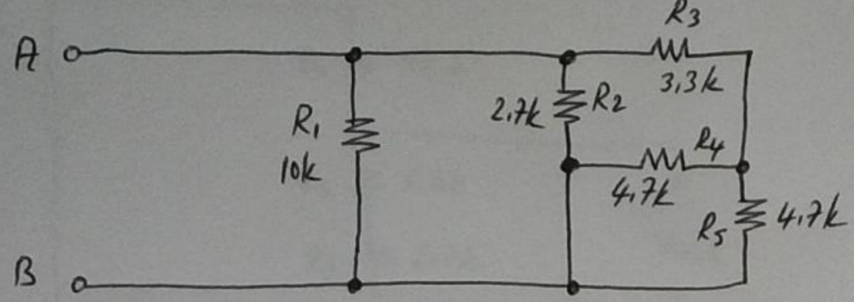
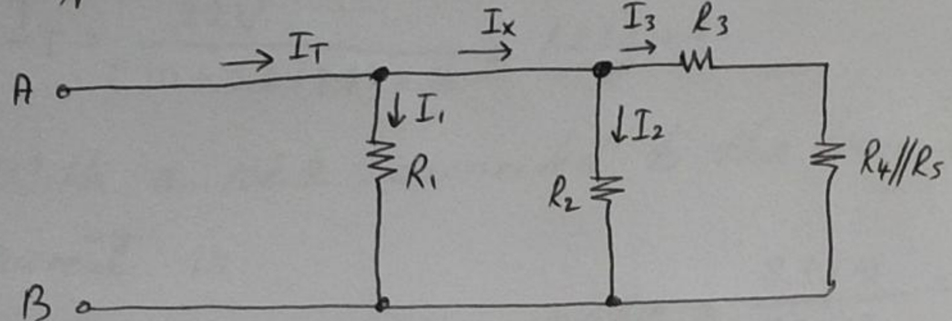
HW #2 - Solutions

10)



a) $R_4 // R_5 = 2.35\,k\Omega$

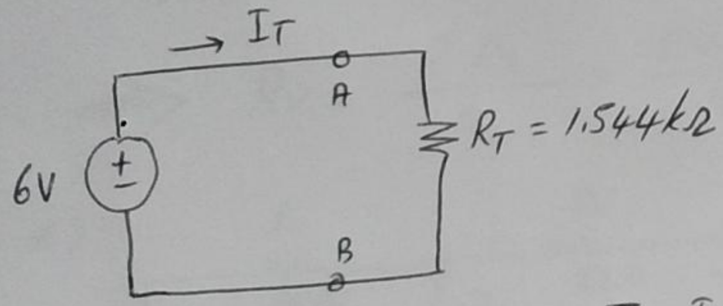


$$R_{3,eq} = R_3 + R_4//R_5 = 3.3 + 2.35 = 5.65\,k\Omega$$

$$R_{2,eq} = R_{3,eq} // R_2 = \frac{2.7 \times 5.65}{2.7 + 5.65} = 1.826\,k\Omega$$

$$R_T = R_1 // R_{2,eq} = \frac{10 \times 1.826}{10 + 1.826} = \underline{\underline{1.544\,k\Omega}}$$

b)



$$I_T = \frac{6V}{1.544\,k\Omega} = \underline{\underline{3.88\,mA}}$$

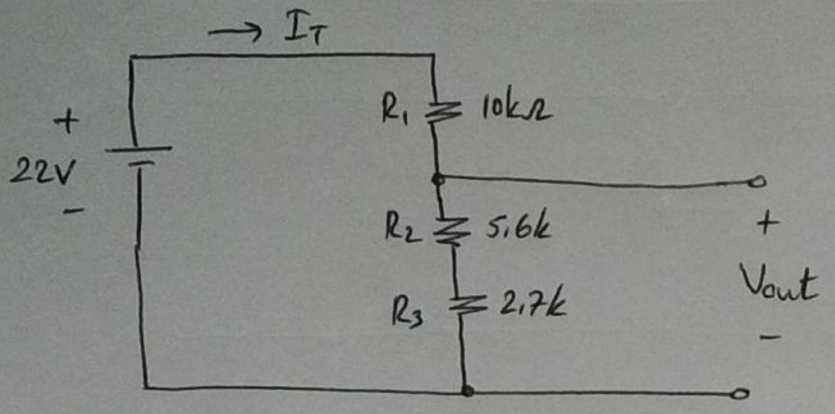
c) $I_1 = \dfrac{6V}{10\,k\Omega} = 0.6\,mA$ $\qquad I_x = I_T - I_1 = 3.88 - 0.6 = 3.28\,mA$

