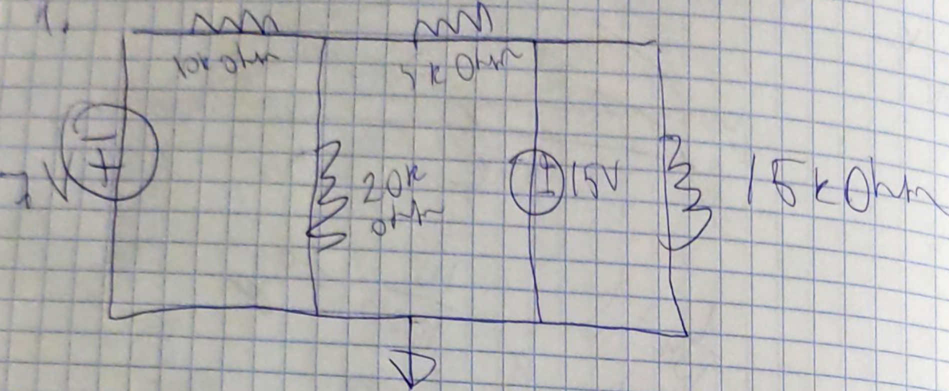
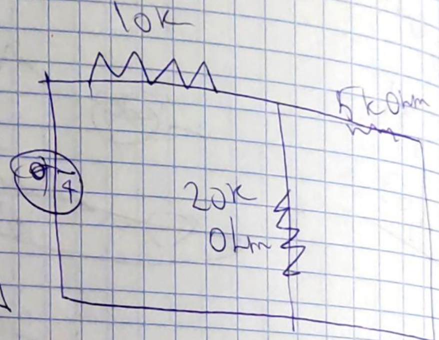
Pre lab

1.



1) switching off V_1



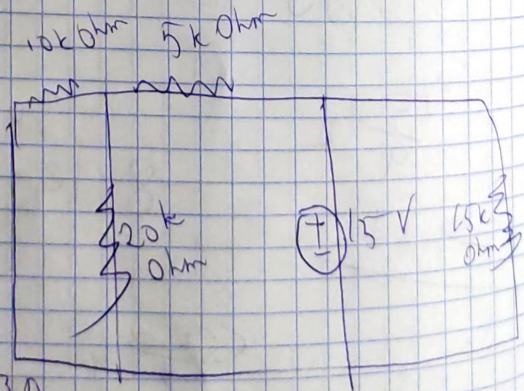
$R_{eq} = \frac{20\cdot5}{20+5}k = 4\ k\,Ohm$

$I_{R_2} = \frac{7}{10k+4k} = 0,5\cdot10^{-3}\ A$

$I_{R_3} = \frac{2}{5\cdot10^{3}} = 0,4\cdot10^{-3}\ A$

$I_{R_1} = \frac{2}{20\cdot10^{3}} = 0,1\cdot10^{-3}$

2) switching off V_2



~~R~~

$I_{R_4} = \frac{15}{15k} = 1\cdot10^{-3}\ A$

$I_{R_3} = \frac{15}{\left(\frac{20\cdot10}{30}\right)k+5k} = 1,3\cdot10^{-3}\ A$

$I_{R_2} = \frac{9,5}{10k} = 0,95\cdot10^{-3}\ A$

$I_{R_1} = \frac{9,5}{20k} = 0,475\cdot10^{-3}\ A$

3) Applying superposition pr.

