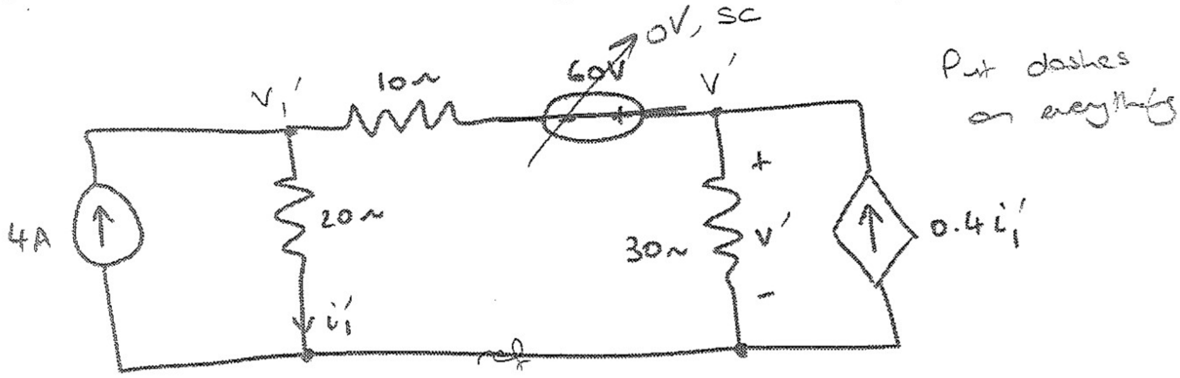
Pre-tutorial 3 Question

Chapter 5, Ex 10: Superposition

Use superposition on the circuit below to find the voltage v. Note that there is a dependent source present.



Consider 4 A source (kill 60V source)

Nodal analysis

Node v_1' $\sum I_{out} = 0$

$$-4 + \frac{v_1'}{20} + \frac{v_1' - v'}{10} = 0 \quad (1)$$

Node v'

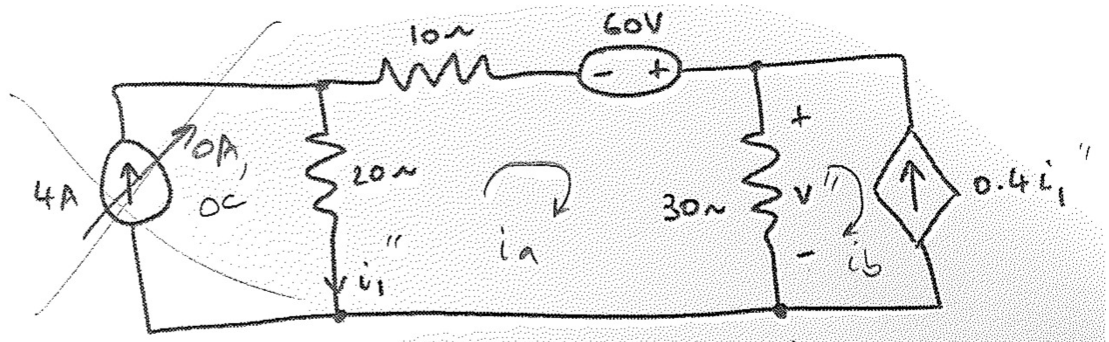
$$-0.4i_1' + \frac{v'}{30} + \frac{v' - v_1'}{10} = 0 \quad (2)$$

$$i_1' = \frac{v_1'}{20} \quad (3)$$

$\downarrow$

$$3v_1' - 2v' = 80$$
$$-7.2v_1' + 8v' = 0$$

$\Rightarrow v' = 60V$



Consider 60V source (kill 4A source)

Mesh analysis

$$20i_a + 10i_a - 60 + 30(i_a - i_b) = 0$$

$$60i_a - 30i_b = 60 \quad (1)$$

$$i_b = -0.4i_1''$$

$$i_a = -i_1''$$

$$\hookrightarrow i_b = 0.4i_a \quad (2)$$

(2) into (1)