$I_2 = \dfrac{6V}{2.7\,k\Omega} = 2.22\,mA$ $\qquad I_3 = I_x - I_2 = 3.28 - 2.22 = 1.06\,mA$

Current Division $\quad I_5 = \dfrac{R_4}{R_4 + R_5} I_3 = \dfrac{4.7}{4.7 + 4.7} 1.06 = \underline{\underline{0.53\,mA}}$

d) $V_{R_2} = 6V \implies V_{R_2} = I_2 \times R_2 = \underline{\underline{6V}}$

16)



$$I_T = \frac{22V}{(10+5{,}6+2{,}7)\,k\Omega} = \underline{1{,}202\,mA}$$

With a 10kΩ connected to the terminals, the total current is

$$R_{eq_1} = (R_2+R_3)\,//\,10k\Omega = 8{,}3//10 = \frac{8{,}3\times 10}{8{,}3+10} = \underline{4{,}535\,k\Omega}$$

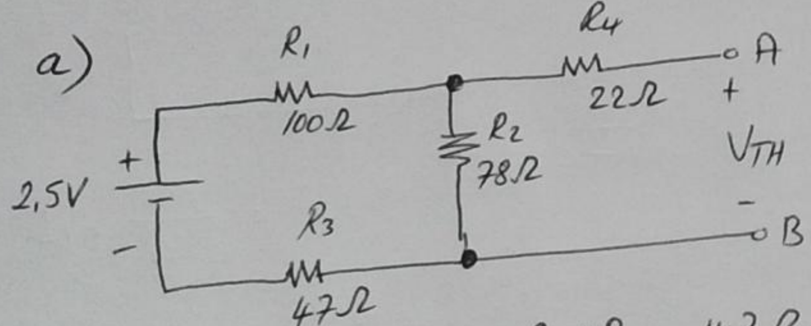
$$R_T = R_1 + R_{eq_1} = 10 + 4{,}535 = \underline{\underline{14.535\,k\Omega}}$$

$$I_T = \frac{22V}{14{,}535\,k\Omega} = \underline{\underline{1{,}513\,mA}}$$

24) $R_V R_2 = R_1 R_3$ for a balanced bridge.

$$\Rightarrow R_V = \frac{R_1 R_3}{R_2} = \frac{390\times 560}{1000} = \underline{\underline{218{,}4\,\Omega}}$$

28) a)