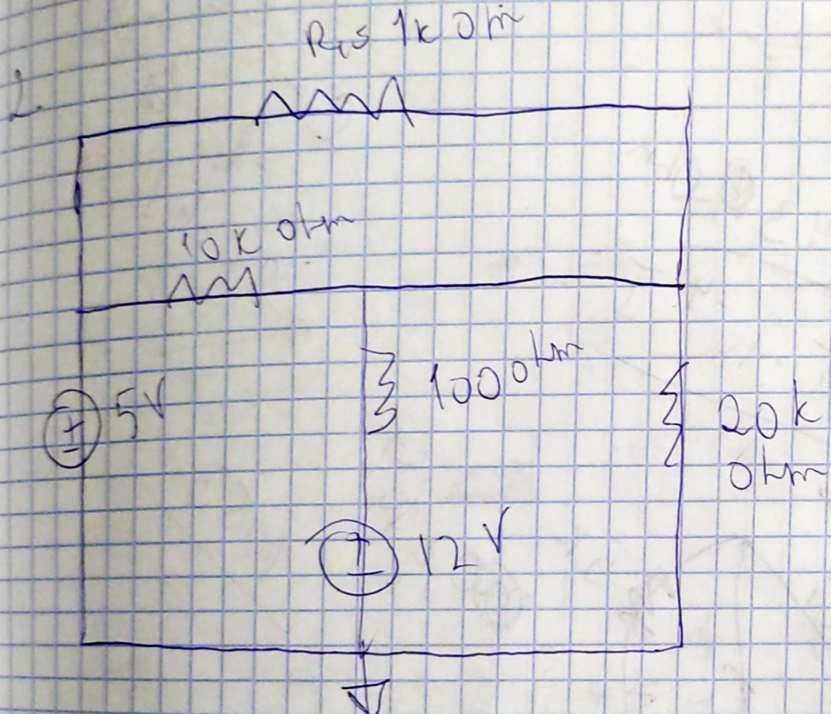
$I_{R_3} = 1{,}3\cdot10^{-3} + 0{,}4\cdot10^{-3} = 1{,}7\cdot10^{-3}$ A

$I_{C_2} = 0{,}95\cdot10^{-3} + 0{,}5\cdot10^{-3} = 1{,}45\cdot10^{-3}$ A

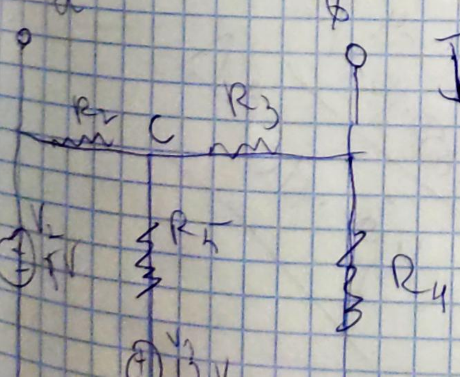
$I_{C_1} = 0{,}475\cdot10^{-3} - 0{,}1\cdot10^{-3} = 0{,}375\cdot10^{-3}$

$I_{R_4} = 10^{-3}$ A

2.



1) finding R_1

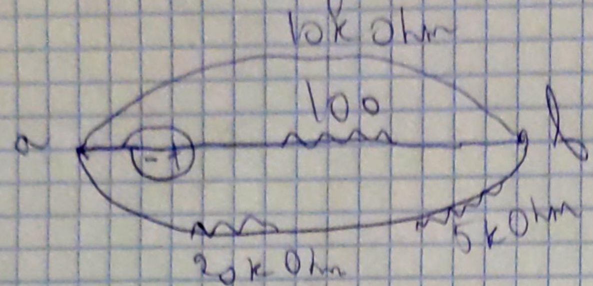


1.1) Switching off V_3

$I_{R_2} = \dfrac{5}{\left(10k + \frac{25k\cdot10^2}{25100}\right)} = 4{,}95\cdot10^{-4}$ A

$I_{R_3} = \dfrac{0{,}5}{25k} = 0{,}02\cdot10^{-3}$ A

1.2) Switching off V_2



$$I_{R_2} = \frac{12 - 100 \cdot \left(\frac{12}{\frac{25\cdot 10}{35}k + 100} \right)}{10k} = \frac{11,835V}{10k} = 1,1835$$