$$60i_a - 12i_a = 60$$

$$i_a = 1.25\,A, \quad i_b = 0.5A$$

$$v'' = 30(i_a - i_b)$$

$$= 22.5V$$

Overall

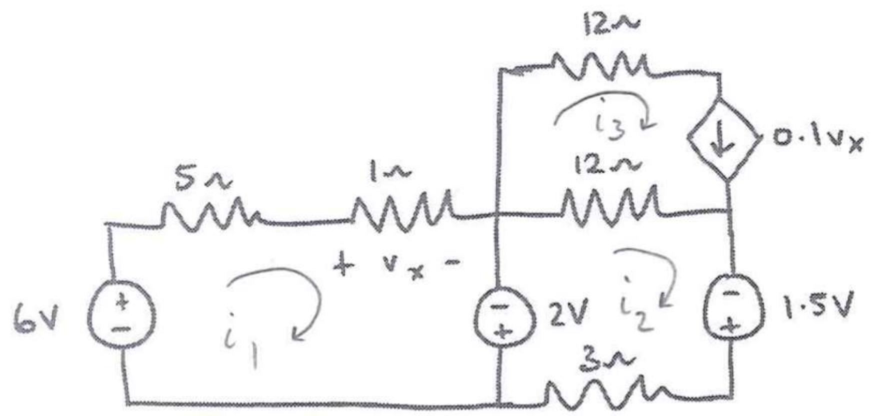
$$v = v' + v'' = 60 + 22.5$$

$$= 82.5V$$

At Tutorial 3 – Marked Question

Chapter 4, Ex 36: Mesh analysis

Determine each mesh current in the circuit below.



Mesh 1: $-6 + 5i_1 + i_1 - 2 = 0$

$6i_1 = 8 \rightarrow i_1 = 1.33\dot{3}\,A$

Mesh2: $2 + 12(i_2 - i_3) - 1.5 + 3i_2 = 0$

$15i_2 - 12i_3 = -0.5 \qquad (1)$

Mesh 3:

First find V_x in terms of mesh currents.

L looking at loop 1.

$V_x = i_1$

Looking at mesh 3

$i_3 = 0.1 V_x = 0.1 i_1 = 133.3\,mA$ ← 10^{-3}

Subst i_3 into (1)

$$i_2 = \frac{-0.5 + 12(133.3m)}{15}$$

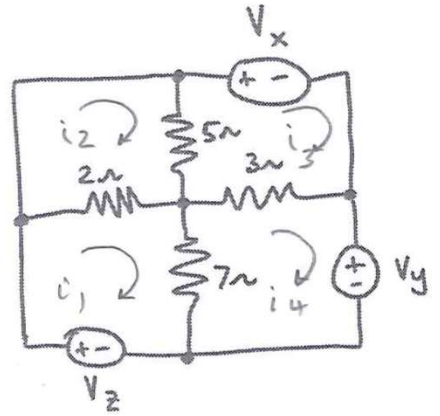
$= 73.31\,mA$

Recall $i_1 = 1.33\,A$

At Tutorial 3 – Unmarked Questions

Chapter 4, Ex 40: Mesh analysis

Choose non-zero values for the three voltage sources in the circuit below, such that no current flows through any resistor in the circuit. Recommend using mesh analysis to solve.



Mesh 1: $-V_z + 2(i_1 - i_2) + 7(i_1 - i_4) = 0$

$$-V_z + 9i_1 - 2i_2 - 7i_4 = 0 \quad (1)$$

Mesh 2: $2(i_2 - i_1) + 5(i_2 - i_3) = 0$

$$-2i_1 + 7i_2 - 5i_3 = 0 \quad (2)$$

Mesh 3: $3(i_3 - i_4) + 5(i_3 - i_2) + V_x = 0$

$$-5i_2 + 8i_3 - 3i_4 + V_x = 0 \quad (3)$$

Mesh 4: $V_y + 7(i_4 - i_1) + 3(i_4 - i_3) = 0$

$$V_y - 7i_1 - 3i_3 + 10i_4 = 0 \quad (4)$$

For no current flow through any resistor we want

$i_1 - i_2 = 0 \rightarrow i_1 = i_2$

$i_2 - i_3 = 0 \rightarrow i_2 = i_3$

$i_3 - i_4 = 0 \rightarrow i_3 = i_4$

$i_1 - i_4 = 0 \rightarrow i_1 = i_4$

So, $i_1 = i_2 = i_3 = i_4 = i$

From (1)

$$-V_z + i\,(9 - 2 - 7) = 0$$

$$V_z = 0.$$

From (2)

$$i\,(-2 + 7 - 5) = 0$$

$$0 = 0$$

From (3)

$$V_x + i\,(-5 + 8 - 3) = 0$$

$$V_x = 0$$

From (4)

$$V_y + i\,(-7 - 3 + 10) = 0$$

$$V_y = 0.$$

Request for non-zero values can't be satisfied.