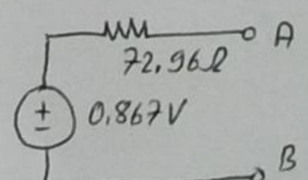


$$V_{TH} = V_{R_2} = \frac{78}{100+78+47}\times 2{,}5$$
$$= 0{,}867\,V$$

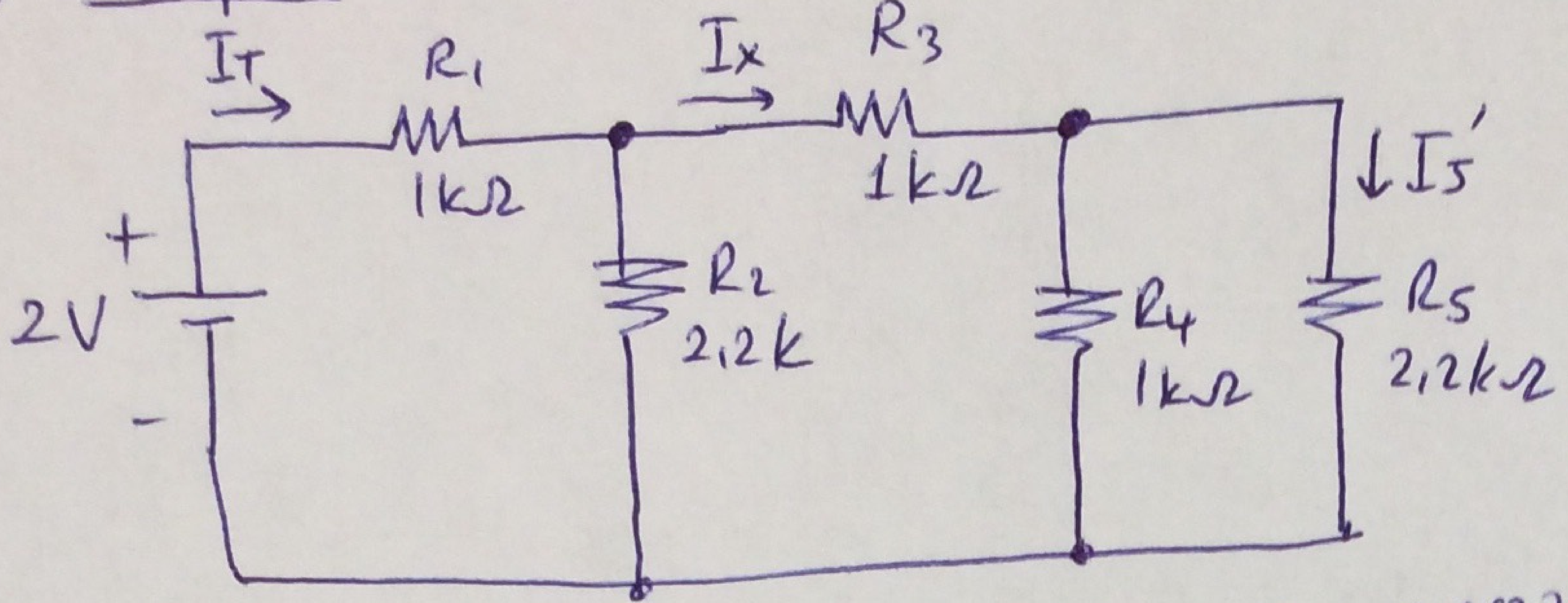
$R_{TH} = ?$ (Kill 2,5V) $R_1+R_3 = 147\Omega$

$$(R_1+R_3)//R_2 = \frac{147\times 78}{147+78} = 50{,}96\Omega \quad R_{TH} = R_4 + 50{,}96 = 72{,}96\Omega$$

Thevenin equivalent $\Rightarrow$



51) Step 1 : Kill 3V



$R_4 // R_5 = 0{,}6875\,k\Omega \implies R_3 + 0{,}6875 = 1{,}6875\,k\Omega$

$R_2 // 1{,}6875 = 0{,}955\,k\Omega \implies R_T = R_1 + 0{,}955\,k\Omega = \underline{\underline{1{,}955\,k\Omega}}$

