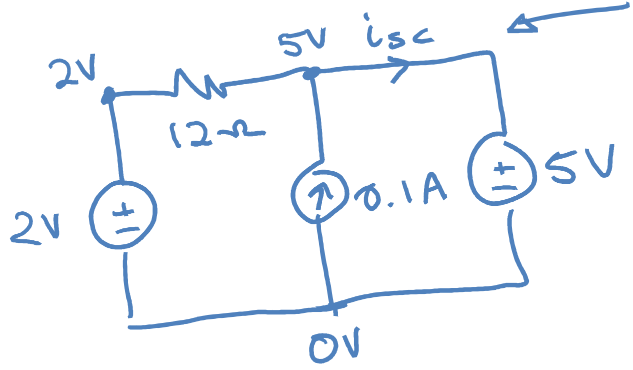
Thévenin cct

Norton

$$i_N = \frac{v_{TH}}{R_{TH}} = -150mA$$



OR



sc in // w 15Ω resistor, so can remove $R_{15\Omega}$.

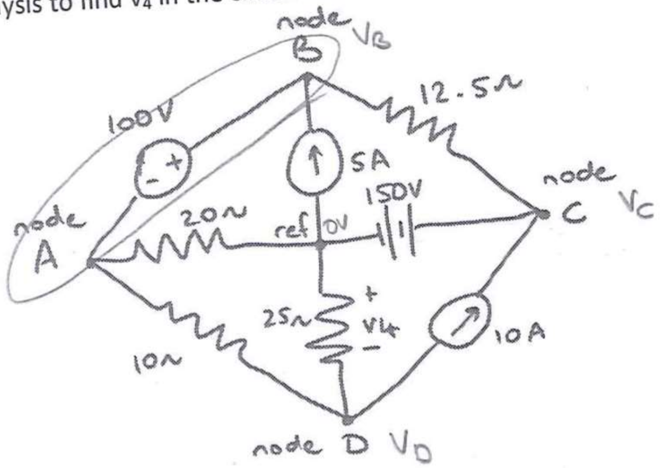
$$i_{sc} = 0.1 + \frac{2-5}{12}$$

$= 150mA$ as before ☺

At Tutorial 2 – Unmarked Questions

Chapter 4, Ex 16: Nodal analysis $-V_D$.

Use nodal analysis to find v_4 in the circuit below.



Supernode A – B : $\sum I_{out} = 0$

$$\frac{V_A}{20} + \frac{V_A - V_D}{10} + \frac{V_B - V_C}{12.5} - 5 = 0$$

$$0.15 V_A + 0.08 V_B - 0.08 V_C - 0.1 V_D = 5 \quad (1)$$

Extra equation $V_B - V_A = 100 \quad (2)$

Node C

By observation $V_C = 150V$

Node D $\sum I_{out} = 0$

$$\frac{V_D - V_A}{10} + \frac{V_D}{25} + 10 = 0$$

$$-25 V_A + 35 V_D = -2500 \quad (3)$$

↓

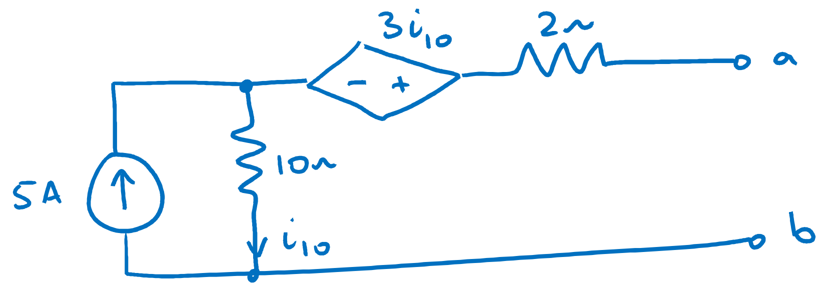
$$V_D = -63.06V$$

But $V_D = -V_4$

$\longrightarrow V_4 = 63.06V.$

Chapter 5, Ex 63: Thévenin equivalent

a) Determine the Thévenin equivalent of the network shown below.



V_{oc}

$i_{10} = 5A$ by inspection

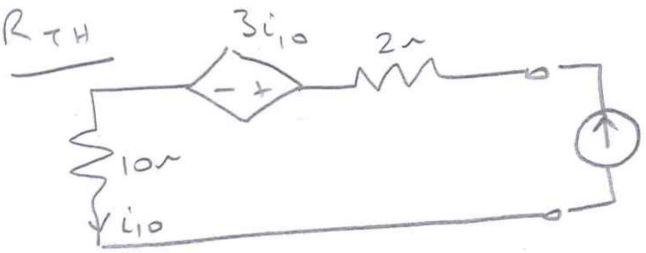
$V_{TH} = 10 i_{10} + 3 i_{10}$

$= 13 \times 5$

$= 65V$

R_{TH}

0A → OC



(KVL)