Sometimes as an engineer you will be asked to do the impossible.

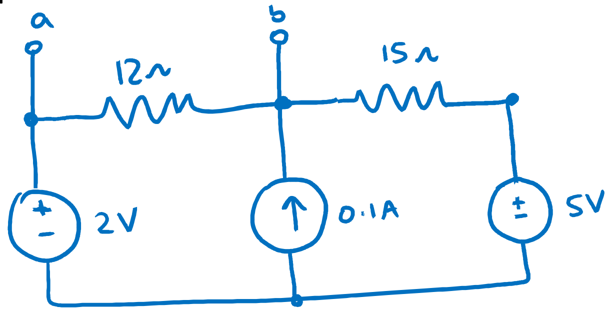
You must check and double check your results.

Then you can argue why it is impossible.

Chapter 5, Ex 45: Norton equivalent (use mesh analysis)

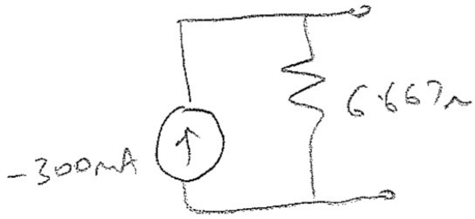
For the network below:

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

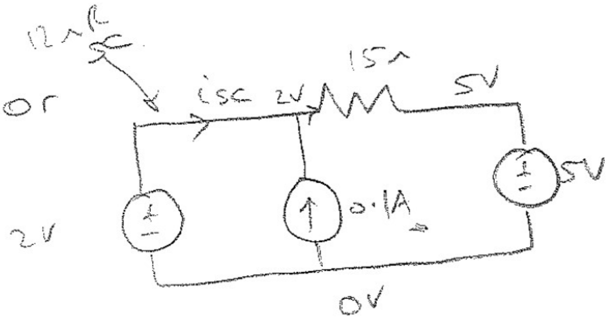


For Norton

$I_N = \frac{V_{TH}}{R_{TH}} = -300mA$



or



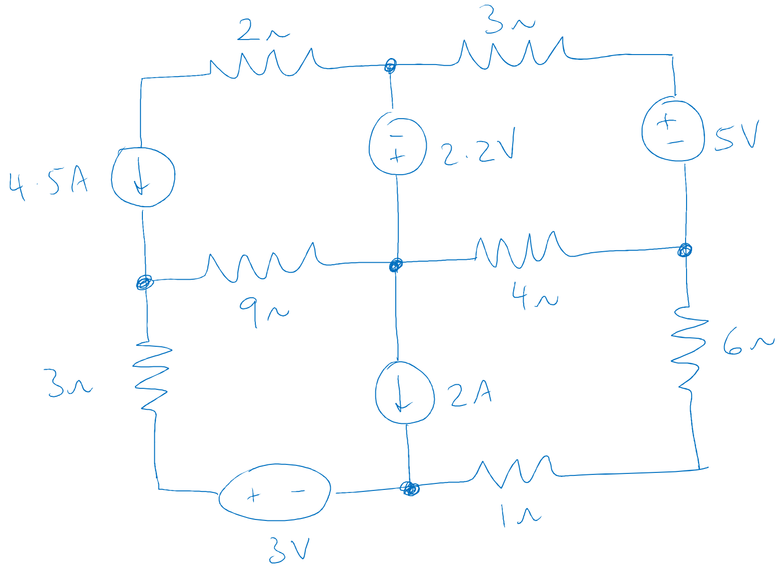
$isc + 0.1 = \frac{2-5}{15}$

$isc = -0.3A$

Extra Questions for Tutorial 3 (no worked solutions just final answer given)

Ch 4, Ex 43: Mesh analysis [Ans: -3.654 W]

Use the supermesh technique to determine the power supplied by the 2.2 V source in the circuit below.



Ch 5 ex 7: Superposition [Ans: $v_x = 10.33\ V$]

Apply superposition to the circuit below in order to find the value of v_x.