$I_T = \frac{2V}{R_T} = \frac{2V}{1{,}955\,k\Omega} = 0{,}511\ mA$

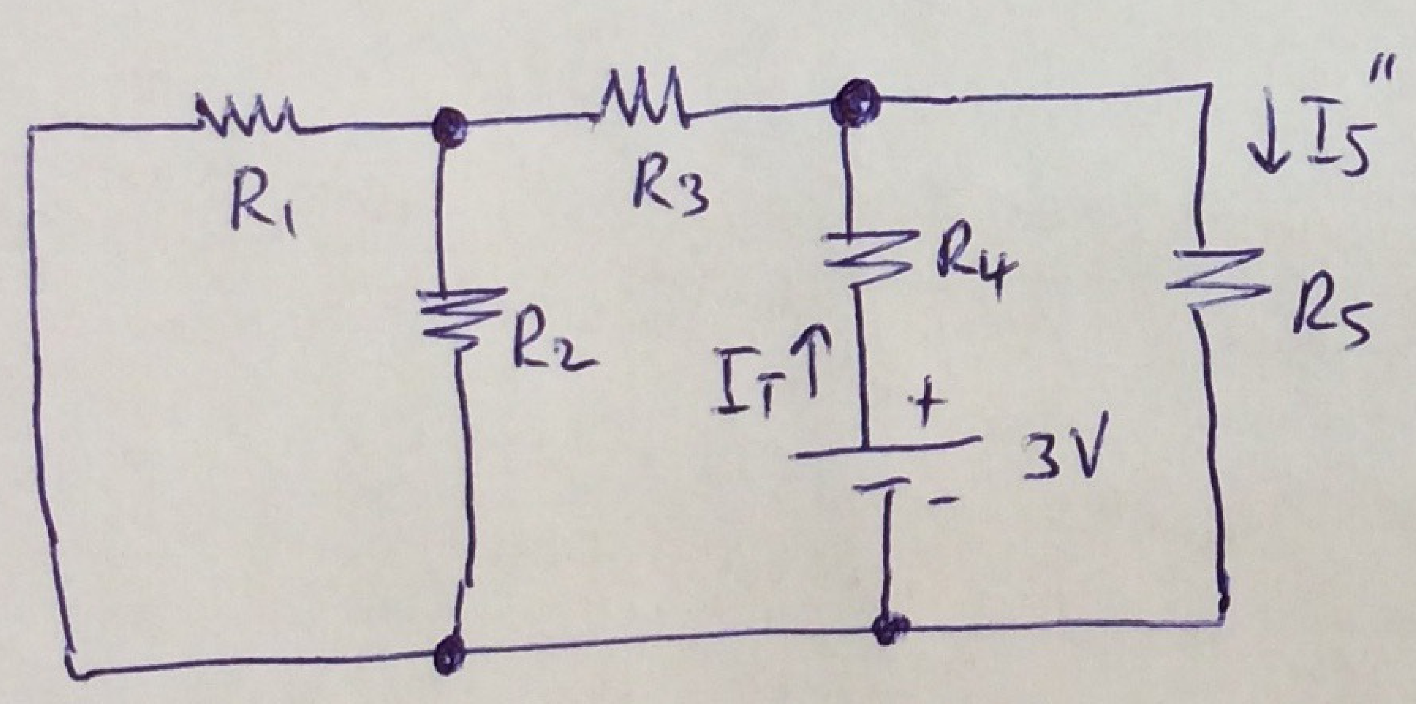
From current division, $I_x = \frac{R_2}{R_2 + 1{,}6875} \times I_T = \frac{2{,}2}{2{,}2+1{,}6875} \times 0{,}511$