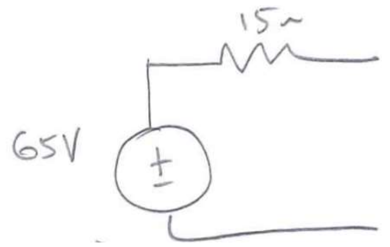
$V_x = 2 \times 1 + 3i_{10} + 10i_{10}$

$i_{10} = 1A$

↳ $V_x = 15V$

$R_{TH} = \frac{V_x}{1} = 15Ω$

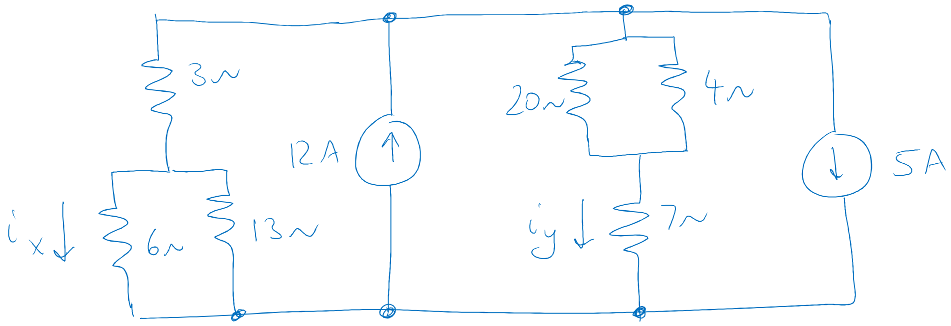
Or could calculate i_{sc} and use ohms law.



Extra Questions for Tutorial 2 (no worked solutions just final answer given)

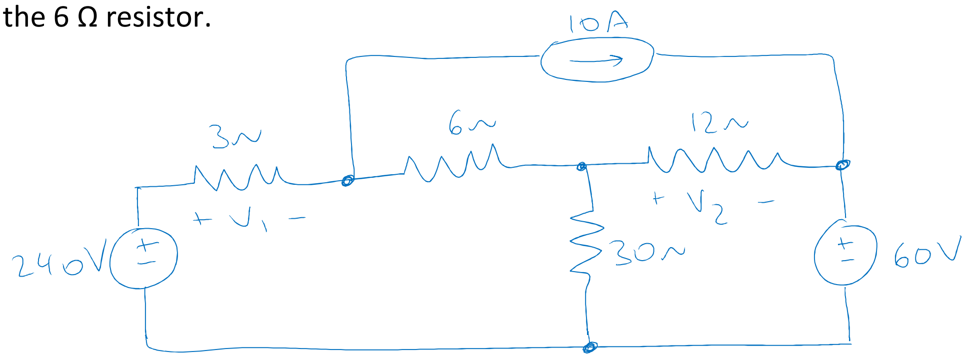
Ch 3, Ex 74: Current divider [Ans: i_x = 2.837 A, i_y = 2.853 A, P = 51.59 W]

For the circuit below, find i_x, i_y and the power dissipated/ absorbed by the 3 Ω resistor.



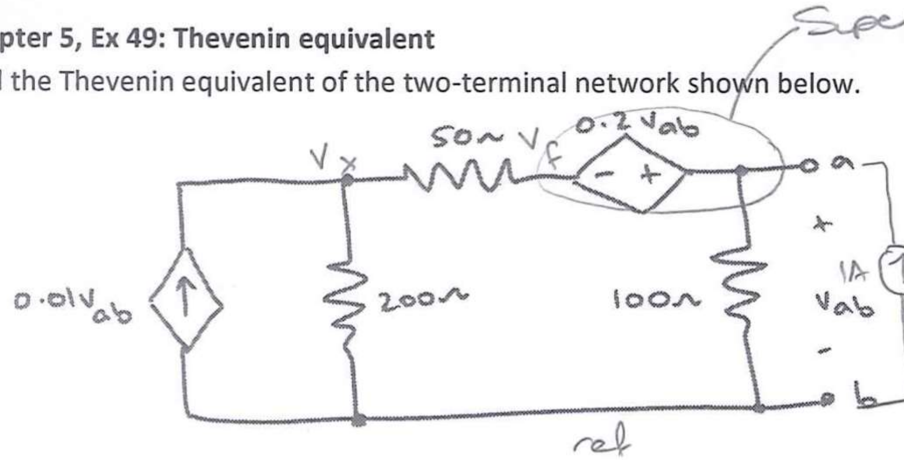
Ch 4, Ex 9: Nodal analysis [Ans: v_1 = 58.5 V, v_2 = 64.4 V, P = 543.4 W]

For the circuit below: (a) Use nodal analysis to determine v_1 and v_2. (b) Compute the power absorbed by the 6 Ω resistor.



Chapter 5, Ex 49: Thevenin equivalent

Find the Thevenin equivalent of the two-terminal network shown below.



No indep V or I sources

$V_{TH} = 0$

Use a 1A test source.

Node x ($\Sigma I_{out} = 0$)

$$-0.01 V_{ab} + \frac{V_x}{200} + \frac{V_x - V_f}{50} = 0$$

Supernode f–a ($\Sigma I_{out} = 0$)

$$\frac{V_f - V_x}{50} + \frac{V_{ab}}{100} - 1 = 0$$

$$V_{ab} - V_f = 0.2 V_{ab}$$

$$\downarrow$$

$$V_{ab} = 192.3\text{V}$$

$$R_{TH} = \frac{V_{ab}}{1} = 192.3\Omega$$