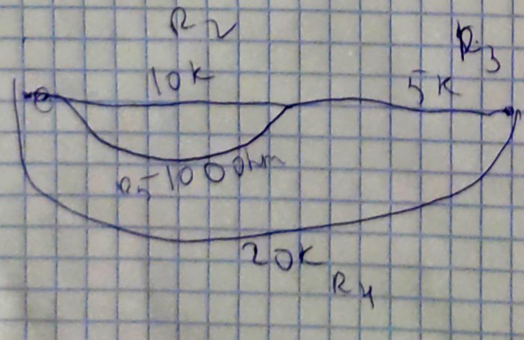
$$I_{R_3} = \frac{11,835}{25k} = 4,7 \cdot 10^{-4} \ A$$

1.3) Using superposition pr.

$$I_{R_2} = 0,02 \cdot 10^{-3} - 0,118 \cdot 10^{-4} = \text{[illegible]} \ 10^{-4} A$$

$$I_{R_3} = 4,7 \cdot 10^{-4} + 4,95 \cdot 10^{-4} = 9,65 \cdot 10^{-4}$$

1.4) finding R_{eq}



$$R_{eq} = \frac{\left(\frac{R_2 \cdot R_5}{R_2 + R_5} + R_3 \right) R_4}{\left(\frac{R_2 \cdot R_5}{R_2 + R_5} + R_3 \right) + R_4} = 4k$$

5) V on R_1

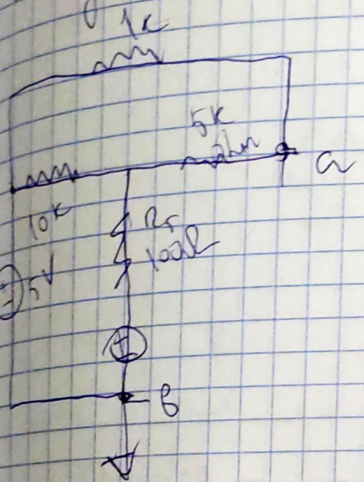
$a-c = -9,8$ V

$b-c = -4,865$ V

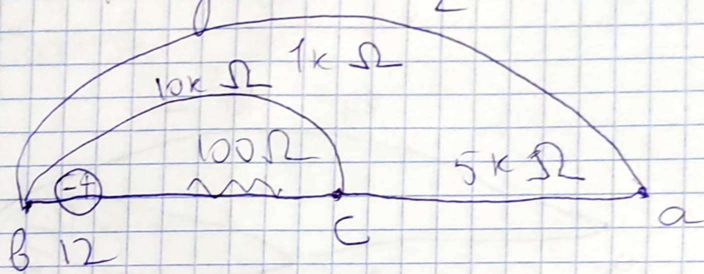
$a-b = 4,935$ V

$V_{R1} = 0,2 \cdot 4,935 = 0,987$ V

Finding R_4 using Norton



1.1) Switching off V_2



$12 - V_{R5}$

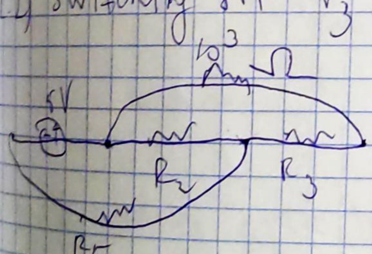
$R_{eq} = \left(\frac{10 \cdot 6}{10+6}\right) k = \frac{15}{4} k$

$R_{eq} = \frac{15}{4} k + 100 = 3850\,\Omega$

$V_{R5} = \frac{12}{3850} \cdot 100 = 0,31$ V

$I_{R_1} = \frac{11,69}{6k} \approx 2 \cdot 10^{-3}$ A

1.2) Switching off V_3



$R_{eq} = \frac{6 \cdot 10}{16} k = \frac{15}{4} k$

$R_{eq} = 3850$ Ohm

$V_{R_5} = 100 \cdot \left(\frac{5}{3850}\right) = 0,13$ V

$I_{R_1} = \frac{4,87\text{V}}{6k} = 0,81 \cdot 10^{-3}$ A

1.3) Using superposition pr.