$= 0{,}289\ mA$

From current division, $I_5' = \frac{R_4}{R_4+R_5} I_x$

$= \frac{1}{1+2{,}2} \times 0{,}289 = 0{,}09\ mA$

Step 2: Kill 2V



$R_1 // R_2 = 0{,}6875\,k\Omega$

$R_3 + 0{,}6875 = 1{,}6875\,k\Omega$

$R_5 // 1{,}6875 = 0{,}955\,k\Omega$

$R_T = R_4 + 0{,}955 = 1{,}955\,k\Omega$

$I_T = \frac{3V}{R_T} = \frac{3V}{1{,}955\,k\Omega} = 1{,}53\ mA$

From current division,

$I_5'' = \frac{1{,}6875}{1{,}6875 + R_5} \times I_T = 0{,}66\ mA$

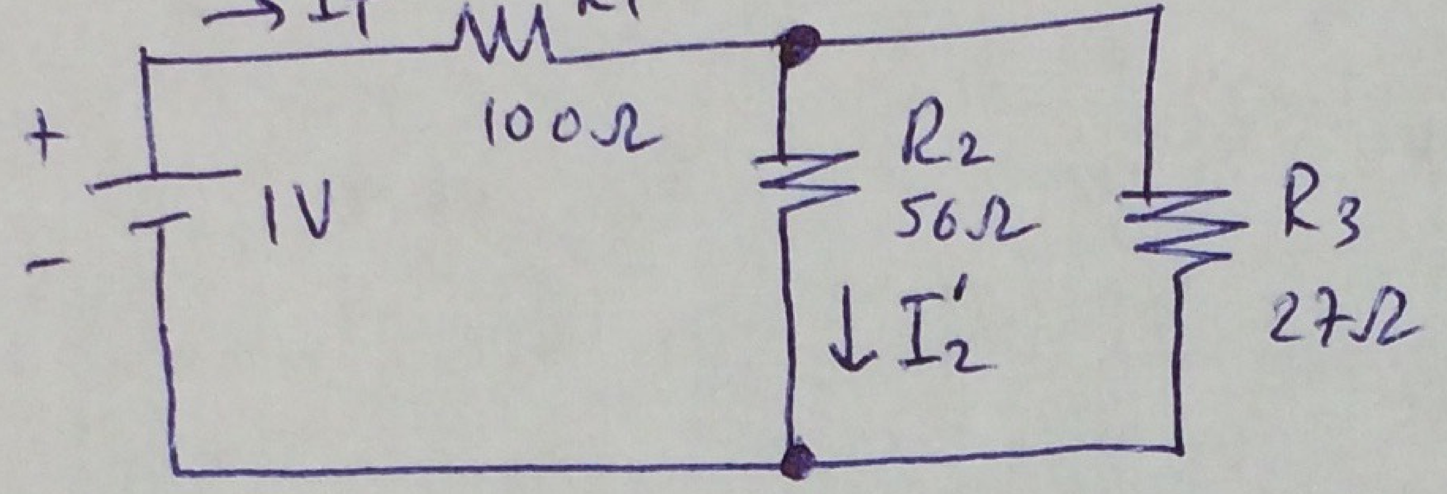
$\implies I_5 = I_5' + I_5'' = 0{,}09 + 0{,}66 = 0{,}75\ mA$

32) In order to transfer maximum power, the external resistor should be equal to the Thevenin resistance.

$$\Longrightarrow R_L = R_{TH} = 72.96\,\Omega$$

34) Using superposition, we obtain the following result.

step 1: Kill 1,5V



$R_T = R_1 + R_2 // R_3 = 118.22\,\Omega$

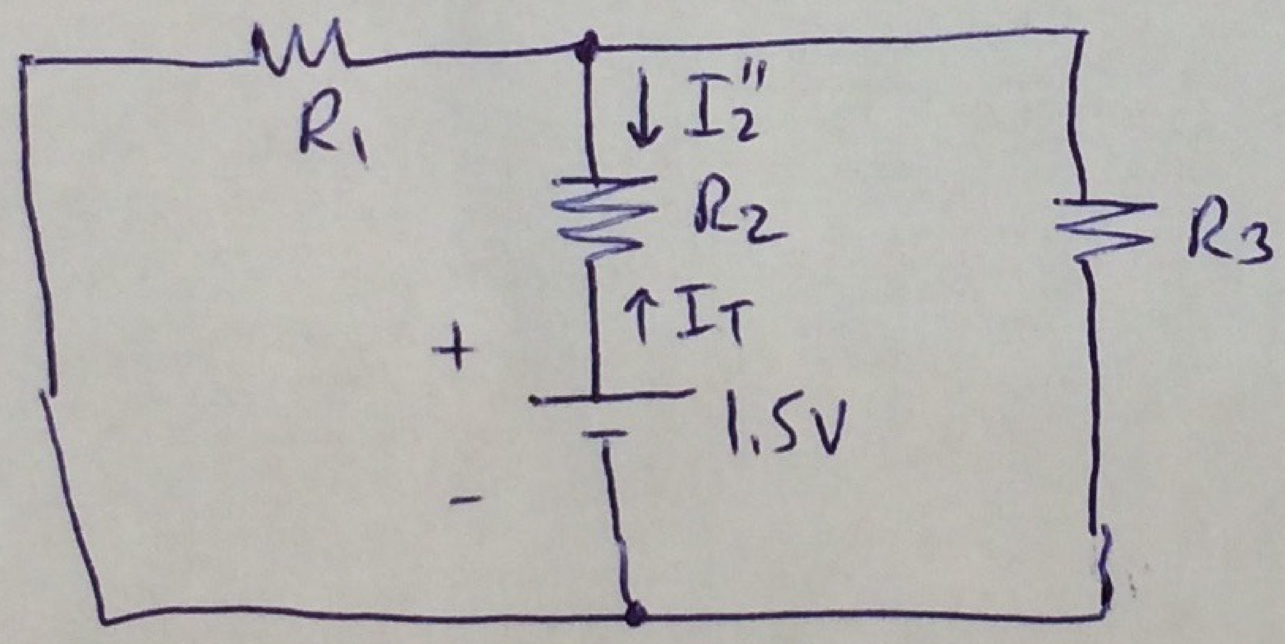
$I_T = \dfrac{1V}{118{,}22\,\Omega} = 8{,}45\,mA$