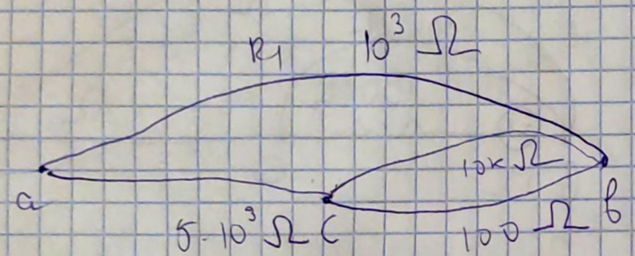
$I_{R_1} = 2\cdot10^{-3} - 0{,}81\cdot10^{-3} = 1{,}19\cdot10^{-3}\ A$

a - c = 1,19 V

c - b = 5 V

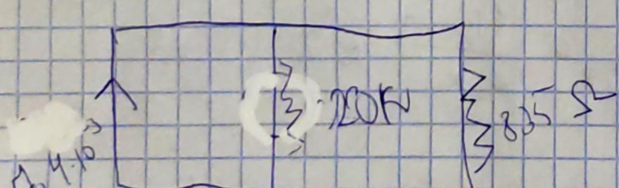
a - b = 6,2 V

1.4) Finding R_{eq}



$$R_{eq} = \frac{10^3 \cdot \left(5\cdot10^3 + \left(\frac{10k\cdot100}{10k+100}\right)\right)}{10^3 + \left(5\cdot10^3 + \left(\frac{10k\cdot100}{10k+100}\right)\right)} \approx 835{,}0\ \Omega$$

$$I_N = \frac{6{,}2}{835{,}0} = 7{,}4\cdot10^{-3}\ A$$



$$V_{R_4} = 297\cdot10^{-6}\cdot20\cdot10^{3} = 5940\cdot10^{-3} = 5{,}94\ V$$

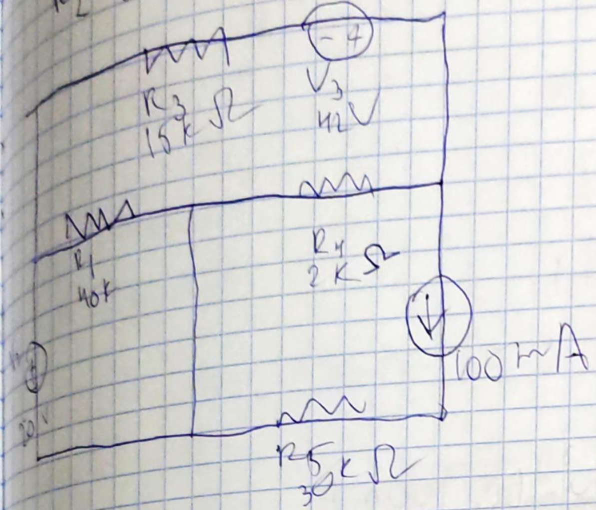
$$20\cdot10^3\cdot i_1 = 835\cdot i_2$$

$$i_1 = \frac{835\cdot7{,}4\cdot10^{-3}}{20835} = 297\cdot10^{-6}\ A$$

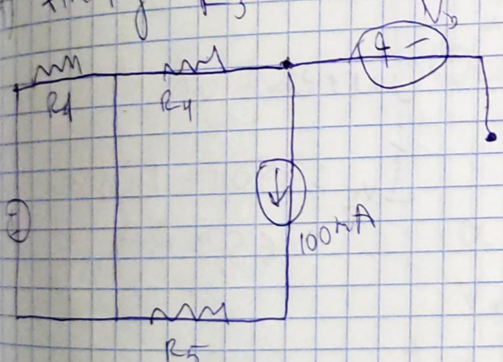
Post Lab

R_3, R_1 using Thevenin

R_2 and R_4 using Norton



1) finding R_3



2) Switching off V_2

$40 \cdot 10^3 \cdot I_1 = 18 \cdot 10^3 \cdot I_2$

$58 \cdot 10^3 \cdot I_1 = 1800$

$I_1 = \frac{900}{29} \cdot 10^{-3} \approx 31 \cdot 10^{-3}$ A

3) find V_T

$b - c = 31 \cdot 10^{-3} \cdot 40 \cdot 10^3 \approx 1241$ V

$c - d = 2 \cdot 10^3 \cdot 100 \cdot 10^{-3} = 200$ V

$d - a = 42$ V

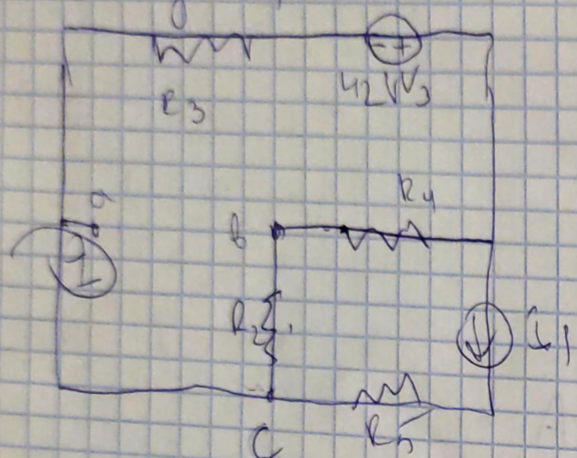
4) R_T

$$\frac{\left(\frac{40 \cdot 18}{58}k + 2k\right)}{\left(\frac{40 \cdot 18}{58}k + 2k\right)^{-1}} 14,41k$$

$b - a = 1483$ V

5) $\frac{14,83\,V}{15k + 14,47k} = 50,1$ mA

finding R_1



$15i_1 = 20i_2 = i_1 + i_2 = 100$ mA

$35i_2 = 1500$

$i_2 = 43$ mA

a - c = 20V

b - c = 7,72

a - b = +7,72 V

$V_1 = -7,72$ V

finding R_{eq}

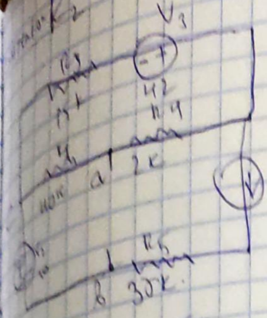
$R_{eq} = \frac{17 \cdot 18}{35}k = 8,75k\ \Omega$

$I_{R_1} = \frac{7,72}{48,75k} = 15,8$ mA

Current on V_2

$I_{V_2} = 50,1 + 15,8 =$ 65,9 mA

R_2 and R_4 using Norton



$42k\, i_1 = 15k\, i_2$

$57k\, i_1 = 1500$

$i_1 = 26{,}3\ mA$

$c - a = 40k \cdot 26{,}3\ mA = 1053\ V$

$c - b = 20\ V$

$b - a = 1033\ V$

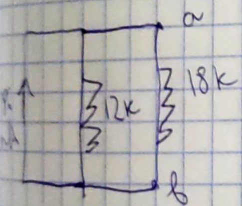
$V_{Th} = 1033\ V$

2) Finding R_{th}

$R_{eq} = \frac{40 \cdot 17}{57} k = 12k$

3) I_N

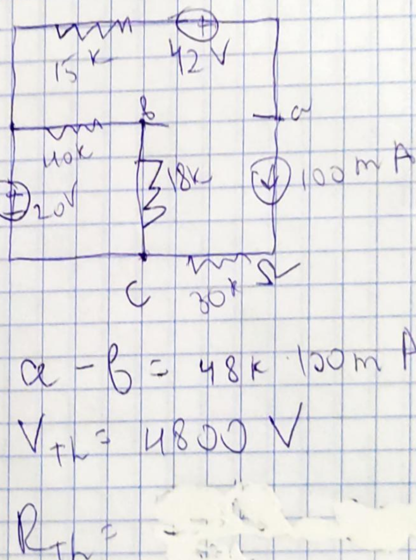
$I_N = \frac{1033}{12k} = \quad 86\ mA$



$12k\, i_1 = 18k\, i_2$

$30k\, i_2 = 1033$

$i_1 = 34{,}4\ A$



$a - b = 48k \cdot 100mA = 4800\ V$

$V_{Th} = 4800\ V$

$R_{Th} =$