From current division

$$I_2' = \frac{R_3}{R_2+R_3} I_T$$

$$= \frac{27}{56+27} \times 8{,}45 = 2{,}75\,mA$$

step 2: Kill 1V:



$R_T = R_2 + R_1 // R_3 = 77{,}26\,\Omega$

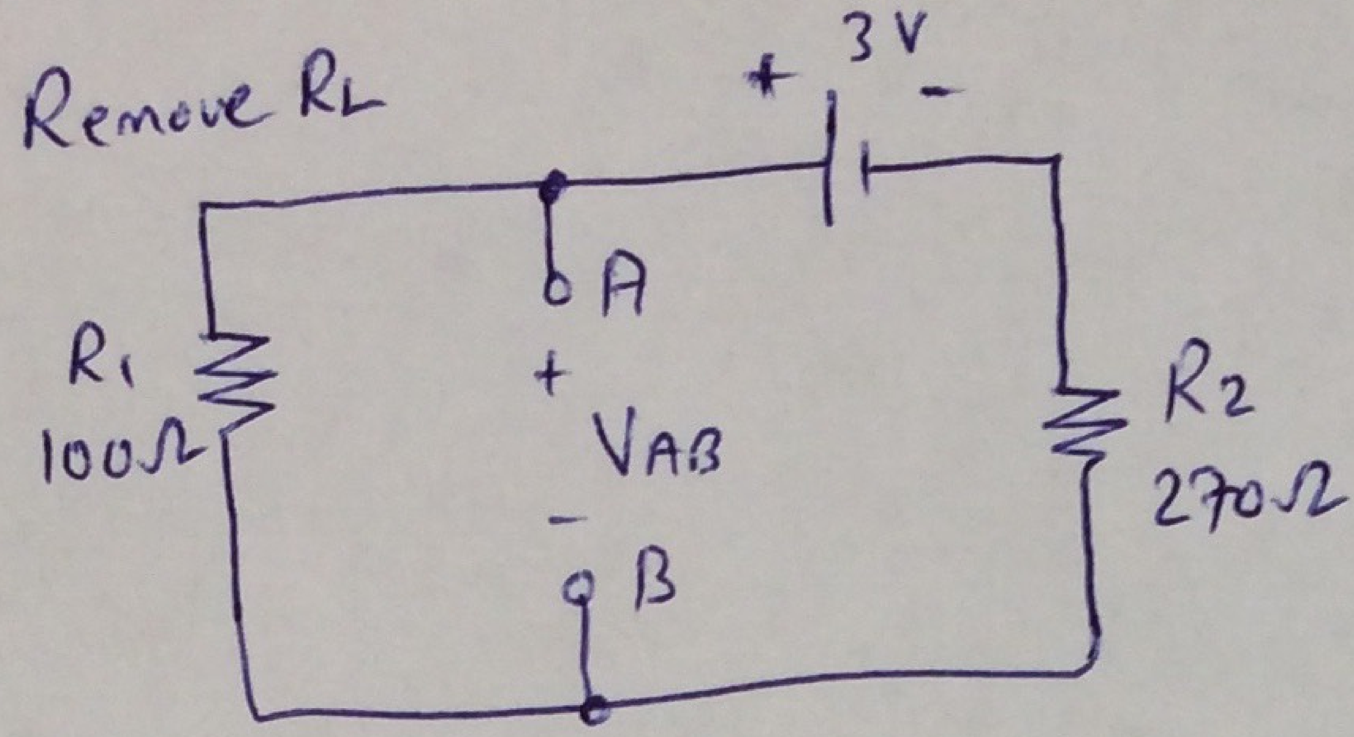
$I_2'' = -I_T = -\dfrac{1{,}5}{R_T} = -19{,}4\,mA$

$$\Longrightarrow I_2 = I_2' + I_2'' = 2{,}75 - 19{,}4$$

$$= -16{,}65\,mA$$

HW2 - Solutions

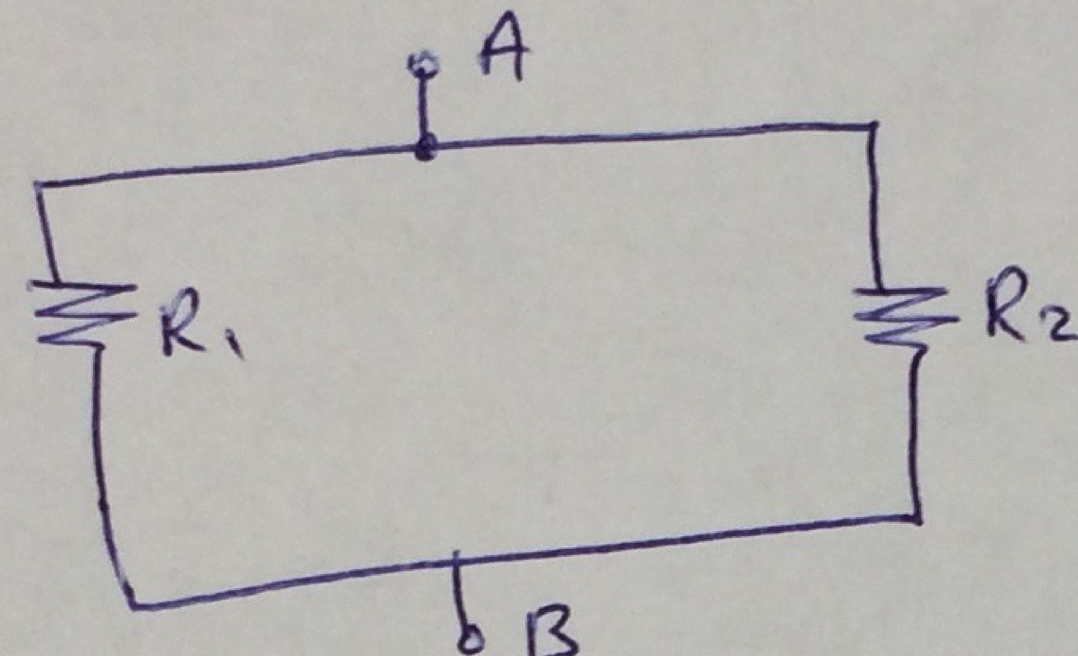
28 b) Remove R_L



$$V_{AB} = V_{TH} = \frac{R_1}{R_1+R_2} \times 3$$

$$= \frac{100}{370} \times 3 = 0.81V$$

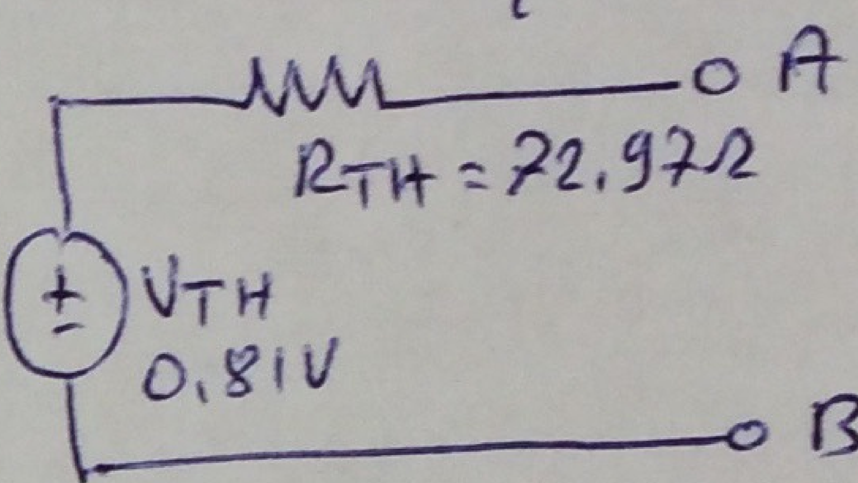
Kill 3V :



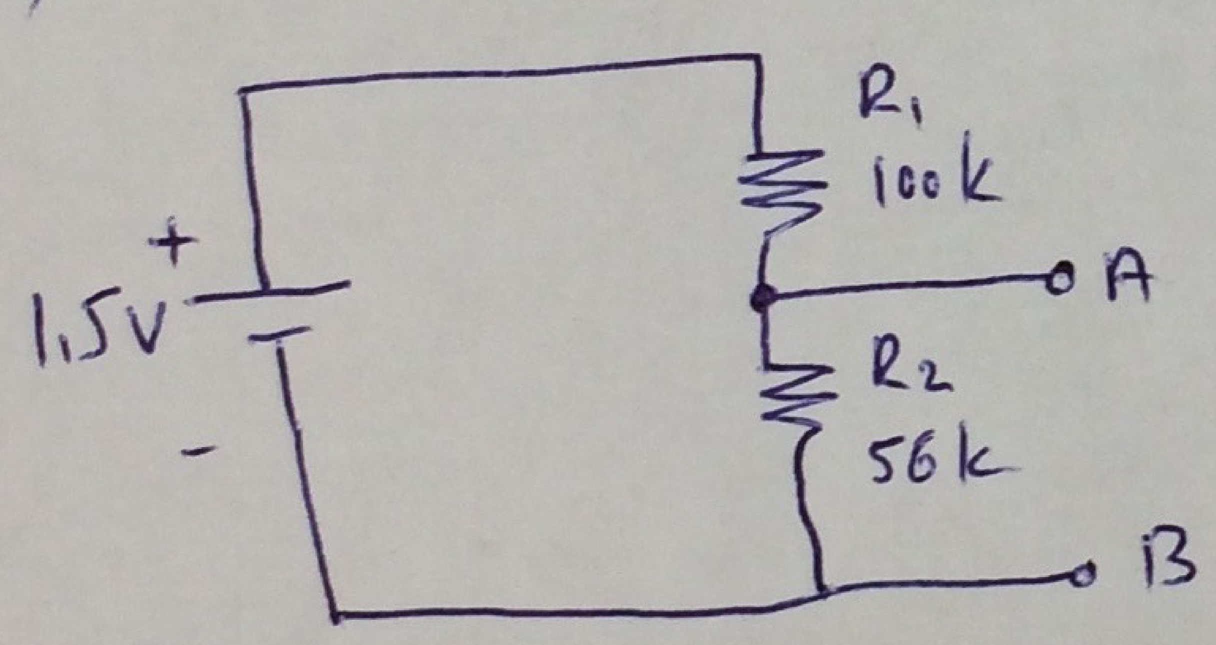
$$R_{TH} = R_1 // R_2 = \underline{72.97\Omega}$$

Thevenin equivalent

$\Rightarrow$



c) Remove R_L

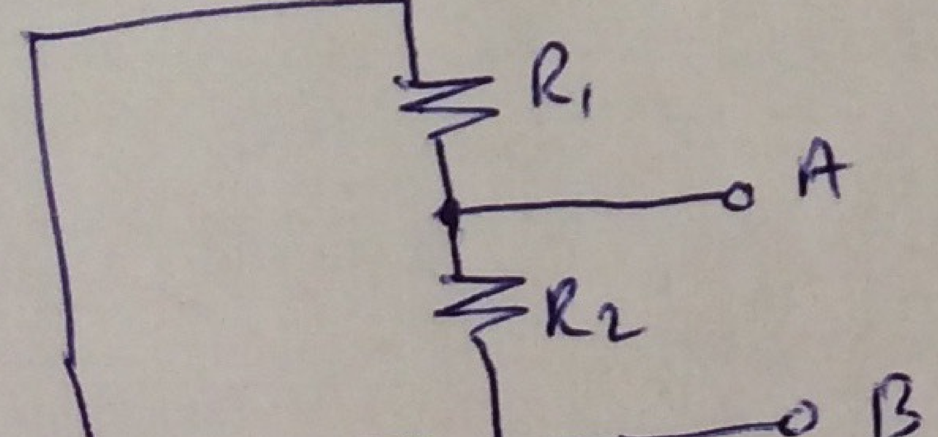


$$V_{AB} = V_{TH} = \frac{R_2}{R_1+R_2} \times 1.5 = \frac{56}{156} \times 1.5$$

$$= 0.54V$$

Kill 1.5V :

$$R_{TH} = R_1 // R_2 = \underline{35.9k\Omega}$$



$\Rightarrow$ Thevenin equivalent